B. Testing:

1. RO water piping shall be pressure tested in accordance with Section 22 0813, "Testing Piping Systems."

2. Pneumatic testing is not authorized for volumes greater than 2 cubic ft (ft^3) and only with owner's approval.

3. Plastic pipe joints shall be inspected in accordance with ASME B31.3 A341.4.1. Examiner shall have ASNT TC 1 A certification.

3.4 CLEANING

A. Upon completion of the leak testing, all piping installed under this contract shall be cleaned with chlorinated water (sodium hypochlorite, 500 ppm) for a four-hour period.

B. All valves in the lines being sterilized shall be in the open position during the cleaning procedure. Once an hour all end-use points shall be opened. New sodium hypochlorite shall be added to the system to maintain concentration level.

C. After cleaning, the system shall be flushed with deionized water until detected chlorine is less than .1 ppm.

END OF SECTION

SECTION 23 0593

TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Requirements of Subcontractor, LANL, and Subcontractor-retained TAB Agency.

B. TAB of air, hydronics, and refrigerating systems.

C. Sound and vibration measurements of equipment operating conditions.

1.2 RELATED SECTIONS

A. Section 01 4000, "Quality Requirements."

B. Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

C. Section 23 0800, "Commissioning of HVAC."

1.3 ABBREVIATIONS AND ACRONYMS, DEFINITIONS, AND REFERENCES

A. Refer to Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

1.4 SUBCONTRACTOR PERFORMED WORK

A. TAB will be performed by an independent AABC or NEBB-certified TAB Agency, subcontracted and directed by the Subcontractor.

1.5 SUBMITTALS

A. TAB Agency shall submit to the Subcontractor for submission to the LANL STR the following in accordance with the requirements of Exhibit I:

1. Date of expiration of AABC or NEBB certification (prior to starting work).
2. TAB instruments that are to be used and calibration dates per AABC or NEBB requirements (prior to starting work).
3. Proposed TAB procedures, together with the TAB schematic drawings and Report Forms, for review.
4. Field Reports indicating deficiencies preventing proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
5. Draft copies of test report for review prior to final acceptance TAB test result.
6. Final test reports that are signed and stamped by an AABC or NEBB TAB Supervisor on the latest edition of approved AABC or NEBB Report Forms.

1.6 QUALITY ASSURANCE

A. Work identified in this section shall be done under a Quality Assurance program in accordance with Section 01 4000, "Quality Requirements."

B. TAB Agency: Perform Work in accordance with the latest edition of AABC or NEBB procedural standards for TAB of environmental systems. All quality assurance provisions, recommendations, and suggested practices contained in these TAB standards are considered mandatory.

C. A LANL representative may witness all or portions of the TAB Agencies Work.

1.7 QUALIFICATIONS

A. Agency: Company specializing in testing, adjusting, and balancing of systems specified in this section with minimum three years documented experience certified by AABC or NEBB.

B. Perform Work under supervision of AABC Certified Test and Balance Engineer or NEBB Certified Testing, Balancing and Adjusting Supervisor experienced in performance of this Work.

PART 2 PRODUCT

2.1 INSTRUMENTS

A. The TAB Agency shall furnish instruments required for testing, adjusting, and balancing.

B. Instruments used for measurements shall meet AABC or NEBB-specified accuracy and calibration histories, and shall be available for spot-checking by LANL during testing.

PART 3 EXECUTION

3.1 SUBCONTRACTOR RESPONSIBILITIES

A. Provide window in project schedule for completion of TAB services prior to final inspection of project.

B. Have mechanical, controls, structural and related electrical systems complete and operable before notifying subcontractor's TAB agency that project is ready for TAB Agency services and the requirements of 3.1 have been met. Advance written notice to the Contractor of not less than 15 calendar days is required, and have Contractor authorization to commence TAB activities

C. Complete operational readiness prior to commencement of TAB services. Verify the following:

1. Doors, windows and ceilings are installed. Pipe penetrations and other holes or openings are sealed.

2. Systems are started and operating in safe and normal condition.

3. Temperature control systems are installed complete and operating. Testing and programming of all system components and the overall system has been completed.

4. Proper thermal overload protection is in place for electrical equipment.

5. Construction filters have been replaced and the final filters are clean and in-place.

6. Duct systems are clean of debris.

7. Fans are rotating correctly, and fan belts are aligned and tight.
8. Fire, smoke, and manual volume dampers are in place and open and the location of volume dampers are accessible and appropriate for effective balancing.
9. Air coil fins are cleaned and combed.
10. Access doors are closed and duct end caps are in place.
11. Air outlets and inlets are installed and connected.
12. Fume hoods and other local exhaust ventilation inlets are installed and connected.
13. Duct and piping supports are installed.
14. Duct systems are leak and pressure tested.
15. Hydronic systems are leak tested.
16. Hydronic systems are flushed, filled and vented.
17. Refrigerant systems are leak tested.
18. Pumps are rotating correctly.
19. Start-up screens from pump suction diffusers are removed.
20. Proper strainer baskets are clean and in place.
21. Service and balance valves are open.
22. Pressure gauges, temperature gauges, test fittings, etc., are installed.

D. Put HVAC systems and equipment into full operation and continue operation during times of testing and balancing.

1. Do not operate equipment until properly lubricated and brought into manufacturer's specified operating conditions.

E. Provide labor and materials to make any change in sheaves, belts, and dampers, required for correct balance as requested by the TAB Agency.

F. Provide labor, i.e., remove and reinstall ceiling tiles, etc., to access concealed equipment as requested by TAB Agency.

G. After TAB Agency is notified and TAB work started, should system(s) be found to not be in readiness or a dispute occurs as to readiness of system(s), the STR may require a joint inspection be made by representatives of LANL, the TAB Agency and the Subcontractor.

1. Such items as are not ready for TAB services shall be completed and placed in operational readiness by Subcontractor, and TAB services shall again be scheduled.

H. Provide TAB Agency with Subcontract Drawings, approved submittal data, specifications and supplements required for TAB Agency to accomplish review, inspection and TAB services outlined in this specification.

I. Notify TAB Agency within 48 hours of receipt of written notification from Subcontractor that system(s) will be ready for testing, adjusting and balancing.

3.2 TAB AGENCY RESPONSIBILITIES

A. General

1. Review, inspect, test, adjust and balance systems, as outlined in this section.

2. Promptly report to the Subcontractor, for communication to the Contractor, any conditions that prevent system balancing.

B. Tolerances

1. Air Handling Systems: Adjust to within plus or minus 10 percent of design flow rates.

2. Air Outlets and Inlets: Adjust total to within plus 10 percent and minus 5 percent of design flow rates to space. Adjusts outlets and inlets in space to within plus or minus 10 percent of design flow rates.

3. Hydronic Systems: Adjust to within plus or minus 10 percent of design flow rates.

C. Adjusting

1. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.

2. After adjustment, take measurements to verify balance has not been disrupted. If disrupted, verify correcting adjustments have been made.

3. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

D. Air System Procedure

1. Adjust air handling and distributions systems to obtain required or design supply, return and exhaust airflow rates.

2. Make airflow rate measurements in main ducts by Pitot tube traverse of entire cross sectional area of duct. Use the LOG method for rectangular ducts.

3. Measure airflow rates at air inlets and outlets.

4. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts.

5. Use volume control devices to regulate airflow rates only to extent adjustments do not create objectionable air motion or sound levels. Effect volume control by using volume dampers located in ducts.

6. Vary total system airflow rates by adjustment of fan speeds. Vary branch airflow rates by damper regulation

7. Provide system schematic with design and actual airflow rates recorded at each outlet or inlet.

8. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across fan. Make allowances for 50 percent loading of filters.

9. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions. Check dampers for proper operation.

10. Check leakage across outside air, return air, and exhaust dampers in closed position.

11. At modulating damper locations, take measurements and balance at extreme conditions. Balance variable volume systems at maximum airflow rate, full cooling, and at minimum airflow rate, full heating.

12. Measure building static pressure and adjust supply, return, and exhaust air systems to obtain required relationships shown on the Drawings.

13. For constant air volume units set volume controller to airflow setting indicated. Confirm connections properly made and confirm proper operation for automatic temperature control.

E. Water System Procedure

1. Adjust water systems, after air balancing, to obtain design flow rates.

2. Use calibrated Venturi tubes, orifices, or other metered fittings and pressure gauges to determine flow rate for system balance. Where flow-metering devices are not installed, base flow balance on temperature difference across various heat transfer elements in system.

3. Adjust systems to obtain specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.

4. Effect system balance with automatic control valves fully open or in normal position to heat transfer elements.

5. Effect adjustment of water distribution systems by means of balancing cocks, valves, and fittings. Do not use service or shut-off valves for balancing unless indexed for balance point.

6. Where available pump capacity is less than total flow requirements or individual system parts simulate full flow in one part by temporary restriction of flow to other parts.

3.3 COMMISSIONING

A. See Section 23 0800 "Commissioning of HVAC" for additional requirements.

B. Perform prerequisites prior to starting commissioning activities.

C. Fill out Pre-Functional Checklists for:

1. Air side systems.

2. Water side systems.

D. Furnish the --LANL STR, upon request, any data gathered but not shown in the final TAB report.

E. In the presence of the Commissioning Authority, verify that:

1. Final settings of all valves, splitters, dampers, and other adjustment devices have been permanently marked.

2. Label exhaust fans that serve fume hoods and other local exhaust ventilation systems with a permanent printed label indicating fan static pressure, RPM, and motor current.

3.4 TAB AGENCY TEST REPORT FORMS

A. Submit draft of Test Report to the Subcontractor for submission to the LANL STR for review prior to final acceptance TAB test result as required by Paragraph 1.5A.5.

B. Final report forms shall contain the following minimum data.

C. Report Forms

1. Title Page:

a. Name of Testing, Adjusting, and Balancing Agency
b. Address of Testing, Adjusting, and Balancing Agency
c. Telephone and facsimile numbers of Testing, Adjusting, and Balancing Agency
d. Project name
e. Project location
f. Subcontract Technical Representative (STR)
g. Project Subcontractor
h. Project altitude
i. Report date

2. Summary Comments:

a. Design versus final performance
b. Notable characteristics of system
c. Description of systems operation sequence
d. Summary of outdoor and exhaust flows to indicate building pressurization
e. Nomenclature used throughout report
f. Test conditions

3. Instrument List:

a. Instrument
b. Manufacturer
c. Model number
d. Serial number
e. Range
f. Calibration date

4. Electric Motors:

a. Manufacturer
b. Model/Frame
c. HP/BHP
d. Phase, voltage, amperage; nameplate, actual, no load
e. RPM
f. Service factor
g. Starter size, rating, heater elements
h. Sheave Make/Size/Bore

5. V-Belt Drive:

a. Identification/location

b. Required driven RPM
c. Driven sheave, diameter and RPM
d. Belt, size and quantity
e. Motor sheave diameter and RPM
f. Center to center distance

6. Pump Data:

a. Identification/number
b. Manufacturer
c. Size/model
d. Impeller size: Include info on how this is determined (pump curves, etc.)
e. Service
f. Design flow rate, pressure drop, BHP
g. Actual flow rate, pressure drop, BHP
h. Discharge pressure
i. Suction pressure
j. Total operating head pressure
k. Shut off, discharge and suction pressures
l. Shut off, total head pressure

7. Air Cooled Condenser:

a. Identification/number
b. Location
c. Manufacturer
d. Model number
e. Serial number
f. Entering DB air temperature, design and actual
g. Leaving DB air temperature, design and actual
h. Number of compressors

8. Chillers:

a. Identification/number
b. Manufacturer
c. Capacity
d. Model number
e. Serial number
f. Evaporator entering water temperature, design and actual
g. Evaporator leaving water temperature, design and actual
h. Evaporator pressure drop, design and actual
i. Evaporator water flow rate, design and actual

9. Heat Exchanger:

a. Identification/number
b. Location
c. Service
d. Manufacturer
e. Model number
f. Serial number
g. Process cooling water entering temperature, design and actual
h. Process cooling water leaving temperature, design and actual
i. Process cooling water flow, design and actual
j. Process cooling water pressure drop, design and actual

k. Chilled water leaving temperature, design and actual
l. Chilled water leaving temperature, design and actual
m. Chilled water flow, design and actual
n. Chilled water pressure drop, design and actual

10. Cooling Coil Data:

a. Identification/number
b. Location
c. Service
d. Manufacturer
e. Air flow, design and actual
f. Entering air DB temperature, design and actual
g. Entering air WB temperature, design and actual
h. Leaving air DB temperature, design and actual
i. Leaving air WB temperature, design and actual
j. Water flow, design and actual
k. Water pressure drop, design and actual
l. Entering water temperature, design and actual
m. Leaving water temperature, design and actual
n. Saturated suction temperature, design and actual for DX coils
o. Air pressure drop, design and actual

11. Heating Coil Data:

a. Identification/number
b. Location
c. Service
d. Manufacturer
e. Air flow, design and actual
f. Water flow, design and actual
g. Water pressure drop, design and actual
h. Entering water temperature, design and actual
i. Leaving water temperature, design and actual
j. Entering air temperature, design and actual
k. Leaving air temperature, design and actual
l. Air pressure drop, design and actual

12. Unit Ventilator and Fan Coil Data:

a. Manufacturer
b. Identification/number
c. Location
d. Model number
e. Size
f. Air flow, design and actual
g. Water flow, design and actual
h. Water pressure drop, design and actual
i. Entering water temperature, design and actual
j. Leaving water temperature, design and actual
k. Entering air temperature, design and actual
l. Leaving air temperature, design and actual

13. Air Moving Equipment:

a. Location

b. Manufacturer
c. Model number
d. Serial number
e. Arrangement/Class/Discharge
f. Air flow, specified and actual
g. Return air flow, specified and actual
h. Outside air flow, specified and actual
i. Total static pressure (total external), specified and actual
j. Inlet pressure
k. Discharge pressure
l. Sheave Make/Size/Bore
m. Number of Belts/Make/Size
n. Fan RPM

14. Return Air/Outside Air Data:

a. Identification/location
b. Design air flow
c. Actual air flow
d. Design return air flow
e. Actual return air flow
f. Design outside air flow
g. Actual outside air flow
h. Return air temperature
i. Outside air temperature
j. Required mixed air temperature
k. Actual mixed air temperature
l. Design outside/return air ratio
m. Actual outside/return air ratio

15. Exhaust Fan Data:

a. Location
b. Manufacturer
c. Model number
d. Serial number
e. Air flow, specified and actual
f. Total static pressure (total external), specified and actual
g. Inlet pressure
h. Discharge pressure
i. Sheave Make/Size/Bore
j. Number of Belts/Make/Size
k. Fan RPM

16. Duct Traverse: (Use Log method for rectangular ducts)

a. System zone/branch
b. Duct size
c. Area
d. Design velocity
e. Design air flow
f. Test velocity
g. Test air flow
h. Duct static pressure
i. Air temperature

j. Air correction factor

17. Air Monitoring Station Data:

a. Identification/location
b. System
c. Size
d. Area
e. Design velocity
f. Design air flow
g. Test velocity
h. Test air flow

18. Flow Measuring Station:

a. Identification/number
b. Location
c. Size
d. Manufacturer
e. Model number
f. Serial number
g. Design Flow rate
h. Design pressure drop
i. Actual/final pressure drop
j. Actual/final flow rate
k. Station calibrated setting

19. Terminal Unit Data:

a. Manufacturer
b. Type, constant, variable, single, dual duct
c. Identification/number
d. Location
e. Model number
f. Size
g. Minimum static pressure
h. Minimum design air flow
i. Maximum design air flow
j. Maximum actual air flow
k. Inlet static pressure

20. Air Distribution Test Sheet:

a. Air terminal number
b. Room number/location
c. Terminal type
d. Terminal size
e. Area factor
f. Design velocity
g. Design air flow
h. Test (final) velocity
i. Test (final) air flow
j. Percent of design air flow

21. Sound Level Report:

a. Location

b. Octave bands - equipment off
c. Octave bands - equipment on
d. RC level - equipment on

22. Vibration Test:

a. Location of points:

1) Fan bearing, drive end
2) Fan bearing, opposite end
3) Motor bearing, center (when applicable)
4) Motor bearing, drive end
5) Motor bearing, opposite end
6) Casing (bottom or top)
7) Casing (side)
8) Duct after flexible connection (discharge)
9) Duct after flexible connection (suction)

b. Test readings:

1) Horizontal, velocity and displacement
2) Vertical, velocity and displacement
3) Axial, velocity and displacement

c. Normally acceptable readings, velocity and acceleration

d. Unusual conditions at time of test

e. Vibration source (when non-complying)

END OF SECTION

FOR LANL USE ONLY

This project specification is based on LANL Master Specification 23 0593, Rev. 3, dated September 15, 2009.

SECTION 23 0800

COMMISSIONING OF HVAC

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Commissioning process requirements for HVAC&R systems, assemblies, and equipment.

1.2 RELATED SECTIONS

A. Section 01 4000, "Quality Requirements."

B. Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

C. Section 23 2113, "Hydronic Piping."

D. Section 23 2500, "HVAC Water Treatment."

E. Section 23 5233, "Water-Tube Boilers."

F. Section 25 5000, "Integrated Automated Facility Controls."

1.3 ABBREVIATIONS AND ACRONYMS, DEFINITIONS, AND REFERENCES

A. Refer to Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

1.4 SUBCONTRACTOR'S RESPONSIBILITIES

A. Perform pre-functional and functional tests under observation by the CxA.

B. Attend construction phase controls coordination meeting.

C. Attend testing, adjusting, and balancing review and coordination meeting.

D. Participate in HVAC&R systems, assemblies, equipment, and component maintenance orientation and inspection.

E. Provide information requested by the STR for final commissioning documentation.

F. Provide measuring instruments and logging devices to record test data, and provide data acquisition equipment to record data for the complete range of testing for the required test period.

G. Provide Project-specific construction checklists, data sheets, and functional test procedures for actual HVAC&R systems, assemblies, equipment, and components to be furnished and installed as part of the construction contract.

H. Direct pre-functional and functional testing activities.

I. Verify testing, adjusting, and balancing of work are complete.

J. Provide test data, inspection reports, and certificates in Operating & Maintenance Manual.

1.5 COMMISSIONING DOCUMENTATION

A. Provide the following information to the STR for inclusion in the final commissioning documentation:

1. A plan (including process steps and schedule) for delivery and review of submittals, Operating & Maintenance Manuals, and other documents and reports.
2. Identification drawings of installed systems, assemblies, equipment, and components including design changes that occurred during the construction phase.
3. Process and schedule for completing construction checklists and manufacturer's prestart and startup checklists for HVAC&R systems, assemblies, equipment, and components to be verified and tested.
4. Certificate of completion certifying that installation, prestart checks, and startup procedures have been completed.
5. Certificate of readiness certifying that HVAC&R systems, subsystems, equipment, and associated controls are ready for testing.
6. Test and inspection reports and certificates.
7. Corrective action documents.
8. Verification of testing, adjusting, and balancing reports.

1.6 SUBMITTALS

A. Commissioning documentation listed in Paragraph 1.5A in accordance with the requirements of Exhibit I.

1.7 QUALITY ASSURANCE

A. Work identified in this section shall be done under a Quality Assurance Program in accordance with Section 01 4000, "Quality Requirements."

PART 2 PRODUCTS

A. Not Used.

PART 3 EXECUTION

3.1 TESTING PREPARATION

A. Certify that HVAC&R systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents.

B. Certify that HVAC&R instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents, and that pretest set points have been recorded.

C. Certify that testing, adjusting, and balancing procedures have been completed and that testing, adjusting, and balancing reports have been submitted, discrepancies corrected, and corrective work approved.

D. Set systems, subsystems, and equipment into operating mode to be tested (e.g., normal shutdown, normal auto position, normal manual position, emergency power, and alarm conditions).

E. Inspect and verify the position of each device and interlock identified on checklists.

F. Check safety cutouts, alarms, and interlocks with smoke control and life-safety systems during each mode of operation.

G. Testing Instrumentation: Install measuring instruments and logging devices to record test data.

3.2 TESTING AND BALANCING VERIFICATION

A. Prior to performance of testing and balancing work, the Testing and Balancing (TAB) Agency shall provide copies of reports, sample forms, checklists, and certificates to the Sub-Contractor.

B. The TAB Agency shall notify the Sub-Contractor at least 10 days in advance of testing and balancing work, and provide access for the CxA to witness testing and balancing work.

C. The TAB Agency shall provide technicians, instrumentation, and tools to verify testing and balancing of HVAC&R systems at the direction of the Sub-Contractor.

1. The Sub-Contractor will notify TAB Agency 10 days in advance of the date of field verification. Notice will not include data points to be verified.

2. The TAB Agency shall use the same instruments (by model and serial number) that were used when original data were collected.

3. Failure of an item includes, other than sound, a deviation of more than 10 percent. Failure of more than 10 percent of selected items shall result in rejection of final testing, adjusting, and balancing report. For sound pressure readings, a deviation of 3 dB shall result in rejection of final testing. Variations in background noise must be considered.

4. Remedy the deficiency and notify the TAB Agency so verification of failed portions can be performed.

3.3 GENERAL TESTING REQUIREMENTS

A. Provide technicians, instrumentation, and tools to perform pre-functional and functional tests under observation by the CxA.

B. Scope of HVAC&R testing shall include entire HVAC&R installation, from central equipment for heat generation and refrigeration through distribution systems to each conditioned space. Testing shall include measuring capacities and effectiveness of operational and control functions.

C. Test all operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and verify proper response of building automation system controllers and sensors.

D. Detailed Testing Procedures: The CxA along with the HVAC&R Subcontractor, TAB Agency, and HVAC&R Instrumentation and Control Subcontractor shall collaborate to prepare detailed testing plans, procedures, and checklists for HVAC&R systems, subsystems, and equipment.

E. Tests will be performed using design conditions whenever possible.

F. Simulated conditions may need to be imposed using an artificial load when it is not practical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by the Test Director and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.

G. The Test Director may direct that set points be altered when simulating conditions is not practical.

H. The Test Director may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are not practical.

I. If tests cannot be completed because of a deficiency outside the scope of the HVAC&R system, document the deficiency and report it to the owner. After deficiencies are resolved, reschedule tests.

J. If the testing plan indicates specific seasonal testing, complete appropriate initial performance tests and documentation and schedule seasonal tests.

3.4 HVAC&R SYSTEMS, SUBSYSTEMS, AND EQUIPMENT TESTING PROCEDURES

A. Boiler Testing and Acceptance Procedures: Testing requirements are specified in Section 23 5233, "Water-Tube Boilers." Provide submittals, test data, inspector record, and boiler certification to the STR.

B. HVAC&R Instrumentation and Control System Testing: Field testing plans and testing requirements are specified in Section 25 5000, "Integrated Automated Facility Controls."

C. Pipe system cleaning, flushing, hydrostatic tests, and chemical treatment requirements are specified in Section 23 2113 "Hydronic Piping," and Section 23 2500, "HVAC Water Treatment." HVAC&R Subcontractor shall prepare a pipe system cleaning, flushing, and hydrostatic testing plan. Provide cleaning, flushing, testing, and treating plan and final reports to the STR. Plan shall include the following:

1. Sequence of testing and testing procedures for each section of pipe to be tested, identified by pipe zone or sector identification marker. Markers shall be keyed to Drawings for each pipe sector, showing the physical location of each designated pipe test section. Drawings keyed to pipe zones or sectors shall be formatted to allow each section of piping to be physically located and identified when referred to in pipe system cleaning, flushing, hydrostatic testing, and chemical treatment plan.

2. Description of equipment for flushing operations.

3. Minimum flushing water velocity.

4. Tracking checklist for managing and ensuring that all pipe sections have been cleaned, flushed, hydrostatically tested, and chemically treated.

D. Energy Supply System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of gas and hot water systems and equipment. The Sub-Contractor shall determine the sequence of testing and testing procedures for each equipment item and pipe section to be tested in accordance with the project system turnover schedule.

E. Refrigeration System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of chillers, cooling towers, refrigerant compressors and condensers, heat pumps, and other refrigeration systems. The Sub-Contractor shall determine the sequence of testing and testing procedures for each equipment item and pipe section to be tested.

F. HVAC&R Distribution System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of air, steam, and hydronic distribution systems; special exhaust; and other distribution systems, including HVAC&R terminal equipment and unitary equipment.

G. Vibration and Sound Tests: Provide technicians, instrumentation, tools, and equipment to test performance of vibration isolation and seismic controls.

3.5 COMMISSIONING TEAM TEST FORMS AND CHECKLISTS

A. Designate Subcontractor team members to participate in the Pre-Functional Performance Test Checklists and the Functional Performance Tests specified herein. In addition, the LANL team members will include a representative of the Contracting Officer, the Design Agent's Representative, and the Using Agency's Representative. The team members shall be as follows:

Designation	Function
M	Subcontractor's Mechanical Representative
E	Subcontractor's Electrical Representative
T	Subcontractor's Testing, Adjusting, and Balancing (TAB) Specialist
C	Subcontractor's Controls Representative
A	LANL Commissioning Agent (CxA)
U	FOD Representative

B. Attachments 1 and 2 shall be completed by the commissioning team. Acceptance by each commissioning team member of each Pre-Functional Test Checklist item shall be indicated by initials and date unless an "X" is shown indicating that participation by that individual is not required. Acceptance by each commissioning team member of each functional performance test item shall be indicated by signature and date.

C. Perform the pre-functional test checklists and functional tests in a manner that essentially duplicates the checking, testing, and inspection methods established in the related sections. Where checking, testing, and inspection methods are not specified in other sections, establish methods which will provide the information required. Testing and verification required by this section shall be performed during the Commissioning phase. Requirements in related sections are independent from the requirements of this section and shall not be used to satisfy any of the requirements specified in this section. Provide all materials, services, and labor required to perform the pre- functional tests checks and functional tests. A functional test shall be aborted if any system deficiency prevents the successful completion of the test or if any participating non-LANL commissioning team member or the LANL CxA of which participation is specified is not present for the test.

1. Pre-Functional Test Checklists: Perform Pre-Functional Test Checklists for the items indicated in Attachment 1. Correct and re-inspect

deficiencies discovered during these checks in accordance with the applicable contract requirements.

2. Functional Tests: Perform Functional Tests for the items indicated in Attachment 2. Begin Functional Tests only after all Pre-Functional Test Checklists have been successfully completed. Tests shall prove all modes of the sequences of operation, and shall verify all other relevant contract requirements. Begin Tests with equipment or components and progress through subsystems to complete systems. Upon failure of any Functional Performance Test item, correct all deficiencies in accordance with the applicable contract requirements. The item shall then be retested until it has been completed with no errors.

3.6 COMMISSIONING REPORT

A. The Commissioning Report shall consist of completed Pre- Functional Test Checklists and completed Functional Tests organized by system and by subsystem and submitted as one package. The Commissioning Report shall also include all HVAC systems test reports, inspection reports (Preparatory, Initial and Follow-up inspections), start-up reports, TAB report, TAB verification report, Controls start-up test reports and Controls Performance Verification Test (PVT) report. The results of failed tests shall be included along with a description of the corrective action taken.

Pre-Functional Performance Test Checklist – Constant Volume Air Handling Unit For Air Handling Unit: HVA-5321						
Installation		**M**	**E**	**T**	**C**	**A**
a. Inspection and access doors are operable and sealed.			X		X	
b. Condensate drainage is unobstructed. (Visually verify pan drains completely by pouring a cup of water into drain pan.)			X	X	X	
c. Fan belt adjusted.			X		X	
Electrical		**M**	**E**	**T**	**C**	**A**
a. Power available to unit disconnect.		X		X	X	
b. Power available to unit control panel.		X		X	X	
c. Proper motor rotation verified.		X			X	
d. Verify that power disconnect is located within sight of the unit it controls.		X		X	X	
Coils		**M**	**E**	**T**	**C**	**A**
a. Chilled water piping properly connected.			X	X	X	
b. Hot water piping properly connected.			X	X	X	
Controls		**M**	**E**	**T**	**C**	**A**
a. Control valves/actuators properly installed.			X	X	X	
b. Control valves/actuators operable.			X	X	X	
c. Dampers/actuators properly installed.			X	X	X	
d. Dampers/actuators operable.			X	X	X	
e. Verify proper location, installation, and calibration of duct static pressure sensor.			X	X	X	
f. Fan air volume controller operable.			X	X	X	
g. Air handler controls system operational.			X	X	X	
Testing, Adjusting, and Balancing (TAB)		**M**	**E**	**T**	**C**	**A**
a. Construction filters removed and replaced.			X			
b. TAB report approved.			X	X		X

Pre-Functional Performance Test Checklist – Constant Volume Air Handling Unit For Air Handling Unit: HVA-5322						
Installation		**M**	**E**	**T**	**C**	**A**
a. Inspection and access doors are operable and sealed.			X		X	
b. Condensate drainage is unobstructed. (Visually verify pan drains completely by pouring a cup of water into drain pan.)			X	X	X	
c. Fan belt adjusted.			X		X	
Electrical		**M**	**E**	**T**	**C**	**A**
a. Power available to unit disconnect.		X		X	X	
b. Power available to unit control panel.		X		X	X	
c. Proper motor rotation verified.		X			X	
d. Verify that power disconnect is located within sight of the unit it controls.		X		X	X	
Coils		**M**	**E**	**T**	**C**	**A**
a. Chilled water piping properly connected.			X	X	X	
b. Hot water piping properly connected.			X	X	X	
Controls		**M**	**E**	**T**	**C**	**A**
a. Control valves/actuators properly installed.			X	X	X	
b. Control valves/actuators operable.			X	X	X	
c. Dampers/actuators properly installed.			X	X	X	
d. Dampers/actuators operable.			X	X	X	
e. Verify proper location, installation, and calibration of duct static pressure sensor.			X	X	X	
f. Fan air volume controller operable.			X	X	X	
g. Air handler controls system operational.			X	X	X	
Testing, Adjusting, and Balancing (TAB)		**M**	**E**	**T**	**C**	**A**
a. Construction filters removed and replaced.			X			
b. TAB report approved.			X	X		X

Pre-Functional Performance Test Checklist – Constant Volume Air Handling Unit For Air Handling Unit: HVA-5324						
Installation		**M**	**E**	**T**	**C**	**A**
a. Inspection and access doors are operable and sealed.			X		X	
b. Condensate drainage is unobstructed. (Visually verify pan drains completely by pouring a cup of water into drain pan.)			X	X	X	
c. Fan belt adjusted.			X		X	
Electrical		**M**	**E**	**T**	**C**	**A**
a. Power available to unit disconnect.		X		X	X	
b. Power available to unit control panel.		X		X	X	
c. Proper motor rotation verified.		X			X	
d. Verify that power disconnect is located within sight of the unit it controls.		X		X	X	
Coils		**M**	**E**	**T**	**C**	**A**
a. Chilled water piping properly connected.			X	X	X	
Heating		**M**	**E**	**T**	**C**	**A**
a. Check piping for leaks and proper gas line pressure.			X	X	X	
b. Ensure proper and secure mounting.			X	X	X	
c. Check for clearances from combustibles.			X	X	X	
Controls		**M**	**E**	**T**	**C**	**A**
a. Control valves/actuators properly installed.			X	X	X	
b. Control valves/actuators operable.			X	X	X	
c. Dampers/actuators properly installed.			X	X	X	
d. Dampers/actuators operable.			X	X	X	
e. Verify proper location, installation, and calibration of duct static pressure sensor.			X	X	X	
f. Fan air volume controller operable.			X	X	X	
g. Air handler controls system operational.			X	X	X	
Testing, Adjusting, and Balancing (TAB)		**M**	**E**	**T**	**C**	**A**
a. Construction filters removed and replaced.			X			
b. TAB report approved.			X	X		X

Pre-Functional Performance Test Checklist – CAV Terminal For CAV Terminal: CAV-5331						
Installation		**M**	**E**	**T**	**C**	**A**
a. Reheat coil connected to hot water pipe.			X		X	
Controls		**M**	**E**	**T**	**C**	**A**
a. Cooling only CAV terminal controls set.			X	X	X	
b. Cooling only CAV controls verified.			X	X	X	
c. Reheat CAV terminal controls set.			X	X	X	
d. Reheat terminal/coil controls verified.			X	X	X	
Testing, Adjusting, and Balancing (TAB)		**M**	**E**	**T**	**C**	**A**
a. TAB report approved.			X		X	

Pre-Functional Performance Test Checklist – CAV Terminal For CAV Terminal: CAV-5332						
Installation		**M**	**E**	**T**	**C**	**A**
a. Reheat coil connected to hot water pipe.			X		X	
Controls		**M**	**E**	**T**	**C**	**A**
a. Cooling only CAV terminal controls set.			X	X	X	
b. Cooling only CAV controls verified.			X	X	X	
c. Reheat CAV terminal controls set.			X	X	X	
d. Reheat terminal/coil controls verified.			X	X	X	
Testing, Adjusting, and Balancing (TAB)		**M**	**E**	**T**	**C**	**A**
a. TAB report approved.			X		X	

Pre-Functional Performance Test Checklist – CAV Terminal For CAV Terminal: CAV-5333						
Installation		**M**	**E**	**T**	**C**	**A**
a. Reheat coil connected to hot water pipe.			X		X	
Controls		**M**	**E**	**T**	**C**	**A**
a. Cooling only CAV terminal controls set.			X	X	X	
b. Cooling only CAV controls verified.			X	X	X	
c. Reheat CAV terminal controls set.			X	X	X	
d. Reheat terminal/coil controls verified.			X	X	X	
Testing, Adjusting, and Balancing (TAB)		**M**	**E**	**T**	**C**	**A**
a. TAB report approved.			X		X	

Pre-Functional Performance Test Checklist – CAV Terminal For CAV Terminal: CAV-5334						
Installation		**M**	**E**	**T**	**C**	**A**
a. Reheat coil connected to hot water pipe.			X		X	
Controls		**M**	**E**	**T**	**C**	**A**
a. Cooling only CAV terminal controls set.			X	X	X	
b. Cooling only CAV controls verified.			X	X	X	
c. Reheat CAV terminal controls set.			X	X	X	
d. Reheat terminal/coil controls verified.			X	X	X	
Testing, Adjusting, and Balancing (TAB)		**M**	**E**	**T**	**C**	**A**
a. TAB report approved.			X		X	

Pre-Functional Performance Test Checklist – CAV Terminal For CAV Terminal: CAV-5335						
Installation		**M**	**E**	**T**	**C**	**A**
a. Reheat coil connected to hot water pipe.			X		X	
Controls		**M**	**E**	**T**	**C**	**A**
a. Cooling only CAV terminal controls set.			X	X	X	
b. Cooling only CAV controls verified.			X	X	X	
c. Reheat CAV terminal controls set.			X	X	X	
d. Reheat terminal/coil controls verified.			X	X	X	
Testing, Adjusting, and Balancing (TAB)		**M**	**E**	**T**	**C**	**A**
a. TAB report approved.			X		X	

Pre-Functional Performance Test Checklist – CAV Terminal For CAV Terminal: CAV-5336						
Installation		**M**	**E**	**T**	**C**	**A**
a. Reheat coil connected to hot water pipe.			X		X	
Controls		**M**	**E**	**T**	**C**	**A**
a. Cooling only CAV terminal controls set.			X	X	X	
b. Cooling only CAV controls verified.			X	X	X	
c. Reheat CAV terminal controls set.			X	X	X	
d. Reheat terminal/coil controls verified.			X	X	X	
Testing, Adjusting, and Balancing (TAB)		**M**	**E**	**T**	**C**	**A**
a. TAB report approved.			X		X	

Pre-Functional Performance Test Checklist – CAV Terminal For CAV Terminal: CAV-5337						
Installation		**M**	**E**	**T**	**C**	**A**
a. Reheat coil connected to hot water pipe.			X		X	
Controls		**M**	**E**	**T**	**C**	**A**
a. Cooling only CAV terminal controls set.			X	X	X	
b. Cooling only CAV controls verified.			X	X	X	
c. Reheat CAV terminal controls set.			X	X	X	
d. Reheat terminal/coil controls verified.			X	X	X	
Testing, Adjusting, and Balancing (TAB)		**M**	**E**	**T**	**C**	**A**
a. TAB report approved.			X		X	

Pre-Functional Performance Test Checklist – CAV Terminal For CAV Terminal: CAV-5338						
Installation		**M**	**E**	**T**	**C**	**A**
a. Reheat coil connected to hot water pipe.			X		X	
Controls		**M**	**E**	**T**	**C**	**A**
a. Cooling only CAV terminal controls set.			X	X	X	
b. Cooling only CAV controls verified.			X	X	X	
c. Reheat CAV terminal controls set.			X	X	X	
d. Reheat terminal/coil controls verified.			X	X	X	
Testing, Adjusting, and Balancing (TAB)		**M**	**E**	**T**	**C**	**A**
a. TAB report approved.			X		X	

Pre-Functional Performance Test Checklist – CAV Terminal For CAV Terminal: CAV-5339						
Installation		**M**	**E**	**T**	**C**	**A**
a. Reheat coil connected to hot water pipe.			X		X	
Controls		**M**	**E**	**T**	**C**	**A**
a. Cooling only CAV terminal controls set.			X	X	X	
b. Cooling only CAV controls verified.			X	X	X	
c. Reheat CAV terminal controls set.			X	X	X	
d. Reheat terminal/coil controls verified.			X	X	X	
Testing, Adjusting, and Balancing (TAB)		**M**	**E**	**T**	**C**	**A**
a. TAB report approved.			X		X	

Pre-Functional Performance Test Checklist – Pumps For Pump: PHW-5105						
Installation		**M**	**E**	**T**	**C**	**A**
a. Piping system installed.			X	X	X	
Electrical		**M**	**E**	**T**	**C**	**A**
a. Power available to pump disconnect.		X		X	X	
b. Pump rotation verified.		X		X	X	
c. Control system interlocks functional.		X		X		
Testing, Adjusting, and Balancing (TAB)		**M**	**E**	**T**	**C**	**A**
a. Pressure/temperature gauges installed.			X		X	
b. TAB report approved.			X		X	

Pre-Functional Performance Test Checklist – Pumps For Pump: PHW-5106						
Installation		**M**	**E**	**T**	**C**	**A**
a. Piping system installed.			X	X	X	
Electrical		**M**	**E**	**T**	**C**	**A**
a. Power available to pump disconnect.		X		X	X	
b. Pump rotation verified.		X		X	X	
c. Control system interlocks functional.		X		X		
Testing, Adjusting, and Balancing (TAB)		**M**	**E**	**T**	**C**	**A**
a. Pressure/temperature gauges installed.			X		X	
b. TAB report approved.			X		X	

Pre-Functional Performance Test Checklist – Pumps For Pump: PHW-5110						
Installation		**M**	**E**	**T**	**C**	**A**
a. Piping system installed.			X	X	X	
Electrical		**M**	**E**	**T**	**C**	**A**
a. Power available to pump disconnect.		X		X	X	
b. Pump rotation verified.		X		X	X	
c. Control system interlocks functional.		X		X		
Testing, Adjusting, and Balancing (TAB)		**M**	**E**	**T**	**C**	**A**
a. Pressure/temperature gauges installed.			X		X	
b. TAB report approved.			X		X	

Pre-Functional Performance Test Checklist – Pumps For Pump: PHW-5111						
Installation		**M**	**E**	**T**	**C**	**A**
a. Piping system installed.			X	X	X	
Electrical		**M**	**E**	**T**	**C**	**A**
a. Power available to pump disconnect.		X		X	X	
b. Pump rotation verified.		X		X	X	
c. Control system interlocks functional.		X		X		
Testing, Adjusting, and Balancing (TAB)		**M**	**E**	**T**	**C**	**A**
a. Pressure/temperature gauges installed.			X		X	
b. TAB report approved.			X		X	

Pre-Functional Performance Test Checklist – Pumps For Pump: PHW-5313						
Installation		**M**	**E**	**T**	**C**	**A**
a. Piping system installed.			X	X	X	
Electrical		**M**	**E**	**T**	**C**	**A**
a. Power available to pump disconnect.		X		X	X	
b. Pump rotation verified.		X		X	X	
c. Control system interlocks functional.		X		X		
Testing, Adjusting, and Balancing (TAB)		**M**	**E**	**T**	**C**	**A**
a. Pressure/temperature gauges installed.			X		X	
b. TAB report approved.			X		X	

Pre-Functional Performance Test Checklist – Pumps For Pump: PHW-5314						
Installation		**M**	**E**	**T**	**C**	**A**
a. Piping system installed.			X	X	X	
Electrical		**M**	**E**	**T**	**C**	**A**
a. Power available to pump disconnect.		X		X	X	
b. Pump rotation verified.		X		X	X	
c. Control system interlocks functional.		X		X		
Testing, Adjusting, and Balancing (TAB)		**M**	**E**	**T**	**C**	**A**
a. Pressure/temperature gauges installed.			X		X	
b. TAB report approved.			X		X	

Pre-Functional Performance Test Checklist – Pumps For Pump: PHW-5103						
Installation		**M**	**E**	**T**	**C**	**A**
a. Piping system installed.			X	X	X	
Electrical		**M**	**E**	**T**	**C**	**A**
a. Power available to pump disconnect.		X		X	X	
b. Pump rotation verified.		X		X	X	
c. Control system interlocks functional.		X		X		
Testing, Adjusting, and Balancing (TAB)		**M**	**E**	**T**	**C**	**A**
a. Pressure/temperature gauges installed.			X		X	
b. TAB report approved.			X		X	

Pre-Functional Performance Test Checklist – Pumps For Pump: PCW-5211						
Installation		**M**	**E**	**T**	**C**	**A**
a. Piping system installed.			X	X	X	
Electrical		**M**	**E**	**T**	**C**	**A**
a. Power available to pump disconnect.		X		X	X	
b. Pump rotation verified.		X		X	X	
c. Control system interlocks functional.		X		X		
Testing, Adjusting, and Balancing (TAB)		**M**	**E**	**T**	**C**	**A**
a. Pressure/temperature gauges installed.			X		X	
b. TAB report approved.			X		X	

Pre-Functional Performance Test Checklist – Pumps For Pump: PCW-5212						
Installation		**M**	**E**	**T**	**C**	**A**
a. Piping system installed.			X	X	X	
Electrical		**M**	**E**	**T**	**C**	**A**
a. Power available to pump disconnect.		X		X	X	
b. Pump rotation verified.		X		X	X	
c. Control system interlocks functional.		X		X		
Testing, Adjusting, and Balancing (TAB)		**M**	**E**	**T**	**C**	**A**
a. Pressure/temperature gauges installed.			X		X	
b. TAB report approved.			X		X	

Pre-Functional Performance Test Checklist – Pumps For Pump: PCW-5213						
Installation		**M**	**E**	**T**	**C**	**A**
a. Piping system installed.			X	X	X	
Electrical		**M**	**E**	**T**	**C**	**A**
a. Power available to pump disconnect.		X		X	X	
b. Pump rotation verified.		X		X	X	
c. Control system interlocks functional.		X		X		
Testing, Adjusting, and Balancing (TAB)		**M**	**E**	**T**	**C**	**A**
a. Pressure/temperature gauges installed.			X		X	
b. TAB report approved.			X		X	

Pre-Functional Performance Test Checklist – Pumps For Pump: PCW-5214						
Installation		**M**	**E**	**T**	**C**	**A**
a. Piping system installed.			X	X	X	
Electrical		**M**	**E**	**T**	**C**	**A**
a. Power available to pump disconnect.		X		X	X	
b. Pump rotation verified.		X		X	X	
c. Control system interlocks functional.		X		X		
Testing, Adjusting, and Balancing (TAB)		**M**	**E**	**T**	**C**	**A**
a. Pressure/temperature gauges installed.			X		X	
b. TAB report approved.			X		X	

Pre-Functional Performance Test Checklist – Packaged Air Cooled Chiller For Chiller: CWR-5201						
Installation		**M**	**E**	**T**	**C**	**A**
a. Chiller properly piped.			X			
Electrical		**M**	**E**	**T**	**C**	**A**
a. Power available to unit disconnect.		X		X		
b. Power available to unit control panel.		X		X		
c. Separate power is supplied to electric heating tape.		X				
d. Verify that power disconnect is located within sight of the unit it controls.		X		X		
Controls		**M**	**E**	**T**	**C**	**A**
a. Factory startup and checkout complete.			X	X		
b. Chiller safety/protection devices tested.			X	X		
c. Chilled water flow switch installed.			X	X		
d. Chilled water flow switch tested.			X	X		
e. Chilled water pump interlock installed.			X	X	X	
f. Chilled water pump interlock tested.				X		

Pre-Functional Performance Test Checklist – Packaged Air Cooled Chiller For Chiller: CWR-5202						
Installation		**M**	**E**	**T**	**C**	**A**
a. Chiller properly piped.			X			
Electrical		**M**	**E**	**T**	**C**	**A**
a. Power available to unit disconnect.		X		X		
b. Power available to unit control panel.		X		X		
c. Separate power is supplied to electric heating tape.		X				
d. Verify that power disconnect is located within sight of the unit it controls.		X		X		
Controls		**M**	**E**	**T**	**C**	**A**
a. Factory startup and checkout complete.			X	X		
b. Chiller safety/protection devices tested.			X	X		
c. Chilled water flow switch installed.			X	X		
d. Chilled water flow switch tested.			X	X		
e. Chilled water pump interlock installed.			X	X	X	
f. Chilled water pump interlock tested.				X		

Pre-Functional Performance Test Checklist – Packaged Air Cooled Chiller For Chiller: CWR-5203						
Installation		**M**	**E**	**T**	**C**	**A**
a. Chiller properly piped.			X			
Electrical		**M**	**E**	**T**	**C**	**A**
a. Power available to unit disconnect.		X		X		
b. Power available to unit control panel.		X		X		
c. Separate power is supplied to electric heating tape.		X				
d. Verify that power disconnect is located within sight of the unit it controls.		X		X		
Controls		**M**	**E**	**T**	**C**	**A**
a. Factory startup and checkout complete.			X	X		
b. Chiller safety/protection devices tested.			X	X		
c. Chilled water flow switch installed.			X	X		
d. Chilled water flow switch tested.			X	X		
e. Chilled water pump interlock installed.			X	X	X	
f. Chilled water pump interlock tested.				X		

Pre-Functional Performance Test Checklist – Hot Water Boiler For Boiler: BHW-5101						
Installation		**M**	**E**	**T**	**C**	**A**
a. Boiler hot water piping installed.			X			
b. Boiler makeup water piping installed.			X			
d. Boiler gas piping installed.			X	X	X	
Startup		**M**	**E**	**T**	**C**	**A**
a. Boiler safety/protection devices, including high temperature burner shut-off, low water cutoff, flame failure, pre- and post-purge, have been tested.				X		
b. Verify that PRV rating conforms to boiler rating.				X		
c. Boiler water treatment system functional.			X	X		
d. Boiler startup and checkout complete.			X	X		
e. Combustion efficiency demonstrated.			X		X	
Electrical		**M**	**E**	**T**	**C**	**A**
a. Verify that power disconnect is located within sight of the unit served.		X		X		
Controls		**M**	**E**	**T**	**C**	**A**
a. Hot water pump interlock installed and tested.				X		
b. Hot water proof-of-flow switch installed and tested.			X	X		
c. Hot water heating controls operational.			X	X		
Testing, Adjusting, and Balancing (TAB)		**M**	**E**	**T**	**C**	**A**
a. TAB report approved.			X		X	

Pre-Functional Performance Test Checklist – Hot Water Boiler For Boiler: BHW-5102						
Installation		**M**	**E**	**T**	**C**	**A**
a. Boiler hot water piping installed.			X			
b. Boiler makeup water piping installed.			X			
d. Boiler gas piping installed.			X	X	X	
Startup		**M**	**E**	**T**	**C**	**A**
a. Boiler safety/protection devices, including high temperature burner shut-off, low water cutoff, flame failure, pre- and post-purge, have been tested.				X		
b. Verify that PRV rating conforms to boiler rating.				X		
c. Boiler water treatment system functional.			X	X		
d. Boiler startup and checkout complete.			X	X		
e. Combustion efficiency demonstrated.			X		X	
Electrical		**M**	**E**	**T**	**C**	**A**
a. Verify that power disconnect is located within sight of the unit served.		X		X		
Controls		**M**	**E**	**T**	**C**	**A**
a. Hot water pump interlock installed and tested.				X		
b. Hot water proof-of-flow switch installed and tested.			X	X		
c. Hot water heating controls operational.			X	X		
Testing, Adjusting, and Balancing (TAB)		**M**	**E**	**T**	**C**	**A**
a. TAB report approved.			X		X	

Pre-Functional Performance Test Checklist – Exhaust Fan For Exhaust Fan: FE-5309						
Installation		**M**	**E**	**T**	**C**	**A**
a. Fan belt adjusted.			X		X	
Electrical		**M**	**E**	**T**	**C**	**A**
a. Power available to fan disconnect.				X		
b. Proper motor rotation verified.					X	
c. Verify that power disconnect is located within sight of the unit it controls.				X		
Controls		**M**	**E**	**T**	**C**	**A**
a. Control interlocks properly installed.				X		
b. Control interlocks operable.				X		
c. Dampers/actuators properly installed.			X			
d. Dampers/actuators operable.			X			
e. Verify proper location and installation of thermostat.			X			
Testing, Adjusting, and Balancing (TAB)		**M**	**E**	**T**	**C**	**A**
a. TAB report approved.			X		X	

Pre-Functional Performance Test Checklist – Exhaust Fan For Exhaust Fan: FE-5310						
Installation		**M**	**E**	**T**	**C**	**A**
a. Fan belt adjusted.			X		X	
Electrical		**M**	**E**	**T**	**C**	**A**
a. Power available to fan disconnect.				X		
b. Proper motor rotation verified.					X	
c. Verify that power disconnect is located within sight of the unit it controls.				X		
Controls		**M**	**E**	**T**	**C**	**A**
a. Control interlocks properly installed.				X		
b. Control interlocks operable.				X		
c. Dampers/actuators properly installed.			X			
d. Dampers/actuators operable.			X			
e. Verify proper location and installation of thermostat.			X			
Testing, Adjusting, and Balancing (TAB)		**M**	**E**	**T**	**C**	**A**
a. TAB report approved.			X		X	

Pre-Functional Performance Test Checklist – Exhaust Fan For Exhaust Fan: FE-5323						
Installation		**M**	**E**	**T**	**C**	**A**
a. Fan belt adjusted.			X		X	
Electrical		**M**	**E**	**T**	**C**	**A**
a. Power available to fan disconnect.				X		
b. Proper motor rotation verified.					X	
c. Verify that power disconnect is located within sight of the unit it controls.				X		
Controls		**M**	**E**	**T**	**C**	**A**
a. Control interlocks properly installed.				X		
b. Control interlocks operable.				X		
c. Dampers/actuators properly installed.			X			
d. Dampers/actuators operable.			X			
e. Verify proper location and installation of thermostat.			X			
Testing, Adjusting, and Balancing (TAB)		**M**	**E**	**T**	**C**	**A**
a. TAB report approved.			X		X	

Pre-Functional Performance Test Checklist – HVAC System Controls For HVAC System: BAS Facility Controls						
Installation		**M**	**E**	**T**	**C**	**A**
a. Layout of control panel matches drawings.			X	X		
b. Framed instructions mounted in or near control panel.			X	X		
c. Components properly labeled (on inside and outside of panel).			X	X		
d. Control components piped and/or wired to each labeled terminal strip.			X	X		
e. EMCS connection made to each labeled terminal strip as shown.			X	X		
f. Control wiring and tubing labeled at all terminations, splices, and junctions.			X	X		
Main Power		**M**	**E**	**T**	**C**	**A**
a. 120 volt AC power available to panel.				X		
Testing, Adjusting, and Balancing (TAB)		**M**	**E**	**T**	**C**	**A**
a. TAB report approved.			X		X	

Pre-Functional Performance Test Checklist – Energy Recovery System For HVAC System: Energy Recovery System						
Installation		**M**	**E**	**T**	**C**	**A**
a. Recovery system piping installed.			X		X	
Startup		**M**	**E**	**T**	**C**	**A**
a. Startup and checkout complete.			X	X	X	
Controls		**M**	**E**	**T**	**C**	**A**
a. Control valves/actuators properly installed.			X			
b. Control valves/actuators operable.			X			

Functional Performance Test Checklist – Pump PHW-5105

NOTE: Prior to performing this test, for closed loop systems ensure that the system is pressurized and the make-up water system is operational, or for open loop systems ensure that the sumps are filled to the proper level.

1. Activate pump start using control system commands.
   a. Verify correct operation in:

      HAND_____ OFF_____ AUTO_____

   b. Verify pressure drop across strainer:

      Strainer inlet pressure _____ psig

      Strainer outlet pressure _____ psig

   c. Verify pump inlet/outlet pressure reading, compare to Testing, Adjusting, and Balancing (TAB) Report and pump design conditions.

	Design	TAB Test	Actual
Pump inlet pressure (psig)	_____	_____	_____
Pump outlet pressure (psig)	_____	_____	_____

   d. Operate pump at shutoff and at 100 percent of designed flow when all components are in full flow. Plot test readings on pump curve and compare results against readings taken from flow measuring devices.

	Shutoff	100 percent
Pump inlet pressure (psig)	_____	_____
Pump outlet pressure (psig)	_____	_____
Pump flow rate (gpm)	_____	_____

	Setpoint
Differential Pressure Transmitter	_____

   e. For variable speed pumps, operate pump at shutoff (shutoff to be done in manual on variable speed drive at the minimum rpm that the system is being controlled at) and at minimum flow or when all components are in full by-pass. Plot test readings on pump curve and compare results against readings taken from flow measuring devices.

	Shutoff	100 percent
Pump inlet pressure (psig)	_____	_____
Pump outlet pressure (psig)	_____	_____
Pump flow rate (gpm)	_____	_____

	Setpoint
Differential Pressure Transmitter	_____

Functional Performance Test Checklist – Pump PHW-5105 (Cont)

2. Measure motor amperage each phase and voltage phase to phase and phase to ground for both the full flow and the minimum flow conditions. Compare amperage to nameplate FLA.

   a. Full flow:

Nameplate FLA		_____				
Amperage	Phase 1	_____	Phase 2	_____	Phase 3	_____
Voltage	Ph1–Ph2	_____	Ph1–Ph3	_____	Ph2–Ph3	_____
Voltage	Ph1–gnd	_____	Ph2–gnd	_____	Ph3–gnd	_____

   b. Minimum flow:

Amperage	Phase 1	_____	Phase 2	_____	Phase 3	_____
Voltage	Ph1–Ph2	_____	Ph1–Ph3	_____	Ph2–Ph3	_____
Voltage	Ph1–gnd	_____	Ph2–gnd	_____	Ph3–gnd	_____

3. Note unusual vibration, noise, etc.

_____

_____

4. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

	Signature and Date
Subcontractor's Mechanical Representative	_____
Subcontractor's Electrical Representative	_____
Subcontractor's TAB Representative	_____
Subcontractor's Controls Representative	_____
LANL Commissioning Agent	_____
FOD Representative (Optional)	_____

Functional Performance Test Checklist – Pump PHW-5106

NOTE: Prior to performing this test, for closed loop systems ensure that the system is pressurized and the make-up water system is operational, or for open loop systems ensure that the sumps are filled to the proper level.

1. Activate pump start using control system commands.
   a. Verify correct operation in:

      HAND_____ OFF_____ AUTO_____

   b. Verify pressure drop across strainer:

      Strainer inlet pressure _____psig

      Strainer outlet pressure _____ psig

   c. Verify pump inlet/outlet pressure reading, compare to Testing, Adjusting, and Balancing (TAB) Report and pump design conditions.

	Design	TAB Test	Actual
Pump inlet pressure (psig)	_____	_____	_____
Pump outlet pressure (psig)	_____	_____	_____

   d. Operate pump at shutoff and at 100 percent of designed flow when all components are in full flow. Plot test readings on pump curve and compare results against readings taken from flow measuring devices.

	Shutoff	100 percent
Pump inlet pressure (psig)	_____	_____
Pump outlet pressure (psig)	_____	_____
Pump flow rate (gpm)	_____	_____

	Setpoint
Differential Pressure Transmitter	_____

   e. For variable speed pumps, operate pump at shutoff (shutoff to be done in manual on variable speed drive at the minimum rpm that the system is being controlled at) and at minimum flow or when all components are in full by-pass. Plot test readings on pump curve and compare results against readings taken from flow measuring devices.

	Shutoff	100 percent
Pump inlet pressure (psig)	_____	_____
Pump outlet pressure (psig)	_____	_____
Pump flow rate (gpm)	_____	_____

	Setpoint
Differential Pressure Transmitter	_____

Functional Performance Test Checklist – Pump PHW-5106 (Cont)

2. Measure motor amperage each phase and voltage phase to phase and phase to ground for both the full flow and the minimum flow conditions. Compare amperage to nameplate FLA.

   a. Full flow:

Nameplate FLA		_____				
Amperage	Phase 1	_____	Phase 2	_____	Phase 3	_____
Voltage	Ph1–Ph2	_____	Ph1–Ph3	_____	Ph2–Ph3	_____
Voltage	Ph1–gnd	_____	Ph2–gnd	_____	Ph3–gnd	_____

   b. Minimum flow:

Amperage	Phase 1	_____	Phase 2	_____	Phase 3	_____
Voltage	Ph1–Ph2	_____	Ph1–Ph3	_____	Ph2–Ph3	_____
Voltage	Ph1–gnd	_____	Ph2–gnd	_____	Ph3–gnd	_____

3. Note unusual vibration, noise, etc.

_____

_____

4. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

	Signature and Date
Subcontractor's Mechanical Representative	_____
Subcontractor's Electrical Representative	_____
Subcontractor's TAB Representative	_____
Subcontractor's Controls Representative	_____
LANL Commissioning Agent	_____
FOD Representative (Optional)	_____

Functional Performance Test Checklist – Pump PHW-5110

NOTE: Prior to performing this test, for closed loop systems ensure that the system is pressurized and the make-up water system is operational, or for open loop systems ensure that the sumps are filled to the proper level.

1. Activate pump start using control system commands.
   a. Verify correct operation in:

      HAND_____ OFF_____ AUTO_____

   b. Verify pressure drop across strainer:

      Strainer inlet pressure _____ psig

      Strainer outlet pressure _____ psig

   c. Verify pump inlet/outlet pressure reading, compare to Testing, Adjusting, and Balancing (TAB) Report and pump design conditions.

	Design	TAB Test	Actual
Pump inlet pressure (psig)	_____	_____	_____
Pump outlet pressure (psig)	_____	_____	_____

   d. Operate pump at shutoff and at 100 percent of designed flow when all components are in full flow. Plot test readings on pump curve and compare results against readings taken from flow measuring devices.

	Shutoff	100 percent
Pump inlet pressure (psig)	_____	_____
Pump outlet pressure (psig)	_____	_____
Pump flow rate (gpm)	_____	_____

	Setpoint
Differential Pressure Transmitter	_____

   e. For variable speed pumps, operate pump at shutoff (shutoff to be done in manual on variable speed drive at the minimum rpm that the system is being controlled at) and at minimum flow or when all components are in full by-pass. Plot test readings on pump curve and compare results against readings taken from flow measuring devices.

	Shutoff	100 percent
Pump inlet pressure (psig)	_____	_____
Pump outlet pressure (psig)	_____	_____
Pump flow rate (gpm)	_____	_____

	Setpoint
Differential Pressure Transmitter	_____

Functional Performance Test Checklist – Pump PHW-5110 (Cont)

2. Measure motor amperage each phase and voltage phase to phase and phase to ground for both the full flow and the minimum flow conditions. Compare amperage to nameplate FLA.

   a. Full flow:

Nameplate FLA		_____				
Amperage	Phase 1	_____	Phase 2	_____	Phase 3	_____
Voltage	Ph1–Ph2	_____	Ph1–Ph3	_____	Ph2–Ph3	_____
Voltage	Ph1–gnd	_____	Ph2–gnd	_____	Ph3–gnd	_____

   b. Minimum flow:

Amperage	Phase 1	_____	Phase 2	_____	Phase 3	_____
Voltage	Ph1–Ph2	_____	Ph1–Ph3	_____	Ph2–Ph3	_____
Voltage	Ph1–gnd	_____	Ph2–gnd	_____	Ph3–gnd	_____

3. Note unusual vibration, noise, etc.

_____

_____

4. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

	Signature and Date
Subcontractor's Mechanical Representative	_____
Subcontractor's Electrical Representative	_____
Subcontractor's TAB Representative	_____
Subcontractor's Controls Representative	_____
LANL Commissioning Agent	_____
FOD Representative (Optional)	_____

Functional Performance Test Checklist – Pump PHW-5111

NOTE: Prior to performing this test, for closed loop systems ensure that the system is pressurized and the make-up water system is operational, or for open loop systems ensure that the sumps are filled to the proper level.

1. Activate pump start using control system commands.
   a. Verify correct operation in:

      HAND_____ OFF_____ AUTO_____

   b. Verify pressure drop across strainer:

      Strainer inlet pressure _____ psig

      Strainer outlet pressure _____ psig

   c. Verify pump inlet/outlet pressure reading, compare to Testing, Adjusting, and Balancing (TAB) Report and pump design conditions.

	Design	TAB Test	Actual
Pump inlet pressure (psig)	_____	_____	_____
Pump outlet pressure (psig)	_____	_____	_____

   d. Operate pump at shutoff and at 100 percent of designed flow when all components are in full flow. Plot test readings on pump curve and compare results against readings taken from flow measuring devices.

	Shutoff	100 percent
Pump inlet pressure (psig)	_____	_____
Pump outlet pressure (psig)	_____	_____
Pump flow rate (gpm)	_____	_____

	Setpoint
Differential Pressure Transmitter	_____

   e. For variable speed pumps, operate pump at shutoff (shutoff to be done in manual on variable speed drive at the minimum rpm that the system is being controlled at) and at minimum flow or when all components are in full by-pass. Plot test readings on pump curve and compare results against readings taken from flow measuring devices.

	Shutoff	100 percent
Pump inlet pressure (psig)	_____	_____
Pump outlet pressure (psig)	_____	_____
Pump flow rate (gpm)	_____	_____

	Setpoint
Differential Pressure Transmitter	_____

Functional Performance Test Checklist – Pump PHW-5111 (Cont)

2. Measure motor amperage each phase and voltage phase to phase and phase to ground for both the full flow and the minimum flow conditions. Compare amperage to nameplate FLA.

   a. Full flow:

Nameplate FLA		_____				
Amperage	Phase 1	_____	Phase 2	_____	Phase 3	_____
Voltage	Ph1–Ph2	_____	Ph1–Ph3	_____	Ph2–Ph3	_____
Voltage	Ph1–gnd	_____	Ph2–gnd	_____	Ph3–gnd	_____

   b. Minimum flow:

Amperage	Phase 1	_____	Phase 2	_____	Phase 3	_____
Voltage	Ph1–Ph2	_____	Ph1–Ph3	_____	Ph2–Ph3	_____
Voltage	Ph1–gnd	_____	Ph2–gnd	_____	Ph3–gnd	_____

3. Note unusual vibration, noise, etc.

_____

_____

4. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

	Signature and Date
Subcontractor's Mechanical Representative	_____
Subcontractor's Electrical Representative	_____
Subcontractor's TAB Representative	_____
Subcontractor's Controls Representative	_____
LANL Commissioning Agent	_____
FOD Representative (Optional)	_____

Functional Performance Test Checklist – Pump PHW-5313

NOTE: Prior to performing this test, for closed loop systems ensure that the system is pressurized and the make-up water system is operational, or for open loop systems ensure that the sumps are filled to the proper level.

1. Activate pump start using control system commands.
   a. Verify correct operation in:

      HAND_____ OFF_____ AUTO_____

   b. Verify pressure drop across strainer:

      Strainer inlet pressure _____ psig

      Strainer outlet pressure _____ psig

   c. Verify pump inlet/outlet pressure reading, compare to Testing, Adjusting, and Balancing (TAB) Report and pump design conditions.

	Design	TAB Test	Actual
Pump inlet pressure (psig)	_____	_____	_____
Pump outlet pressure (psig)	_____	_____	_____

   d. Operate pump at shutoff and at 100 percent of designed flow when all components are in full flow. Plot test readings on pump curve and compare results against readings taken from flow measuring devices.

	Shutoff	100 percent
Pump inlet pressure (psig)	_____	_____
Pump outlet pressure (psig)	_____	_____
Pump flow rate (gpm)	_____	_____

	Setpoint
Differential Pressure Transmitter	_____

   e. For variable speed pumps, operate pump at shutoff (shutoff to be done in manual on variable speed drive at the minimum rpm that the system is being controlled at) and at minimum flow or when all components are in full by-pass. Plot test readings on pump curve and compare results against readings taken from flow measuring devices.

	Shutoff	100 percent
Pump inlet pressure (psig)	_____	_____
Pump outlet pressure (psig)	_____	_____
Pump flow rate (gpm)	_____	_____

	Setpoint
Differential Pressure Transmitter	_____

Functional Performance Test Checklist – Pump PHW-5313 (Cont)

2. Measure motor amperage each phase and voltage phase to phase and phase to ground for both the full flow and the minimum flow conditions. Compare amperage to nameplate FLA.

   a. Full flow:

Nameplate FLA		_____				
Amperage	Phase 1	_____	Phase 2	_____	Phase 3	_____
Voltage	Ph1–Ph2	_____	Ph1–Ph3	_____	Ph2–Ph3	_____
Voltage	Ph1–gnd	_____	Ph2–gnd	_____	Ph3–gnd	_____

   b. Minimum flow:

Amperage	Phase 1	_____	Phase 2	_____	Phase 3	_____
Voltage	Ph1–Ph2	_____	Ph1–Ph3	_____	Ph2–Ph3	_____
Voltage	Ph1–gnd	_____	Ph2–gnd	_____	Ph3–gnd	_____

3. Note unusual vibration, noise, etc.

_____

_____

4. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

	Signature and Date
Subcontractor's Mechanical Representative	_____
Subcontractor's Electrical Representative	_____
Subcontractor's TAB Representative	_____
Subcontractor's Controls Representative	_____
LANL Commissioning Agent	_____
FOD Representative (Optional)	_____

Functional Performance Test Checklist – Pump PHW-5314

NOTE: Prior to performing this test, for closed loop systems ensure that the system is pressurized and the make-up water system is operational, or for open loop systems ensure that the sumps are filled to the proper level.

1. Activate pump start using control system commands.
   a. Verify correct operation in:

      HAND_____ OFF_____ AUTO_____

   b. Verify pressure drop across strainer:

      Strainer inlet pressure _____ psig

      Strainer outlet pressure _____ psig

   c. Verify pump inlet/outlet pressure reading, compare to Testing, Adjusting, and Balancing (TAB) Report and pump design conditions.

	Design	TAB Test	Actual
Pump inlet pressure (psig)	_____	_____	_____
Pump outlet pressure (psig)	_____	_____	_____

   d. Operate pump at shutoff and at 100 percent of designed flow when all components are in full flow. Plot test readings on pump curve and compare results against readings taken from flow measuring devices.

	Shutoff	100 percent
Pump inlet pressure (psig)	_____	_____
Pump outlet pressure (psig)	_____	_____
Pump flow rate (gpm)	_____	_____

	Setpoint
Differential Pressure Transmitter	_____

   e. For variable speed pumps, operate pump at shutoff (shutoff to be done in manual on variable speed drive at the minimum rpm that the system is being controlled at) and at minimum flow or when all components are in full by-pass. Plot test readings on pump curve and compare results against readings taken from flow measuring devices.

	Shutoff	100 percent
Pump inlet pressure (psig)	_____	_____
Pump outlet pressure (psig)	_____	_____
Pump flow rate (gpm)	_____	_____

	Setpoint
Differential Pressure Transmitter	_____

Functional Performance Test Checklist – Pump PHW-5314 (Cont)

2. Measure motor amperage each phase and voltage phase to phase and phase to ground for both the full flow and the minimum flow conditions. Compare amperage to nameplate FLA.

   a. Full flow:

Nameplate FLA		_____				
Amperage	Phase 1	_____	Phase 2	_____	Phase 3	_____
Voltage	Ph1–Ph2	_____	Ph1–Ph3	_____	Ph2–Ph3	_____
Voltage	Ph1–gnd	_____	Ph2–gnd	_____	Ph3–gnd	_____

   b. Minimum flow:

Amperage	Phase 1	_____	Phase 2	_____	Phase 3	_____
Voltage	Ph1–Ph2	_____	Ph1–Ph3	_____	Ph2–Ph3	_____
Voltage	Ph1–gnd	_____	Ph2–gnd	_____	Ph3–gnd	_____

3. Note unusual vibration, noise, etc.

_____

_____

4. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

	Signature and Date
Subcontractor's Mechanical Representative	_____
Subcontractor's Electrical Representative	_____
Subcontractor's TAB Representative	_____
Subcontractor's Controls Representative	_____
LANL Commissioning Agent	_____
FOD Representative (Optional)	_____

Functional Performance Test Checklist – Pump PHW-5103

NOTE: Prior to performing this test, for closed loop systems ensure that the system is pressurized and the make-up water system is operational, or for open loop systems ensure that the sumps are filled to the proper level.

1. Activate pump start using control system commands.
   a. Verify correct operation in:

      HAND_____ OFF_____ AUTO_____

   b. Verify pressure drop across strainer:

      Strainer inlet pressure _____ psig

      Strainer outlet pressure _____ psig

   c. Verify pump inlet/outlet pressure reading, compare to Testing, Adjusting, and Balancing (TAB) Report and pump design conditions.

	Design	TAB Test	Actual
Pump inlet pressure (psig)	_____	_____	_____
Pump outlet pressure (psig)	_____	_____	_____

   d. Operate pump at shutoff and at 100 percent of designed flow when all components are in full flow. Plot test readings on pump curve and compare results against readings taken from flow measuring devices.

	Shutoff	100 percent
Pump inlet pressure (psig)	_____	_____
Pump outlet pressure (psi)	_____	_____
Pump flow rate (gpm)	_____	_____

	Setpoint
Differential Pressure Transmitter	_____

   e. For variable speed pumps, operate pump at shutoff (shutoff to be done in manual on variable speed drive at the minimum rpm that the system is being controlled at) and at minimum flow or when all components are in full by-pass. Plot test readings on pump curve and compare results against readings taken from flow measuring devices.

	Shutoff	100 percent
Pump inlet pressure (psig)	_____	_____
Pump outlet pressure (psig)	_____	_____
Pump flow rate (gpm)	_____	_____

	Setpoint
Differential Pressure Transmitter	_____

Functional Performance Test Checklist – Pump PHW-5103 (Cont)

2. Measure motor amperage each phase and voltage phase to phase and phase to ground for both the full flow and the minimum flow conditions. Compare amperage to nameplate FLA.

   a. Full flow:

Nameplate FLA		_____				
Amperage	Phase 1	_____	Phase 2	_____	Phase 3	_____
Voltage	Ph1–Ph2	_____	Ph1–Ph3	_____	Ph2–Ph3	_____
Voltage	Ph1–gnd	_____	Ph2–gnd	_____	Ph3–gnd	_____

   b. Minimum flow:

Amperage	Phase 1	_____	Phase 2	_____	Phase 3	_____
Voltage	Ph1–Ph2	_____	Ph1–Ph3	_____	Ph2–Ph3	_____
Voltage	Ph1–gnd	_____	Ph2–gnd	_____	Ph3–gnd	_____

3. Note unusual vibration, noise, etc.

_____

_____

4. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

	Signature and Date
Subcontractor's Mechanical Representative	_____
Subcontractor's Electrical Representative	_____
Subcontractor's TAB Representative	_____
Subcontractor's Controls Representative	_____
LANL Commissioning Agent	_____
FOD Representative (Optional)	_____

Functional Performance Test Checklist – Pump PCW-5211

NOTE: Prior to performing this test, for closed loop systems ensure that the system is pressurized and the make-up water system is operational, or for open loop systems ensure that the sumps are filled to the proper level.

1. Activate pump start using control system commands.
   a. Verify correct operation in:

      HAND_____ OFF_____ AUTO_____

   b. Verify pressure drop across strainer:

      Strainer inlet pressure _____ psig

      Strainer outlet pressure _____ psig

   c. Verify pump inlet/outlet pressure reading, compare to Testing, Adjusting, and Balancing (TAB) Report and pump design conditions.

	Design	TAB Test	Actual
Pump inlet pressure (psig)	_____	_____	_____
Pump outlet pressure (psig)	_____	_____	_____

   d. Operate pump at shutoff and at 100 percent of designed flow when all components are in full flow. Plot test readings on pump curve and compare results against readings taken from flow measuring devices.

	Shutoff	100 percent
Pump inlet pressure (psig)	_____	_____
Pump outlet pressure (psig)	_____	_____
Pump flow rate (gpm)	_____	_____

	Setpoint
Differential Pressure Transmitter	_____

   e. For variable speed pumps, operate pump at shutoff (shutoff to be done in manual on variable speed drive at the minimum rpm that the system is being controlled at) and at minimum flow or when all components are in full by-pass. Plot test readings on pump curve and compare results against readings taken from flow measuring devices.

	Shutoff	100 percent
Pump inlet pressure (psig)	_____	_____
Pump outlet pressure (psig)	_____	_____
Pump flow rate (gpm)	_____	_____

	Setpoint
Differential Pressure Transmitter	_____

Functional Performance Test Checklist – Pump PCW-5211 (Cont)

2. Measure motor amperage each phase and voltage phase to phase and phase to ground for both the full flow and the minimum flow conditions. Compare amperage to nameplate FLA.

   a. Full flow:

Nameplate FLA		_____				
Amperage	Phase 1	_____	Phase 2	_____	Phase 3	_____
Voltage	Ph1–Ph2	_____	Ph1–Ph3	_____	Ph2–Ph3	_____
Voltage	Ph1–gnd	_____	Ph2–gnd	_____	Ph3–gnd	_____

   b. Minimum flow:

Amperage	Phase 1	_____	Phase 2	_____	Phase 3	_____
Voltage	Ph1–Ph2	_____	Ph1–Ph3	_____	Ph2–Ph3	_____
Voltage	Ph1–gnd	_____	Ph2–gnd	_____	Ph3–gnd	_____

3. Note unusual vibration, noise, etc.

_____

_____

4. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

	Signature and Date
Subcontractor's Mechanical Representative	_____
Subcontractor's Electrical Representative	_____
Subcontractor's TAB Representative	_____
Subcontractor's Controls Representative	_____
LANL Commissioning Agent	_____
FOD Representative (Optional)	_____

Functional Performance Test Checklist – Pump PCW-5212

NOTE: Prior to performing this test, for closed loop systems ensure that the system is pressurized and the make-up water system is operational, or for open loop systems ensure that the sumps are filled to the proper level.

1. Activate pump start using control system commands.
   a. Verify correct operation in:

      HAND_____ OFF_____ AUTO_____

   b. Verify pressure drop across strainer:

      Strainer inlet pressure _____ psig

      Strainer outlet pressure _____ psig

   c. Verify pump inlet/outlet pressure reading, compare to Testing, Adjusting, and Balancing (TAB) Report and pump design conditions.

	Design	TAB Test	Actual
Pump inlet pressure (psig)	_____	_____	_____
Pump outlet pressure (psig)	_____	_____	_____

   d. Operate pump at shutoff and at 100 percent of designed flow when all components are in full flow. Plot test readings on pump curve and compare results against readings taken from flow measuring devices.

	Shutoff	100 percent
Pump inlet pressure (psig)	_____	_____
Pump outlet pressure (psig)	_____	_____
Pump flow rate (gpm)	_____	_____

	Setpoint
Differential Pressure Transmitter	_____

   e. For variable speed pumps, operate pump at shutoff (shutoff to be done in manual on variable speed drive at the minimum rpm that the system is being controlled at) and at minimum flow or when all components are in full by-pass. Plot test readings on pump curve and compare results against readings taken from flow measuring devices.

	Shutoff	100 percent
Pump inlet pressure (psig)	_____	_____
Pump outlet pressure (psig)	_____	_____
Pump flow rate (gpm)	_____	_____

	Setpoint
Differential Pressure Transmitter	_____

Functional Performance Test Checklist – Pump PCW-5212 (Cont)

2. Measure motor amperage each phase and voltage phase to phase and phase to ground for both the full flow and the minimum flow conditions. Compare amperage to nameplate FLA.

   a. Full flow:

Nameplate FLA		_____				
Amperage	Phase 1	_____	Phase 2	_____	Phase 3	_____
Voltage	Ph1–Ph2	_____	Ph1–Ph3	_____	Ph2–Ph3	_____
Voltage	Ph1–gnd	_____	Ph2–gnd	_____	Ph3–gnd	_____

   b. Minimum flow:

Amperage	Phase 1	_____	Phase 2	_____	Phase 3	_____
Voltage	Ph1–Ph2	_____	Ph1–Ph3	_____	Ph2–Ph3	_____
Voltage	Ph1–gnd	_____	Ph2–gnd	_____	Ph3–gnd	_____

3. Note unusual vibration, noise, etc.

_____

_____

4. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

	Signature and Date
Subcontractor's Mechanical Representative	_____
Subcontractor's Electrical Representative	_____
Subcontractor's TAB Representative	_____
Subcontractor's Controls Representative	_____
LANL Commissioning Agent	_____
FOD Representative (Optional)	_____

Functional Performance Test Checklist – Pump PCW-5213

NOTE: Prior to performing this test, for closed loop systems ensure that the system is pressurized and the make-up water system is operational, or for open loop systems ensure that the sumps are filled to the proper level.

1. Activate pump start using control system commands.
   a. Verify correct operation in:

      HAND_____ OFF_____ AUTO_____

   b. Verify pressure drop across strainer:

      Strainer inlet pressure _____ psig

      Strainer outlet pressure _____ psig

   c. Verify pump inlet/outlet pressure reading, compare to Testing, Adjusting, and Balancing (TAB) Report and pump design conditions.

	Design	TAB Test	Actual
Pump inlet pressure (psig)	_____	_____	_____
Pump outlet pressure (psig)	_____	_____	_____

   d. Operate pump at shutoff and at 100 percent of designed flow when all components are in full flow. Plot test readings on pump curve and compare results against readings taken from flow measuring devices.

	Shutoff	100 percent
Pump inlet pressure (psig)	_____	_____
Pump outlet pressure (psig)	_____	_____
Pump flow rate (gpm)	_____	_____

	Setpoint
Differential Pressure Transmitter	_____

   e. For variable speed pumps, operate pump at shutoff (shutoff to be done in manual on variable speed drive at the minimum rpm that the system is being controlled at) and at minimum flow or when all components are in full by-pass. Plot test readings on pump curve and compare results against readings taken from flow measuring devices.

	Shutoff	100 percent
Pump inlet pressure (psig)	_____	_____
Pump outlet pressure (psig)	_____	_____
Pump flow rate (gpm)	_____	_____

	Setpoint
Differential Pressure Transmitter	_____

Functional Performance Test Checklist – Pump PCW-5213 (Cont)

2. Measure motor amperage each phase and voltage phase to phase and phase to ground for both the full flow and the minimum flow conditions. Compare amperage to nameplate FLA.

   a. Full flow:

Nameplate FLA		_____				
Amperage	Phase 1	_____	Phase 2	_____	Phase 3	_____
Voltage	Ph1–Ph2	_____	Ph1–Ph3	_____	Ph2–Ph3	_____
Voltage	Ph1–gnd	_____	Ph2–gnd	_____	Ph3–gnd	_____

   b. Minimum flow:

Amperage	Phase 1	_____	Phase 2	_____	Phase 3	_____
Voltage	Ph1–Ph2	_____	Ph1–Ph3	_____	Ph2–Ph3	_____
Voltage	Ph1–gnd	_____	Ph2–gnd	_____	Ph3–gnd	_____

3. Note unusual vibration, noise, etc.

_____

_____

4. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

	Signature and Date
Subcontractor's Mechanical Representative	_____
Subcontractor's Electrical Representative	_____
Subcontractor's TAB Representative	_____
Subcontractor's Controls Representative	_____
LANL Commissioning Agent	_____
FOD Representative (Optional)	_____

Functional Performance Test Checklist – Pump PCW-5214

NOTE: Prior to performing this test, for closed loop systems ensure that the system is pressurized and the make-up water system is operational, or for open loop systems ensure that the sumps are filled to the proper level.

1. Activate pump start using control system commands.
   a. Verify correct operation in:

      HAND_____ OFF_____ AUTO_____

   b. Verify pressure drop across strainer:

      Strainer inlet pressure _____ psig

      Strainer outlet pressure _____ psig

   c. Verify pump inlet/outlet pressure reading, compare to Testing, Adjusting, and Balancing (TAB) Report and pump design conditions.

	Design	TAB Test	Actual
Pump inlet pressure (psig)	_____	_____	_____
Pump outlet pressure (psig)	_____	_____	_____

   d. Operate pump at shutoff and at 100 percent of designed flow when all components are in full flow. Plot test readings on pump curve and compare results against readings taken from flow measuring devices.

	Shutoff	100 percent
Pump inlet pressure (psig)	_____	_____
Pump outlet pressure (psig)	_____	_____
Pump flow rate (gpm)	_____	_____

	Setpoint
Differential Pressure Transmitter	_____

   e. For variable speed pumps, operate pump at shutoff (shutoff to be done in manual on variable speed drive at the minimum rpm that the system is being controlled at) and at minimum flow or when all components are in full by-pass. Plot test readings on pump curve and compare results against readings taken from flow measuring devices.

	Shutoff	100 percent
Pump inlet pressure (psig)	_____	_____
Pump outlet pressure (psig)	_____	_____
Pump flow rate (gpm)	_____	_____

	Setpoint
Differential Pressure Transmitter	_____

Functional Performance Test Checklist – Pump PCW-5214 (Cont)

2. Measure motor amperage each phase and voltage phase to phase and phase to ground for both the full flow and the minimum flow conditions. Compare amperage to nameplate FLA.

   a. Full flow:

Nameplate FLA		_____				
Amperage	Phase 1	_____	Phase 2	_____	Phase 3	_____
Voltage	Ph1–Ph2	_____	Ph1–Ph3	_____	Ph2–Ph3	_____
Voltage	Ph1–gnd	_____	Ph2–gnd	_____	Ph3–gnd	_____

   b. Minimum flow:

Amperage	Phase 1	_____	Phase 2	_____	Phase 3	_____
Voltage	Ph1–Ph2	_____	Ph1–Ph3	_____	Ph2–Ph3	_____
Voltage	Ph1–gnd	_____	Ph2–gnd	_____	Ph3–gnd	_____

3. Note unusual vibration, noise, etc.

_____

_____

4. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

	Signature and Date
Subcontractor's Mechanical Representative	_____
Subcontractor's Electrical Representative	_____
Subcontractor's TAB Representative	_____
Subcontractor's Controls Representative	_____
LANL Commissioning Agent	_____
FOD Representative (Optional)	_____

Functional Performance Test Checklist– CAV Terminals CAV-5331

NOTE: The Contracting Officer will select CAV terminals to be spot-checked during the functional performance test.

1. Functional Performance Test: Subcontractor shall demonstrate operation of selected CAV boxes as per specifications including the following:

   a. Cooling with reheat CAV boxes:

      1) Verify CAV box response to room temperature set point adjustment. Turn thermostat to 5 degrees F above ambient and measure maximum airflow. Turn thermostat to 5 degrees F below ambient and measure minimum airflow. (NOTE: airflow should not change)

	Setting	Measured	Design
Maximum flow	[_____]	[_____]	[_____] cfm
Minimum flow	[_____]	[_____]	[_____]cfm

      2) Verify reheat coil operation range (full closed to full open) by turning room thermostat

      5 degrees F above ambient _____

      With heating water system and boiler in operation providing design supply hot water temperature record the following:

      Design HW supply temperature _____ deg F

      Actual HW supply temperature _____ deg F

      AHU supply air temperature _____ deg F

      CAV supply air temperature _____ deg F

      Calculate coil capacity and compare to design:

      Design _____ BTU/hr Actual _____ BTU/hr.

Functional Performance Test Checklist– CAV Terminals CAV-5331 (Cont)

2. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

	Signature and Date
Subcontractor's Mechanical Representative	_____
Subcontractor's Electrical Representative	_____
Subcontractor's TAB Representative	_____
Subcontractor's Controls Representative	_____
LANL Commissioning Agent	_____
FOD Representative (Optional)	_____

Functional Performance Test Checklist– CAV Terminals CAV-5332

NOTE: The Contracting Officer will select CAV terminals to be spot-checked during the functional performance test.

1. Functional Performance Test: Subcontractor shall demonstrate operation of selected CAV boxes as per specifications including the following:

   a. Cooling with reheat CAV boxes:

      1) Verify CAV box response to room temperature set point adjustment. Turn thermostat to 5 degrees F above ambient and measure maximum airflow. Turn thermostat to 5 degrees F below ambient and measure minimum airflow. (NOTE: airflow should not change)

	Setting	Measured	Design
Maximum flow	[_____]	[_____]	[_____] cfm
Minimum flow	[_____]	[_____]	[_____]cfm

      2) Verify reheat coil operation range (full closed to full open) by turning room thermostat

      5 degrees F above ambient _____

      With heating water system and boiler in operation providing design supply hot water temperature record the following:

      Design HW supply temperature _____ deg F

      Actual HW supply temperature _____ deg F

      AHU supply air temperature _____ deg F

      CAV supply air temperature _____ deg F

      Calculate coil capacity and compare to design:

      Design _____ BTU/hr Actual _____ BTU/hr.

Functional Performance Test Checklist– CAV Terminals CAV-5332 (Cont)

2. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

	Signature and Date
Subcontractor's Mechanical Representative	_____
Subcontractor's Electrical Representative	_____
Subcontractor's TAB Representative	_____
Subcontractor's Controls Representative	_____
LANL Commissioning Agent	_____
FOD Representative (Optional)	_____

Functional Performance Test Checklist– CAV Terminals CAV-5333

NOTE: The Contracting Officer will select CAV terminals to be spot-checked during the functional performance test.

1. Functional Performance Test: Subcontractor shall demonstrate operation of selected CAV boxes as per specifications including the following:

   a. Cooling with reheat CAV boxes:

      1) Verify CAV box response to room temperature set point adjustment. Turn thermostat to 5 degrees F above ambient and measure maximum airflow. Turn thermostat to 5 degrees F below ambient and measure minimum airflow. (NOTE: airflow should not change)

	Setting	Measured	Design
Maximum flow	[_____]	[_____]	[_____] cfm
Minimum flow	[_____]	[_____]	[_____]cfm

      2) Verify reheat coil operation range (full closed to full open) by turning room thermostat

      5 degrees F above ambient _____

      With heating water system and boiler in operation providing design supply hot water temperature record the following:

      Design HW supply temperature _____ deg F

      Actual HW supply temperature _____ deg F

      AHU supply air temperature _____ deg F

      CAV supply air temperature _____ deg F

      Calculate coil capacity and compare to design:

      Design _____ BTU/hr Actual _____ BTU/hr.

Functional Performance Test Checklist– CAV Terminals CAV-5333 (Cont)

2. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

	Signature and Date
Subcontractor's Mechanical Representative	_____
Subcontractor's Electrical Representative	_____
Subcontractor's TAB Representative	_____
Subcontractor's Controls Representative	_____
LANL Commissioning Agent	_____
FOD Representative (Optional)	_____

Functional Performance Test Checklist– CAV Terminals CAV-5334

NOTE: The Contracting Officer will select CAV terminals to be spot-checked during the functional performance test.

1. Functional Performance Test: Subcontractor shall demonstrate operation of selected CAV boxes as per specifications including the following:

   a. Cooling with reheat CAV boxes:

      1) Verify CAV box response to room temperature set point adjustment. Turn thermostat to 5 degrees F above ambient and measure maximum airflow. Turn thermostat to 5 degrees F below ambient and measure minimum airflow. (NOTE: airflow should not change)

	Setting	Measured	Design
Maximum flow	[_____]	[_____]	[_____] cfm
Minimum flow	[_____]	[_____]	[_____]cfm

      2) Verify reheat coil operation range (full closed to full open) by turning room thermostat

      5 degrees F above ambient _____

      With heating water system and boiler in operation providing design supply hot water temperature record the following:

      Design HW supply temperature _____ deg F

      Actual HW supply temperature _____ deg F

      AHU supply air temperature _____ deg F

      CAV supply air temperature _____ deg F

      Calculate coil capacity and compare to design:

      Design _____ BTU/hr Actual _____ BTU/hr.

Functional Performance Test Checklist– CAV Terminals CAV-5334 (Cont)

2. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

	Signature and Date
Subcontractor's Mechanical Representative	_____
Subcontractor's Electrical Representative	_____
Subcontractor's TAB Representative	_____
Subcontractor's Controls Representative	_____
LANL Commissioning Agent	_____
FOD Representative (Optional)	_____

Functional Performance Test Checklist– CAV Terminals CAV-5335

NOTE: The Contracting Officer will select CAV terminals to be spot-checked during the functional performance test.

1. Functional Performance Test: Subcontractor shall demonstrate operation of selected CAV boxes as per specifications including the following:
   a. Cooling with reheat CAV boxes:
      1) Verify CAV box response to room temperature set point adjustment. Turn thermostat to 5 degrees F above ambient and measure maximum airflow. Turn thermostat to 5 degrees F below ambient and measure minimum airflow. (NOTE: airflow should not change)

	Setting	Measured	Design
Maximum flow	[_____]	[_____]	[_____] cfm
Minimum flow	[_____]	[_____]	[_____]cfm

      2) Verify reheat coil operation range (full closed to full open) by turning room thermostat

         5 degrees F above ambient _____

         With heating water system and boiler in operation providing design supply hot water temperature record the following:

         Design HW supply temperature _____ deg F

         Actual HW supply temperature _____ deg F

         AHU supply air temperature _____ deg F

         CAV supply air temperature _____ deg F

         Calculate coil capacity and compare to design:

         Design _____ BTU/hr Actual _____ BTU/hr.

Functional Performance Test Checklist– CAV Terminals CAV-5335 (Cont)

2. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

	Signature and Date
Subcontractor's Mechanical Representative	_____
Subcontractor's Electrical Representative	_____
Subcontractor's TAB Representative	_____
Subcontractor's Controls Representative	_____
LANL Commissioning Agent	_____
FOD Representative (Optional)	_____

Functional Performance Test Checklist– CAV Terminals CAV-5336

NOTE: The Contracting Officer will select CAV terminals to be spot-checked during the functional performance test.

1. Functional Performance Test: Subcontractor shall demonstrate operation of selected CAV boxes as per specifications including the following:

   a. Cooling with reheat CAV boxes:

      1) Verify CAV box response to room temperature set point adjustment. Turn thermostat to 5 degrees F above ambient and measure maximum airflow. Turn thermostat to 5 degrees F below ambient and measure minimum airflow. (NOTE: airflow should not change)

	Setting	Measured	Design
Maximum flow	[_____]	[_____]	[_____] cfm
Minimum flow	[_____]	[_____]	[_____]cfm

      2) Verify reheat coil operation range (full closed to full open) by turning room thermostat

         5 degrees F above ambient _____

         With heating water system and boiler in operation providing design supply hot water temperature record the following:

         Design HW supply temperature _____ deg F

         Actual HW supply temperature _____ deg F

         AHU supply air temperature _____ deg F

         CAV supply air temperature _____ deg F

         Calculate coil capacity and compare to design:

         Design _____ BTU/hr Actual _____ BTU/hr.

Functional Performance Test Checklist–CAV Terminals CAV-5336 (Cont)

2. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

	Signature and Date
Subcontractor's Mechanical Representative	_____
Subcontractor's Electrical Representative	_____
Subcontractor's TAB Representative	_____
Subcontractor's Controls Representative	_____
LANL Commissioning Agent	_____
FOD Representative (Optional)	_____

Functional Performance Test Checklist– CAV Terminals CAV-5337

NOTE: The Contracting Officer will select CAV terminals to be spot-checked during the functional performance test.

1. Functional Performance Test: Subcontractor shall demonstrate operation of selected CAV boxes as per specifications including the following:

   a. Cooling with reheat CAV boxes:

      1) Verify CAV box response to room temperature set point adjustment. Turn thermostat to 5 degrees F above ambient and measure maximum airflow. Turn thermostat to 5 degrees F below ambient and measure minimum airflow. (NOTE: airflow should not change)

	Setting	Measured	Design
Maximum flow	[_____]	[_____]	[_____] cfm
Minimum flow	[_____]	[_____]	[_____]cfm

      2) Verify reheat coil operation range (full closed to full open) by turning room thermostat

      5 degrees F above ambient _____

      With heating water system and boiler in operation providing design supply hot water temperature record the following:

      Design HW supply temperature _____ deg F
      Actual HW supply temperature _____ deg F
      AHU supply air temperature _____ deg F
      CAV supply air temperature _____ deg F

      Calculate coil capacity and compare to design:

      Design _____ BTU/hr Actual _____ BTU/hr.

Functional Performance Test Checklist– CAV Terminals CAV-5337 (Cont)

2. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

	Signature and Date
Subcontractor's Mechanical Representative	_____
Subcontractor's Electrical Representative	_____
Subcontractor's TAB Representative	_____
Subcontractor's Controls Representative	_____
LANL Commissioning Agent	_____
FOD Representative (Optional)	_____

Functional Performance Test Checklist– CAV Terminals CAV-5338

NOTE: The Contracting Officer will select CAV terminals to be spot-checked during the functional performance test.

1. Functional Performance Test: Subcontractor shall demonstrate operation of selected CAV boxes as per specifications including the following:

   a. Cooling with reheat CAV boxes:

      1) Verify CAV box response to room temperature set point adjustment. Turn thermostat to 5 degrees F above ambient and measure maximum airflow. Turn thermostat to 5 degrees F below ambient and measure minimum airflow. (NOTE: airflow should not change)

	Setting	Measured	Design
Maximum flow	[_____]	[_____]	[_____] cfm
Minimum flow	[_____]	[_____]	[_____]cfm

      2) Verify reheat coil operation range (full closed to full open) by turning room thermostat

      5 degrees F above ambient _____

      With heating water system and boiler in operation providing design supply hot water temperature record the following:

      Design HW supply temperature _____ deg F
      Actual HW supply temperature _____ deg F
      AHU supply air temperature _____ deg F
      CAV supply air temperature _____ deg F

      Calculate coil capacity and compare to design:

      Design _____ BTU/hr Actual _____ BTU/hr.

Functional Performance Test Checklist–CAV Terminals CAV-5338 (Cont)

2. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

	Signature and Date
Subcontractor's Mechanical Representative	_____
Subcontractor's Electrical Representative	_____
Subcontractor's TAB Representative	_____
Subcontractor's Controls Representative	_____
LANL Commissioning Agent	_____
FOD Representative (Optional)	_____

Functional Performance Test Checklist– CAV Terminals CAV-5339

NOTE: The Contracting Officer will select CAV terminals to be spot-checked during the functional performance test.

1. Functional Performance Test: Subcontractor shall demonstrate operation of selected CAV boxes as per specifications including the following:

   a. Cooling with reheat CAV boxes:

      1) Verify CAV box response to room temperature set point adjustment. Turn thermostat to 5 degrees F above ambient and measure maximum airflow. Turn thermostat to 5 degrees F below ambient and measure minimum airflow. (NOTE: airflow should not change)

	Setting	Measured	Design
Maximum flow	[_____]	[_____]	[_____] cfm
Minimum flow	[_____]	[_____]	[_____]cfm

      2) Verify reheat coil operation range (full closed to full open) by turning room thermostat

         5 degrees F above ambient _____

         With heating water system and boiler in operation providing design supply hot water temperature record the following:

         Design HW supply temperature _____ deg F

         Actual HW supply temperature _____ deg F

         AHU supply air temperature _____ deg F

         CAV supply air temperature _____ deg F

         Calculate coil capacity and compare to design:

         Design _____ BTU/hr Actual _____ BTU/hr.

Functional Performance Test Checklist– CAV Terminals CAV-5339 (Cont)

2. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

Subcontractor's Mechanical Representative _____

Subcontractor's Electrical Representative _____

Subcontractor's TAB Representative _____

Subcontractor's Controls Representative _____

LANL Commissioning Agent _____

FOD Representative (Optional) _____

Functional Performance Test Checklist– Air Handling Unit HVA-5321

1. Functional Performance Test: Subcontractor shall verify operation of air handling unit as per specification including the following:

   a. Ensure that a slight negative pressure exists on inboard side of the outside air dampers throughout the operation of the dampers. _____

   b. The following shall be verified supply fan operating mode is initiated:

      1) All dampers in normal position prior to fan start. _____

      2) All valves in normal position prior to fan start. _____

      3) System safeties allow start if safety conditions are met. _____

      4) CAV fan controller shall "soft-start" fan. _____

      5) Modulate all CAV boxes to minimum air flow and verify that the static pressure does not exceed the high static pressure shutdown setpoint. _____

      6) Return all CAV boxes to auto. _____

   c. Occupied mode of operation:

      1) Outside air damper at minimum position. _____

      2) Chilled water control valve modulating to maintain leaving air temperature set point.

         Setpoint _____ deg F Actual _____ deg F.

Functional Performance Test Checklist– Air Handling Unit HVA-5321 (Cont)

3) Hot water control valve modulating to maintain leaving air temperature set point.

   Setpoint _____ deg F Actual _____ deg F.

4) Heat recovery control valve modulating to maintain leaving air temperature set point.

   Setpoint _____ deg F Actual _____ deg F.

5) Fan CAV controller receives signal from duct static pressure sensor and modulates fan to maintain supply duct static pressure set point.

   Setpoint _____ inches-wg Actual _____ inches-wg.

d. The following shall be verified when the supply fan off mode is initiated:

   1) All dampers in normal position. _____

   2) All valves in normal position. _____

   3) Fan de-energizes. _____

e. Verify the chilled water coil control valve operation by setting all CAV's to maximum and minimum cooling.

   Maximum Cooling:

   Supply air temperature _____ deg F Verify cooling valve operation _____.

   Minimum Cooling:

   Supply air temperature _____ deg F Verify cooling valve operation _____.

f. Verify safety shut down initiated by low temperature protection thermostat. _____

g. Verify occupancy schedule is programmed into time. Clock/UMCS _____

Functional Performance Test Checklist– Air Handling Unit HVA-5321 (Cont)

2. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

	Signature and Date
Subcontractor's Mechanical Representative	_____
Subcontractor's Electrical Representative	_____
Subcontractor's TAB Representative	_____
Subcontractor's Controls Representative	_____
LANL Commissioning Agent	_____
FOD Representative (Optional)	_____

Functional Performance Test Checklist– Air Handling Unit HVA-5322

1. Functional Performance Test: Subcontractor shall verify operation of air handling unit as per specification including the following:

   a. Ensure that a slight negative pressure exists on inboard side of the outside air dampers throughout the operation of the dampers. Modulate OA, RA, and EA dampers from fully open to fully closed positions. _____

   b. The following shall be verified supply fan operating mode is initiated:

      1) All dampers in normal position prior to fan start. _____

      2) All valves in normal position prior to fan start. _____

      3) System safeties allow start if safety conditions are met. _____

      4) CAV fan controller shall "soft-start" fan. _____

      5) Modulate all CAV boxes to minimum air flow and verify that the static pressure does not exceed the high static pressure shutdown setpoint. _____

      6) Return all CAV boxes to auto. _____

   c. Occupied mode of operation:

      1) Outside air damper at minimum position. _____

      2) Return air damper open. _____

      3) Chilled water control valve modulating to maintain leaving air temperature set point.

         Setpoint _____ deg F Actual _____ deg F.

Functional Performance Test Checklist– Air Handling Unit HVA-5322 (Cont)

4) Hot water control valve modulating to maintain leaving air temperature set point.

Setpoint _____ deg F Actual _____ deg F.

d. The following shall be verified when the [supply fan off] [supply and return fans off] mode is initiated:

1) All dampers in normal position. _____

2) All valves in normal position. _____

3) Fan de-energizes. _____

e. Verify the chilled water coil control valve operation by setting all CAV's to maximum and minimum cooling.

Maximum Cooling:

Supply air temperature _____ deg F Verify cooling valve operation _____.

Minimum Cooling:

Supply air temperature _____ deg F Verify cooling valve operation _____.

f. Verify safety shut down initiated by low temperature protection thermostat. _____

g. Verify occupancy schedule is programmed into time. Clock/UMCS _____

Functional Performance Test Checklist– Air Handling Unit HVA-5322 (Cont)

2. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

	Signature and Date
Subcontractor's Mechanical Representative	_____
Subcontractor's Electrical Representative	_____
Subcontractor's TAB Representative	_____
Subcontractor's Controls Representative	_____
LANL Commissioning Agent	_____
FOD Representative (Optional)	_____

Functional Performance Test Checklist– Air Handling Unit HVA-5324

1. Functional Performance Test: Subcontractor shall verify operation of air handling unit as per specification including the following:
   a. The following shall be verified supply fan operating mode is initiated:
      1) All dampers in normal position prior to fan start. _____
      2) All valves in normal position prior to fan start. _____
      3) System safeties allow start if safety conditions are met. _____
   b. The following shall be verified when the supply fan off mode is initiated:
      1) All valves in normal position. _____
      2) Fan de-energizes. _____
   c. Verify the chilled water coil control valve operation by setting thermostat to maximum cooling.

      Maximum Cooling:

      Supply air temperature _____ deg F Verify cooling valve operation _____.

      Minimum Cooling:

      Supply air temperature _____deg F Verify cooling valve operation _____.
   d. Verify the natural gas burner operation by setting thermostat to maximum heating.

      Maximum Heating:

      Supply air temperature _____ deg F Verify control valve operation _____.

      Minimum Heating:

      Supply air temperature _____deg F Verify control valve operation _____.
2. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

	Signature and Date
Subcontractor's Mechanical Representative	_____
Subcontractor's Electrical Representative	_____
Subcontractor's TAB Representative	_____
Subcontractor's Controls Representative	_____
LANL Commissioning Agent	_____
FOD Representative (Optional)	_____

Functional Performance Test Checklist– Packaged Air-Cooled Chiller CWR-5201

1. Functional Performance Test: Subcontractor shall demonstrate operation of chilled water system as per specifications including the following:
   a. Start building air handler to provide load for chiller. Activate controls system chiller start sequence as follows.
      1) Start chilled water pump and establish chilled water flow. Verify chiller-chilled water proof-of-flow switch operation. _____
      2) Verify control system energizes chiller start sequence. _____
      3) Verify chiller senses chilled water temperature above set point and control system activates chiller start.

         Setpoint _____ deg F Actual _____ deg F.
      4) Verify functioning of "soft start" sequence. _____
      5) Verify and record chiller data per 2, 3 and 4 below on fully loaded chiller. _____
      6) Shut off air handling equipment to remove load on chilled water system. Verify chiller shutdown sequence is initiated and accomplished after load is removed. _____
      7) Restart air handling equipment one minute after chiller shut down. Verify chiller restart sequence. _____

2. Verify chiller inlet/outlet pressure reading, compare to Testing, Adjusting, and Balancing (TAB) Report, chiller design conditions, and chiller manufacturer's performance data.

	Design	TAB Test	Actual
Chiller inlet pressure (psig)	_____	_____	_____
Chiller inlet pressure (psig)	_____	_____	_____
Chiller outlet pressure (psig)	_____	_____	_____
Chiller outlet pressure (psig)	_____	_____	_____
Chiller flow rate (gpm)	_____	_____	_____

3. Verify chiller amperage each phase and voltage phase-to-phase and phase - to-ground.

Motor F/L Amps		_____			
Amperage	Phase 1	_____	Phase 2	_____	Phase 3 _____
Voltage	Ph1–Ph2	_____	Ph1–Ph3	_____	Ph2–Ph3 _____
Voltage	Ph1–gnd	_____	Ph2–gnd	_____	Ph3–gnd _____

Functional Performance Test Checklist– Packaged Air-Cooled Chiller CWR-5201 (Cont)

4.

a. Record the following information:

		Design
Ambient dry bulb temperature	_____ deg F	_____ deg F.
Entering chilled water temperature	_____ deg F	_____ deg F.
Leaving chilled water temperature	_____ deg F	_____ deg F.

b. Calculate chiller load at ambient conditions and compare to chiller rated capacity from manufacturer's literature.

Calculated _____ Ton Rated _____ Ton.

5. Check and report unusual vibration, noise, etc.

_____

_____

6. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

	Signature and Date
Subcontractor's Mechanical Representative	_____
Subcontractor's Electrical Representative	_____
Subcontractor's TAB Representative	_____
Subcontractor's Controls Representative	_____
LANL Commissioning Agent	_____
FOD Representative (Optional)	_____

Functional Performance Test Checklist– Packaged Air-Cooled Chiller CWR-5202

1. Functional Performance Test: Subcontractor shall demonstrate operation of chilled water system as per specifications including the following:
   a. Start building air handler to provide load for chiller. Activate controls system chiller start sequence as follows.
      1) Start chilled water pump and establish chilled water flow. Verify chiller-chilled water proof-of-flow switch operation. _____
      2) Verify control system energizes chiller start sequence. _____
      3) Verify chiller senses chilled water temperature above set point and control system activates chiller start.

         Setpoint _____ deg F Actual _____ deg F.
      4) Verify functioning of "soft start" sequence. _____
      5) Verify and record chiller data per 2, 3 and 4 below on fully loaded chiller. _____
      6) Shut off air handling equipment to remove load on chilled water system. Verify chiller shutdown sequence is initiated and accomplished after load is removed. _____
      7) Restart air handling equipment one minute after chiller shut down. Verify chiller restart sequence. _____

2. Verify chiller inlet/outlet pressure reading, compare to Testing, Adjusting, and Balancing (TAB) Report, chiller design conditions, and chiller manufacturer's performance data.

	Design	TAB Test	Actual
Chiller inlet pressure (psig)	_____	_____	_____
Chiller inlet pressure (psig)	_____	_____	_____
Chiller outlet pressure (psig)	_____	_____	_____
Chiller outlet pressure (psig)	_____	_____	_____
Chiller flow rate (gpm)	_____	_____	_____

3. Verify chiller amperage each phase and voltage phase-to-phase and phase - to-ground.

Motor F/L Amps		_____			
Amperage	Phase 1	_____	Phase 2	_____	Phase 3 _____
Voltage	Ph1–Ph2	_____	Ph1–Ph3	_____	Ph2–Ph3 _____
Voltage	Ph1–gnd	_____	Ph2–gnd	_____	Ph3–gnd _____

Functional Performance Test Checklist– Packaged Air-Cooled Chiller CWR-5202 (Cont)

4.

a. Record the following information:

		Design
Ambient dry bulb temperature	_____ deg F	_____ deg F.
Entering chilled water temperature	_____ deg F	_____ deg F.
Leaving chilled water temperature	_____ deg F	_____ deg F.

b. Calculate chiller load at ambient conditions and compare to chiller rated capacity from manufacturer's literature.

Calculated _____ Ton Rated _____ Ton.

5. Check and report unusual vibration, noise, etc.

_____

_____

6. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

	Signature and Date
Subcontractor's Mechanical Representative	_____
Subcontractor's Electrical Representative	_____
Subcontractor's TAB Representative	_____
Subcontractor's Controls Representative	_____
LANL Commissioning Agent	_____
FOD Representative (Optional)	_____

Functional Performance Test Checklist– Packaged Air-Cooled Chiller CWR-5203

1. Functional Performance Test: Subcontractor shall demonstrate operation of chilled water system as per specifications including the following:
   a. Start building air handler to provide load for chiller. Activate controls system chiller start sequence as follows.
      1) Start chilled water pump and establish chilled water flow. Verify chiller-chilled water proof-of-flow switch operation. _____
      2) Verify control system energizes chiller start sequence. _____
      3) Verify chiller senses chilled water temperature above set point and control system activates chiller start.

         Setpoint _____ deg F Actual _____ deg F.
      4) Verify functioning of "soft start" sequence. _____
      5) Verify and record chiller data per 2, 3 and 4 below on fully loaded chiller. _____
      6) Shut off air handling equipment to remove load on chilled water system. Verify chiller shutdown sequence is initiated and accomplished after load is removed. _____
      7) Restart air handling equipment one minute after chiller shut down. Verify chiller restart sequence. _____

2. Verify chiller inlet/outlet pressure reading, compare to Testing, Adjusting, and Balancing (TAB) Report, chiller design conditions, and chiller manufacturer's performance data.

	Design	TAB Test	Actual
Chiller inlet pressure (psig)	_____	_____	_____
Chiller inlet pressure (psig)	_____	_____	_____
Chiller outlet pressure (psig)	_____	_____	_____
Chiller outlet pressure (psig)	_____	_____	_____
Chiller flow rate (gpm)	_____	_____	_____

3. Verify chiller amperage each phase and voltage phase-to-phase and phase - to-ground.

Motor F/L Amps		_____			
Amperage	Phase 1	_____	Phase 2	_____	Phase 3 _____
Voltage	Ph1–Ph2	_____	Ph1–Ph3	_____	Ph2–Ph3 _____
Voltage	Ph1–gnd	_____	Ph2–gnd	_____	Ph3–gnd _____

Functional Performance Test Checklist– Packaged Air-Cooled Chiller CWR-5203 (Cont)

4.

a. Record the following information:

		Design
Ambient dry bulb temperature	_____ deg F	_____ deg F.
Entering chilled water temperature	_____ deg F	_____ deg F.
Leaving chilled water temperature	_____ deg F	_____ deg F.

b. Calculate chiller load at ambient conditions and compare to chiller rated capacity from manufacturer's literature.

Calculated _____ Ton Rated _____ Ton.

5. Check and report unusual vibration, noise, etc.

_____

_____

6. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

	Signature and Date
Subcontractor's Mechanical Representative	_____
Subcontractor's Electrical Representative	_____
Subcontractor's TAB Representative	_____
Subcontractor's Controls Representative	_____
LANL Commissioning Agent	_____
FOD Representative (Optional)	_____

Functional Performance Test Checklist– Hot Water Boiler BHW-5101

1. Functional Performance Test: Subcontractor shall demonstrate operation of hot water system as per specifications including the following:
   a. Start building heating equipment to provide load for boiler. Activate controls system boiler start sequence as follows.
      1) Start hot water pump and establish hot water flow. Verify boiler hot water proof-of-flow switch operation. _____
      2) Verify control system energizes boiler start sequence. _____
      3) Verify boiler senses hot water temperature below set point and control system activates boiler start.

         Setpoint _____ deg F.

2. Verify boiler inlet/outlet pressure reading, compare to Test and Balance (TAB) Report, boiler design conditions, and boiler manufacturer's performance data.

	Design	System Test	Actual
Boiler inlet water temperature (deg F)			
Boiler outlet water temperature (deg F)			
Boiler outlet pressure (psig)			
Boiler flow rate (gpm)			
Flue-gas temperature at boiler outlet (deg F)			
Percent carbon dioxide in flue-gas			
Draft at boiler flue-gas exit (inches-wg)			
Stack emission pollutants concentration			
Fuel type			
Combustion efficiency			

3.
   a. Record the following information:

      Ambient dry bulb temperature to determine reset schedule _____ deg F.

      Building entering hot water temperature _____psig.

      Building leaving hot water temperature _____ psig.

4. Verify temperatures in item 3 are in accordance with the reset schedule. _____

Functional Performance Test Checklist– Hot Water Boiler BHW-5101 (Cont)

5. Verify proper operation of boiler safeties. _____
   a. Low water: _____
   b. Water flow: _____
   c. Flame failure: _____
   d. Pilot failure: _____
   e. Pre- and post-purge failure: _____
   f. Pressure relief: _____
   g. High temperature: _____
6. Shut off building heating equipment to remove load on hot water system. Verify boiler shutdown sequence is initiated and accomplished after load is removed. _____
7. Check and report unusual vibration, noise, etc.

   _____

   _____

8. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

	Signature and Date
Subcontractor's Mechanical Representative	_____
Subcontractor's Electrical Representative	_____
Subcontractor's TAB Representative	_____
Subcontractor's Controls Representative	_____
LANL Commissioning Agent	_____
FOD Representative (Optional)	_____

Functional Performance Test Checklist– Hot Water Boiler BHW-5102

1. Functional Performance Test: Subcontractor shall demonstrate operation of hot water system as per specifications including the following:
   a. Start building heating equipment to provide load for boiler. Activate controls system boiler start sequence as follows.
      1) Start hot water pump and establish hot water flow. Verify boiler hot water proof-of-flow switch operation. _____
      2) Verify control system energizes boiler start sequence. _____
      3) Verify boiler senses hot water temperature below set point and control system activates boiler start.

         Setpoint _____ deg F.

2. Verify boiler inlet/outlet pressure reading, compare to Test and Balance (TAB) Report, boiler design conditions, and boiler manufacturer's performance data.

	Design	System Test	Actual
Boiler inlet water temperature (deg F)			
Boiler outlet water temperature (deg F)			
Boiler outlet pressure (psig)			
Boiler flow rate (gpm)			
Flue-gas temperature at boiler outlet (deg F)			
Percent carbon dioxide in flue-gas			
Draft at boiler flue-gas exit (inches-wg)			
Stack emission pollutants concentration			
Fuel type			
Combustion efficiency			

3.
   a. Record the following information:

      Ambient dry bulb temperature to determine reset schedule _____ deg F.

      Building entering hot water temperature _____psig.

      Building leaving hot water temperature _____ psig.

4. Verify temperatures in item 3 are in accordance with the reset schedule. _____

Functional Performance Test Checklist– Hot Water Boiler BHW-5102 (Cont)

5. Verify proper operation of boiler safeties. _____
   a. Low water: _____
   b. Water flow: _____
   c. Flame failure: _____
   d. Pilot failure: _____
   e. Pre- and post-purge failure: _____
   f. Pressure relief: _____
   g. High temperature: _____
6. Shut off building heating equipment to remove load on hot water system. Verify boiler shutdown sequence is initiated and accomplished after load is removed. _____
7. Check and report unusual vibration, noise, etc.

   _____

   _____

8. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

	Signature and Date
Subcontractor's Mechanical Representative	_____
Subcontractor's Electrical Representative	_____
Subcontractor's TAB Representative	_____
Subcontractor's Controls Representative	_____
LANL Commissioning Agent	_____
FOD Representative (Optional)	_____

Functional Performance Test Checklist– HVAC Control system

NOTE: The Contracting Officer will select HVAC control systems to undergo functional performance testing. Perform this test simultaneously with FPT for AHU or other controlled equipment.

1. Functional Performance Test: Subcontractor shall verify operation of HVAC controls by performing the Performance verification Test (PVT) test for that system. Subcontractor to provide blank PVT test procedures previously done by the controls Subcontractor.
2. Verify interlock with BAS system. _____
3. Verify all required I/O points function from the BAS system. _____
4. Certification: We the undersigned have witnessed the Performance verification Test and certify that the item tested has met the performance requirements in this section of the specifications.

	Signature and Date
Subcontractor's Mechanical Representative	_____
Subcontractor's Electrical Representative	_____
Subcontractor's TAB Representative	_____
Subcontractor's Controls Representative	_____
LANL Commissioning Agent	_____
FOD Representative (Optional)	_____

Functional Performance Test Checklist– Energy Recovery System

1. Functional Performance Test: Subcontractor shall demonstrate operation of energy recovery system as per specifications including the following:
   a. Start equipment to provide energy source for recovery system.
      1) Verify energy source is providing recoverable energy. _____
      2) Verify recovery system senses available energy and activates. _____
2. Verify recovery system inlet/outlet readings, compare to design conditions and manufacturer's performance data.

	Design	Actual
Primary loop inlet temperature (deg F)	_____	_____
Primary loop outlet temperature (deg F)	_____	_____
Primary loop flow rate (gmp)	_____	_____
Secondary loop inlet temperature (deg F)	_____	_____
Secondary loop outlet temperature (deg F)	_____	_____
Secondary loop flow rate (gpm	_____	_____
Primary loop energy (BTU/hr)	_____	_____
Secondary loop energy (BUT/hr)	_____	_____

3. Verify that recovery system deactivates longer available. _____
4. Check and report unusual vibration, noise, etc.

_____

_____

Functional Performance Test Checklist– Energy Recovery System

5. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

	Signature and Date
Subcontractor's Mechanical Representative	_____
Subcontractor's Electrical Representative	_____
Subcontractor's TAB Representative	_____
Subcontractor's Controls Representative	_____
LANL Commissioning Agent	_____
FOD Representative (Optional)	_____

END OF SECTION

SECTION 23 1123

FACILITY NATURAL-GAS PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Building gas piping system (above grade) downstream of the site low pressure gas regulator station.

1.2 RELATED SECTIONS

A. Section 01 2500, "Substitution Procedures."

B. Section 01 4000, "Quality Requirements."

C. Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

D. Section 01 4444, "Offsite Welding & Joining Requirements."

E. Section 01 4455, "Onsite Welding & Joining Requirements."

F. Section 09 9100, "Painting."

G. Section 22 0529, "Hangers and Supports for Plumbing Piping and Equipment."

H. Section 22 0548, "Vibration and Seismic Controls for Plumbing Piping and Equipment."

I. Section 22 0554," Identification for Plumbing, HVAC, and Fire Piping and Equipment."

J. Section 22 0813, "Testing Piping Systems."

1.3 ABBREVIATIONS AND ACRONYMS, DEFINITIONS, AND REFERENCES

A. Refer to Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

1.4 SUBMITTALS

A. Submit the following in accordance with the requirements of Exhibit I:

1. Catalog data on pipe materials, pipe fittings, valves, pipe coating, and accessories.

2. Certification of welders and qualified welding procedure per Section 01 4444, "Offsite Welding & Joining Requirements" and Section 01 4455, "Onsite Welding & Joining Requirements."

1.5 QUALITY ASSURANCE

A. Work identified in this section shall be in accordance with Section 01 4000, "Quality Requirements."

B. Welders Certification and Qualified Procedure Standards

1. Interior Steel Pipe: *ASME Boiler and Pressure Vessel Code* (B&PV) (Section IX).

C. Materials and work performed shall be in accordance with NFPA 54, UPC, UMC and ASME B31.8.

PART 2 PRODUCTS

2.1 PRODUCT OPTIONS AND SUBSTITUTIONS

A. Alternate products may be accepted; follow Section 01 2500, "Substitution Procedures."

2.2 STEEL PIPING, ABOVE GRADE

A. Pipe: Standard wall, black steel, ASTM A53, ASTM B36.10, ASTM A 106. Welded for pipe sizes above 2 inches, threaded for pipe sizes 2 inches or less.

B. Pipe Fittings: Class 150 or standard wall

1. For pipes 2 inch and smaller: Malleable iron, black steel threaded type, ASME B16.3, ASTM 197; threads per ASME B1.20.1

2. For pipes greater than 2 inch: Factory made wrought steel butt welding type, ASME B16.9, MSS SP-75.

2.3 PLUG VALVES, ABOVE GRADE

A. Manufacturer: A.Y. McDonald, Series 10685B.

B. Valve: Cast iron body, Female Iron Pipe threaded ends to suit piping, bronze plug style, flat head wrench operated, minimum 100 psig working pressure. Manufactured in accordance with ASME B16.33, threads per ASME B1.20.1.

2.4 TEST PLUG (PETE'S PLUG)

A. Manufacturer: Peterson Equipment Co., part number 100.

B. 1/4 inch NPT, brass body, neoprene core, rated for 500 psig, complete with sealing cap and gasket, to receive 1/8 inch O.D. probe.

PART 3 EXECUTION

3.1 INSTALLATION

A. Furnish, install, and inspect gas piping in accordance with NFPA 54.

B. Do not run gas piping below buildings, structures, or in crawl spaces.

C. Do not run gas piping under walks and equipment pads adjacent to building. If this is unavoidable, sleeve line and vent as required.

D. Install piping to conserve building space and coordinate installation with other trades to optimize the space for all services. Provide clearance for access to valves and fittings.

E. Pressure test piping in accordance with Section 22 0813, "Testing Piping Systems."

F. Label piping in accordance with Section 22 0554, "Identification for Plumbing, HVAC, and Fire Piping and Equipment."

G. Paint outside gas regulator piping, valves, and appurtenances above ground to match building exterior. Refer to Section 09 9100, "Painting."

H. Support piping in accordance with Section 22 0529, "Hangers and Supports for Plumbing Piping and Equipment."

I. Seismically brace piping in accordance with Section 22 0548, "Vibration and Seismic Controls for Plumbing, Piping and Equipment."

J. Use threaded joints for above grade piping 2 inches and smaller and butt-welded joints for piping above 2 inches.

K. Sleeve and caulk pipes penetrating exterior walls or interior bearing walls. Provide waterproof installation for exterior walls. Provide UL/FM approved through-penetration firestop system when penetrating fire-rated barriers (walls, floors, etc.).

L. Natural Gas pipe purging requirements:

1. Purged fuel gases shall be directly vented to a safe location outdoors, away from personnel and ignition sources. This may be accomplished through permanent piping or temporary piping or hosing.

2. If it is not possible to vent purged gases outdoors, the following conditions must be met:

a. Purging activity must be approved by the LANL Fire Marshal based on a documented justification detailing why outdoor venting is not possible and Integrated Work Document (IWD).

b. Gas concentration in the space to which the purge is vented shall be maintained at no more than 25% of the Lower Explosive Limit (LEL). For natural gas, the LEL is a concentration of 5% in air or 50,000 ppm. Therefore a maximum concentration of 12,500 ppm is allowed for natural gas. The concentration may be controlled by providing adequate ventilation or by limiting the amount of purge gas.

c. Combustible gas detectors shall be used during the purging operation to monitor the gas concentration.

d. Non-essential personnel shall be evacuated from the vicinity (including adjacent spaces) during the purging operation.

e. Ignition sources in the purging space shall be controlled or eliminated.

M. Vent ports shall be covered with metallic screens or other type of device to inhibit exhaust ports being blocked by environmental phenomenon (e.g., insect nests). Screens/covers must not inhibit the flow capacity of the vent valve.

END OF SECTION

FOR LANL USE ONLY

This project specification is based on LANL Master Specification 23 1123, Rev. 3, dated March 31, 2010.

SECTION 23 2113

HYDRONIC PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Site and building pipe materials, fittings, valves, and accessories for heating water, chilled water, process cooling water, heat recovery water, equipment drains, and overflow piping.

1.2 RELATED SECTIONS

A. Section 01 2500, "Substitution Procedures."

B. Section 01 4000, "Quality Requirements."

C. Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

D. Section 01 4444, "Offsite Welding & Joining Requirements."

E. Section 01 4455, "Onsite Welding & Joining Requirements."

F. Section 22 0529, "Hangers and Supports for Plumbing Piping and Equipment."

G. Section 22 0548, "Vibration and Seismic Controls for Plumbing, Piping and Equipment."

H. Section 22 0554, "Identification for Plumbing, HVAC, and Fire Piping Equipment."

I. Section 22 0713, "Plumbing and HVAC Insulation."

J. Section 22 0813, "Testing Piping Systems."

K. Section 23 2500, "HVAC Water Treatment."

1.3 ABBREVIATIONS AND ACRONYMS, DEFINITIONS, AND REFERENCES

A. Refer to Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

1.4 SUBMITTALS

Submit the following in accordance with the requirements of Exhibit I:

A. Catalog data on pipe materials, fittings, valves, and accessories.

B. Installation instructions for all purchased components with manufacturer model numbers.

C. Welding procedures and qualifications.

D. Certifications of welders and qualified welding procedures per Section 01 4444, "Offsite Welding & Joining Requirements" and Section 01 4455, "Onsite Welding & Joining Requirements."

E. For components not listed in ASME B31.9, Table 926.1, one of the following must be provided by the manufacturer to substantiate pressure safety compliance:

1. Engineering calculation(s).

2. Experimental stress analysis, such as described in Appendix 6 in Section VIII, Division 2 of the ASME Boiler and Pressure Vessel (B&PV) Code.

3. Proof test in accordance with UG-101 in Section VIII, Division 1 of the ASME B&PV Code.

1.5 QUALITY ASSURANCE

A. Work identified in this section shall be done under a Quality Assurance Program in accordance with Section 01 4000, "Quality Requirements."

B. Steel Support Welding: Qualify processes and operators according to AWS D1.1/D1.1M, *Structural Welding Code - Steel.*

C. All piping shall be fabricated, welded, erected, inspected, examined, and tested in accordance with this specification and ASME B31.9, *Building Services Piping.*

D. Welders Certification and Qualified Procedure Standards shall be in accordance with Section IX of ASME B&PV Code and Sections 01 4444 and 01 4445.

E. Valve Identification: Manufacturer's name and pressure rating shall be marked on the valve body.

F. Subcontractor shall use listed components unless calculations are provided in accordance with ASME requirements for unlisted components.

PART 2 PRODUCTS

2.1 PRODUCT OPTIONS AND SUBSTITUTIONS

A. Alternate products may be accepted; follow Section 01 2500, "Substitution Procedures."

2.2 HEATING WATER PIPING (SERVICE UP TO 250 °F)

A. Pipe: Black steel, ASTM A53 Type S Grade A, standard wall.

1. Fittings: Black steel, ASTM A234, Grade WPB, butt welded type, ASME B16.9, standard wall, or Class 150 malleable iron threaded type, ASME B16.3.

2. Joints: Welded for pipe sizes greater than 2 in. and threaded for pipe sizes 2 in. and under. Threading per ASME B.

B. Copper Tubing: ASTM B88, Type L, hard drawn or annealed UNS C12200 for pipe sizes 2 in. and under.

1. Fittings: ASME B16.22, UNS C12200 wrought copper and copper alloy, solder joint.

2. Joints: Solder, ASTM B32 Grade Sb5, 95-5 tin-antimony, or Grade Sn95 tin and silver, with melting range 430 to 535 °F.

2.3 CHILLED WATER, PROCESS COOLING WATER, AND HEAT RECOVERY WATER PIPING

A. Pipe: Black steel, ASTM A53, Type S Grade A, standard wall.

1. Fittings: Black steel, ASTM A234, Grade WPB, butt welded type, ASME B16.9, standard wall, or Class 150 malleable iron threaded type, ASME B16.3.

2. Joints: Welded for pipe sizes greater than 2 in., threaded for pipe sizes 2 in. and under.

B. Copper Tubing: ASTM B88, Type L, hard drawn or annealed UNS C12200 for pipe sizes 2 in. and under.

1. Fittings: ASME B16.22, UNS C12200 wrought copper and copper alloy, solder joint.

2. Joints: Solder, ASTM B32 Grade Sb5, 95-5 tin-antimony, or Grade Sn95 tin and silver, with melting range 430 to 535 °F.

2.4 EQUIPMENT DRAINS AND OVERFLOWS

A. Pipe: galvanized cast iron, or ASTM A53 Type 2, Grade A standard wall.

1. Fittings: ASTM A338 Galvanized cast iron, or ASME B16.3 Class 150 malleable iron.
2. Joints: Threaded.

B. Copper Tubing: ASTM B88, Type L, hard drawn, UNS C12200.

1. Fittings: ASME B16.22, wrought copper and copper alloy, solder joint.

2. Joints: Solder, ASTM B32, Grade Sb5, 95-5 tin-antimony, or Grade Sn95 tin and silver, with melting range 430 to 535 °F.

2.5 UNIONS, FLANGES, AND COUPLINGS

A. Unions for pipe 2 in. and under.

1. Copper Tubing: ASME B16.22, UNS 12200 wrought copper, solder joint.
2. Ferrous Piping: ASME B16.39, Class 150, malleable iron treaded.

B. Flanges for pipe over 2 in.

1. Copper Tubing: ASME B16.24, Class 150, bronze.
2. Ferrous Piping: Forged Steel, ASME B16.5, Class 150.
3. Gaskets: 1/16 in. thick preformed neoprene. Comply with ASME B16.21, Class 150.

C. Dielectric Connections.

1. Union with galvanized or plated steel threaded end, copper solder end, and water impervious isolation barrier.

2.6 VALVES

A. Ball Valves up to 2 in.

1. Manufacturer: Nibco, Series 585-70.

2. MSS SP-110, 600 psi non-shock cold working pressure, bronze, two piece body, chrome plated brass ball, full port, teflon seats and stuffing box ring, blowout proof stem, lever handle, solder or threaded ends to suit piping.

B. Butterfly Valves over 2 in.

1. Manufacturer: Nibco, Series LD 2000.

2. MSS SP-67, 200 psi non-shock cold water working pressure, ductile iron body, aluminum bronze disc, resilient replaceable EPDM seat, lug style,

extended neck, lever handle, for use between Class 125/150 flanges. Furnish chain-wheel operators for valves 6 in. and larger mounted over 8 ft above floor.

C. Plug Valves.

1. MSS SP-78, tapered plug valve, Class 125, iron body, water service, square head or tee handle, with female NPT threaded or flanged ends to suit piping.

D. Globe Valve

1. Manufacturer: Nibco T-211-B
2. MSS SP-80, globe valve, Class 125, bronze or iron body, water service, with female NPT threaded or flanged ends to suit piping.

E. Gate Valve

1. Manufacturer: Nibco TH-113-HC
2. MSS SP-80, gate valve, Class 125, bronze, non-rising stem, solid wedge, hand wheel, female threaded hose thread with cap end connection.

2.7 CHECK VALVES

A. Sizes up to 2 in.

1. Manufacturer: Nibco T-433-B or S-433-B.
2. MSS SP-80, Class 150, bronze, horizontal swing, y-pattern, renewable seat and disc. Solder or threaded ends to suit piping.

B. Sizes over 2 in.

1. Manufacturer: Nibco F-918-B.
2. MSS SP-71 Type 1, Class 125, cast iron body, fluid to 450 °F, bolted bonnet, horizontal swing, renewable disc seal and seat, flanged end.

2.8 BALANCING VALVES

A. Manufacturer: Bell and Gossett, Circuit Setter Model CB

B. Sizes up to and including 2 in: Threaded or Solder connections.

1. Bronze body, brass ball construction with differential read out ports and drain/purge ports, 300 psig rating at 250 °F, with memory stop features and calibrated nameplate.

C. Sizes above 2 in: Flanged or Grooved connections.

1. Ductile iron or heavy-duty cast iron body, brass ball construction with differential read out ports and drain/purge ports, minimum 175 psig rating at 250 °F, with memory stop features and calibrated nameplate.

D. Submit certification of unlisted component in accordance with ASME B31.9, Section 904.7.2, as listed in Paragraph 1.4E of this specification.

2.9 PRESSURE GAUGES

A. Shall comply with Engineering Standards Manual Chapter 17 11.K.

B. Manufacturer: Ashcroft, Type 1279 or 1009 (Stainless Steel)

C. ASME B40.100, Accuracy Grade 1A, maximum plus or minus 1 percent full scale accuracy, minimum 4-1/2-in. dial, glycerin filled, phosphor bronze bourdon tube, 1/4-in. NPT brass bottom connection, phenolic case. Furnish with ball valve.

1. Range: See drawings.

2.10 THERMOMETER

A. ASME B40.200, Grade A, maximum plus or minus 1 percent full scale accuracy, bimetal thermometer, mercury free, minimum 4-in. dial, stainless steel case, all angle direct mount, with standard connection and stem length to suit piping.

1. Range: See drawings.

2.11 STRAINERS

A. Submit certification of unlisted component in accordance with ASME B31.9, Section 904.7.2, as listed in Paragraph 1.4E of this specification.

B. Sizes up to 2 in.

1. Manufacturer: Watts Series 777.

2. Bronze body, Y-type, screwed or soldered ends, 20 mesh stainless steel screen, for water service-WOG (non-shock) 400 psi at 210 °F.

3. Provide line size (size of blow-off outlet in strainer body) full port ball valve with 3/4-in. national standard hose thread outlet fitting and brass cap/chain. Secure chain to strainer/ball valve assembly.

a. Hose cap: Jones Stephens Corp., Part No. G20-056.

C. Sizes above 2 in.

1. Manufacturer: Watts Series 77F-D.

2. Class 125, cast iron body, Y-type, B16.1, flanged ends, stainless steel standard screen, for water service-WOG (non-shock) 200 psi at 150 °F.

3. Provide line size (size of blow-off outlet in strainer body) full port ball valve with a brass plug.

2.12 TEST PLUGS (PETE'S PLUG)

A. 1/4-in. NPT, brass body, neoprene core, 1,000 psig maximum rating at minus 20 to 140 °F, 500 psig maximum rating at 200 °F, complete with sealing cap and gasket, to receive 1/8 in. OD probe.

1. Provide extra long (XL) plug when pipe insulation exceeds 1 in. thickness.

2.13 RELIEF VALVE

A. Manufacturer: Kunkle, Model 912.

B. Bronze body, brass trim, ASME Section VIII (UV) rated for liquid service, maximum pressure and temperature rating 300 psig and 406 °F.

1. Size: 1/2-in. inlet, 3/4-in. outlet.
2. Set Pressure: see drawings.
3. Orifice: 0.1213 dia.
4. Capacity: 645 gpm.

2.14 EXPANSION TANK

A. Manufacturer: Amtrol, Model AX, ASME coded.

B. Vertical flow mount tank with removable and replaceable butyl rubber bladder, steel shell, rated for 150 psig and 240 °F and factory precharged to 12 psig. Manufacturer's "Optional Seismic Restraints" shall be included.

1. Tank & Acceptance Volume: See drawings.

C. ASME code stamped for Section VIII of the ASME Boiler and Pressure Vessel Code Section VIII, Division 1. Provide NBIC registration and number.

2.15 AIR VENT

A. Manufacturer: Bell and Gossett, Model No. 87.

B. Automatic float type with overflow connection, brass, rated for 150 psi and 240 °F.

2.16 TANGENTIAL-TYPE AIR SEPARATORS

A. Manufacturer: Amtrol, Model AS-L.

B. Tank: Welded steel; ASME constructed and labeled for 125-psig minimum working pressure and 350 deg F maximum operating temperature.

C. Air Collector Tube: Perforated stainless steel, constructed to direct released air into expansion tank.

D. Tangential Inlet and Outlet Connections: Threaded for NPS 2 and smaller; flanged or grooved connections for NPS 2-1/2 and larger.

E. Blowdown Connection: Threaded.

F. Size: See drawings.

G. ASME Boiler and Pressure Vessel Section 8, Division 1 stamped. Provide NBIC registration and number.

2.17 PRESSURE REDUCING VALVE

A. Manufacturer: Bell and Gossett, Model FB-38TU.

B. Brass body, factory setting 12 psig, adjustable range 10-25 psig, removable strainer, low inlet pressure check valve, ½" NPT union and ½" sweat connections.

2.18 FLEXIBLE CONNECTORS

A. Bronze Braided Hose: Copper pipe sizes 2 in and smaller, Bronze hose and braid with female copper sweat ends, minimum end to end length of 18 in.

B. Double sphere flexible connectors: Pipe sizes 2-1/2 in. and larger, EPDM reinforced with Kevlar, double sphere rated for minimum 215 psig at 250 °F, with Class 150 floating flanges on both ends.

C. Single sphere flexible connectors: Iron pipe sizes 2 in. and smaller, EPDM reinforced with Kevlar, single sphere rated for minimum 215 psig at 250 °F, with threaded ductile iron fittings on both ends.

D. Submit certification of unlisted component in accordance with ASME B31.9, Section 904.7.2, as listed in Paragraph 1.4E of this specification.

PART 3 EXECUTION

3.1 PREPARATION

A. Ream pipe and tube ends. Remove burrs.

B. Remove scale and dirt on inside and outside before assembly.

C. Prepare piping connections to equipment with flanges or unions.

3.2 INSTALLATION

A. Fabricate and install heating water, chilled water, processing cooling water, and heat recovery water equipment drains, and overflow piping in conformance with ASME B31.9.

B. Provide non-conducting dielectric connections wherever jointing dissimilar metals. Matching of bronze fittings with steel or copper pipe does not require dielectrics.

C. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.

D. Install piping to maintain headroom and neither interfere with use of space nor take more space than necessary.

E. Group piping whenever practical at common elevations.

F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

G. Provide access where valves and other equipment are not exposed.

H. All valves shall be installed in accordance with the manufacturer's instructions and ASME B31.9, with sufficient clearance and access for ease of operation and maintenance. Install valves with stems upright or horizontal, not inverted.

I. Sleeve and caulk pipes penetrating exterior walls or interior bearing walls. Provide waterproof installation for exterior walls. Provide UL/FM approved through-penetration firestop system when penetrating fire rated barriers (i.e., walls, floors, etc).

J. Pipe relief valves to nearest floor drain. Install a union in the piping after each relief valve.

K. Slope water piping and provide drain valves at low points.

L. Flush and chemically treat HVAC water piping systems in accordance with Section 23 2500, "HVAC Water Treatment."

M. Label piping system in accordance with Section 22 0554, "Identification for Plumbing, HVAC, and Fire Piping and Equipment."

N. Insulate piping system in accordance with Section 22 0713, "Plumbing and HVAC Insulation" after all applicable tests have been completed, see Paragraph 3.3 of this specification.

O. Support piping system in accordance with Section 22 0529, "Hangers and Supports for Plumbing Piping and Equipment."

P. Seismic brace piping in accordance with Section 22 0548, "Vibration and Seismic Controls for Plumbing, Piping and Equipment."

Q. Provide automatic air vents in hydronic closed piping systems at high point. Provide isolation ball valve at inlet connection.

R. Install chrome-plated steel escutcheons for insulated pipes at finished surfaces.

S. Unless otherwise noted, provide ball valves in piping 2 in. and smaller, butterfly valves in piping 2-1/2 in. and larger, and gate valves with standard male capped hose connection, for equipment and drain valves. Provide globe valves for throttling applications.

T. Provide strainers with full port ball valves, etc. as noted in Paragraph 2.11.

U. Instrument taps shall be isolated from the main process by a root valve. Instrumentation gauges and instruments that are calibrated shall be provided with a calibration port, normally the same size as the instrument impulse line.

3.3 EXAMINATION, INSPECTION, AND TESTING

A. Pressure test piping system in accordance with Section 22 0813, "Testing Piping Systems."

B. All welds shall be inspected, examined, and tested in accordance with ASME B31.9, ASME B&PV Code, and LANL's ESM (ISD 341-2 and PD342, Chapter 13, "Welding, Joining, and NDE").

END OF SECTION

SECTION 23 2123

HYDRONIC PUMPS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Separately coupled, base-mounted, end-suction centrifugal pumps.

B. Close-coupled, in-line centrifugal pumps.

C. Booster, in-line pumps.

1.2 PERFORMANCE REQUIREMENTS

A. Pumps and associated motors shall perform satisfactorily in the following service conditions:

1. Elevation: 7,500 feet above sea level.

2. Maximum ambient temperature: 104 degrees F.

3. Minimum ambient temperature: Minus 20 degrees F.

4. 24-hour average temperature: not exceeding 86 degrees F.

5. Pump load shall not exceed the altitude and temperature de-rated capacity of the motor. (Refer to Table 5020-4 in ESM Chapter 7, Section D5020)

6. Maximum solar heat gain: 110 W/sq ft.

1.3 RELATED SECTIONS

A. Section 01 2500, "Substitution Procedures."

B. Section 01 4000, "Quality Requirements."

C. Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

D. Section 22 0529, "Hangers and Supports for Plumbing Piping and Equipment."

E. Section 22 0548, "Vibration and Seismic Controls for Plumbing Piping and Equipment."

F. Section 23 2113, "Hydronic Piping."

G. Section 26 0519, "Low-Voltage Electrical Power Conductors and Cables."

H. Section 26 0526, "Grounding and Bonding for Electrical Systems."

I. Section 26 0700, "Induction Motors – 500HP and Smaller."

1.4 ABBREVIATIONS AND ACRONYMS, DEFINITIONS, AND REFERENCES

A. Refer to Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

1.5 SUBMITTALS

Submit the following in accordance with the requirements of Exhibit I:

A. Product Data: Include certified performance curves and rated capacities, operating characteristics, furnished specialties, final impeller dimensions, and

accessories for each type of product indicated. Indicate pump's operating point on curves.

B. Shop Drawings: Show pump layout and connections. Include setting drawings with templates for installing foundation and anchor bolts and other anchorages.

C. Operation and maintenance data.

1.6 QUALITY ASSURANCE

A. Work identified in this section shall be done under a Quality Assurance program in accordance with Section 01 4000, "Quality Requirements."

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. UL Compliance: Comply with UL 778 for motor-operated water pumps.

PART 2 PRODUCTS

2.1 PRODUCT OPTIONS AND SUBSTITUTIONS

A. Alternate products may be accepted; follow Section 01 2500, "Substitution Procedures."

2.2 SEPARATELY COUPLED, BASE-MOUNTED, END-SUCTION CENTRIFUGAL PUMPS

A. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, separately coupled, end-suction pump as defined in Hydraulic Institute HI 1.1-1.2 and HI 1.3; designed for base mounting, with pump and motor shafts horizontal. Rate pump for 175-psig minimum working pressure and a continuous water temperature of 225 deg F.

B. Pump Construction:

1. Casing: Radially split, cast iron, with replaceable bronze wear rings, threaded gage tappings at inlet and outlet, drain plug at bottom and air vent at top of volute, and flanged connections.

2. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. Trim impeller to match specified performance.

3. Pump Shaft: Steel, with copper-alloy shaft sleeve.

4. Mechanical Seal: Carbon rotating ring against a ceramic seat held by a stainless-steel spring, and Buna-N bellows and gasket.

5. Pump Bearings: Grease-lubricated ball bearings contained in cast-iron housing with grease fittings.

C. Shaft Coupling: Molded rubber insert and interlocking spider capable of absorbing vibration.

D. Coupling Guard: Dual rated; ANSI B15.1, Section 8; OSHA 1910.219 approved; steel; removable; attached to mounting frame.

E. Mounting Frame: Welded-steel frame and cross members, factory fabricated from ASTM A 36/A 36M channels and angles. Fabricate to mount pump casing, coupling guard, and motor.

F. Motor: Single speed, with grease-lubricated ball bearings, unless otherwise indicated; secured to mounting frame, with adjustable alignment. See Section 26 0700, "Induction Motors – 500HP and Smaller."

G. Capacities and Characteristics: See Drawings.

2.3 CLOSE-COUPLED, IN-LINE CENTRIFUGAL PUMPS

A. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, close-coupled, in-line pump as defined in HI 1.1-1.2 and HI 1.3; designed for installation with pump and motor shafts mounted horizontally or vertically. Rate pump for 125-psig (860-kPa) minimum working pressure and a continuous water temperature of 225 deg F (107 deg C).

B. Pump Construction:

1. Casing: Radially split, cast iron, with replaceable bronze wear rings, threaded gage tappings at inlet and outlet, and threaded companion-flange connections.

2. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. Trim impeller to match specified performance.

3. Pump Shaft: Steel, with copper-alloy shaft sleeve.

4. Mechanical Seal: Carbon rotating ring against a ceramic seat held by a stainless-steel spring, and Buna-N bellows and gasket. Include water slinger on shaft between motor and seal.

5. Pump Bearings: Permanently lubricated ball bearings.

6. Motor: Single speed, with permanently lubricated ball bearings, unless otherwise indicated; and rigidly mounted to pump casing. Comply with requirements in Section 26 0700, "Induction Motors – 500HP and Smaller."

7. Capacities and Characteristics: As Scheduled on Drawings.

2.4 BOOSTER, IN-LINE PUMP

A. In-line horizontal oil lubricated type. Suitable for 125 psig (826 kpa) working pressure and 225 °F (107 °C) continuous operating temperature. Cast Iron body, carbon steel heat treated shaft, bronze sleeve oil lubricated bearings, flexible spring type coupler.

B. Motor: Single speed, with permanently lubricated ball bearings, unless otherwise indicated; and rubber mounted to pump casing. Motor shall be non-overloading at any point on pump curve.

C. Capacity and Characteristics: As Scheduled on Drawings.

2.5 PUMP SPECIALTY FITTINGS

A. Suction Diffuser: Angle pattern, 175-psig pressure rating, cast-iron body and end cap, pump-inlet fitting; with bronze startup and bronze or stainless-steel permanent strainers; bronze or stainless-steel straightening vanes; drain plug; and factory-fabricated support.

B. Triple-Duty Valve: Angle or straight pattern, 175-psig pressure rating, cast-iron body, pump-discharge fitting; with drain plug and bronze-fitted shutoff, balancing,

and check valve features. Brass gage ports with integral check valve, and orifice for flow measurement.

PART 3 EXECUTION

3.1 PUMP INSTALLATION

A. Comply with HI 1.4.

B. Install pumps with access for periodic maintenance including removal of motors, impellers, couplings, and accessories.

C. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.

D. Install continuous-thread hanger rods and spring hangers with vertical-limit stop of sufficient size to support pump weight. Vibration isolation devices are specified in Section 22 0548, "Vibration and Seismic Controls for Plumbing Piping and Equipment." Fabricate brackets or supports as required. Hanger and support materials are specified in Section 22 0529, "Hangers and Supports for Plumbing Piping and Equipment."

E. Set base-mounted pumps on concrete foundation. Disconnect coupling before setting. Do not reconnect couplings until alignment procedure is complete.

1. Support pump baseplate on rectangular metal blocks and shims, or on metal wedges with small taper, at points near foundation bolts to provide a gap of 3/4 to 1-1/2 inches between pump base and foundation for grouting.

2. Adjust metal supports or wedges until pump and driver shafts are level. Check coupling faces and suction and discharge flanges of pump to verify that they are level and plumb.

3.2 ALIGNMENT

A. Align pump and motor shafts and piping connections after setting on foundation, grout has been set and foundation bolts have been tightened, and piping connections have been made.

B. Comply with pump and coupling manufacturers' written instructions.

C. Adjust pump and motor shafts for angular and offset alignment by methods specified in HI 1.1-1.5, "Centrifugal Pumps for Nomenclature, Definitions, Application and Operation."

D. After alignment is correct, tighten foundation bolts evenly but not too firmly. Completely fill baseplate with nonshrink, nonmetallic grout while metal blocks and shims or wedges are in place. After grout has cured, fully tighten foundation bolts.

3.3 CONNECTIONS

A. Piping installation requirements are specified in Section 23 2113, "Hydronic Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to machine to allow service and maintenance.

C. Connect piping to pumps. Install valves that are same size as piping connected to pumps.

D. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.

E. Install triple duty valve on discharge side of base mounted pumps.

F. Install suction diffuser and shutoff valve on suction side of base mounted pumps.

G. Install flexible connectors on suction and discharge sides of base-mounted pumps between pump casing and valves, or as shown.

H. Install pressure gages on pump suction and discharge, at integral pressure-gage tapping, or install single gage with multiple input selector valve.

I. Ground equipment according to Section 26 0526, "Grounding and Bonding for Electrical Systems."

J. Connect wiring according to Section 26 0519, "Low-Voltage Electrical Power Conductors and Cables."

END OF SECTION

SECTION 23 2300

REFRIGERANT PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Site and building refrigerant piping and fittings.

1.2 RELATED SECTIONS

A. Section 01 2500, "Substitution Procedures."

B. Section 01 4000, "Quality Requirements."

C. Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

D. Section 01 4444, "Offsite Welding & Joining Requirements."

E. Section 01 4455, "Onsite Welding & Joining Requirements."

F. Section 22 0529, "Hangers and Supports for Plumbing Piping and Equipment."

G. Section 22 0548, "Vibration and Seismic Controls for Plumbing, Piping and Equipment."

H. Section 22 0554, "Identification for Plumbing, HVAC, and Fire Piping Equipment."

I. Section 22 0713, "Plumbing and HVAC Insulation."

J. Section 22 0813, "Testing Piping Systems."

1.3 ABBREVIATIONS AND ACRONYMS, DEFINITIONS, AND REFERENCES

A. Refer to Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

1.4 SUBMITTALS

Submit the following in accordance with the requirements of Exhibit I:

A. Catalog Data:

1. Data on pipe materials, fittings, and accessories.

B. Manufacturer's Installation Instructions: Submit hanging and support methods, joining procedures and isolation.

C. Welding procedures and qualifications.

D. Certifications of welders and qualified welding procedures per Section 01 4444, "Offsite Welding & Joining Requirements" and Section 01 4455, "Onsite Welding & Joining Requirements."

1.5 QUALITY ASSURANCE

A. Work identified in this section shall be done under a Quality Assurance Program in accordance with Section 01 4000, "Quality Requirements."

B. Comply with ASME B31.5, *Refrigeration Piping and Heat Transfer Components*; ASHRAE 15, *Safety Standard for Refrigeration Systems*; and ASHRAE 34, *Designation and Safety Classification of Refrigerants*.

C. Subcontractor shall use listed components unless calculations are provided in accordance with ASME B31.5, 526.1 and 504 requirements for unlisted components.

PART 2 PRODUCTS

2.1 PRODUCT OPTIONS AND SUBSTITUTIONS

A. Alternate products may be accepted; follow Section 01 2500, "Substitution Procedures."

2.2 REFRIGERANT PIPING

A. Copper Tubing: ASTM B280, Type ACR hard drawn [or annealed].

B. Fittings: ASME B16.22 Wrought Copper and Copper Alloy Solder-joint pressure fittings.

C. Joints: Braze, AWS A5.8 BCuP silver/phosphorus/copper alloy with melting range 1190 to 1480°F. Brazing to comply with 01 4444 and 01 4445.

2.3 UNIONS, FLANGES, AND COUPLINGS

A. 2 inches and Smaller:

1. Copper Pipe: Bronze, soldered joints. Solder to be according to ASTM B32.

B. 2-1/2 inches and Larger:

1. Copper Piping: Bronze, flanged joints. Flanges per ASME B16.24.

2. Gaskets: 1/16 inch thick preformed neoprene.

C. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

PART 3 EXECUTION

3.1 PREPARATION

A. Ream pipe and tube ends. Remove burrs.

B. Remove scale and dirt on inside and outside before assembly.

C. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

3.2 INSTALLATION – ABOVE GROUND PIPING SYSTEM

A. Install refrigerant piping in accordance with ASME B31.5, *Refrigeration Piping and Heat Transfer Components.*

B. Where more than one piping system material is specified, provide compatible system components and joints. Use non-conducting dielectric connections when joining dissimilar metals in systems.

C. Provide flanges, unions, or couplings at locations requiring servicing. Use unions, flanges, or couplings downstream of valves and at equipment connections. Do not use direct welded or threaded connections to valves or equipment.

D. Provide flexible connectors at or near equipment where piping configuration does not absorb vibration.

E. Install flexible connectors at right angles to axial movement of compressor, parallel to crankshaft.

F. Route piping parallel to building structure and maintain gradient.

G. Install piping to conserve building space, and not interfere with use of space.

H. Group piping whenever practical at common elevations.

I. Sleeve pipe passing through partitions, walls and floors.

J. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

K. Arrange refrigerant piping to return oil to compressor. Provide traps and loops in piping, and provide double risers as required. Slope horizontal piping 1/2 inch in 10 feet in direction of flow.

L. Flood refrigerant piping system with nitrogen when brazing.

M. Fully charge completed system with refrigerant after testing.

N. Comply with ASHRAE 15 procedures for charging and purging of systems and for disposal of refrigerant.

O. Support piping in accordance with Section 22 0529, Hangers and Supports for Plumbing Piping and Equipment.

P. Sleeve pipe penetration and caulk in accordance with Section 22 0548, Vibration and Seismic Control for Plumbing Piping and Equipment.

Q. Pressure test piping in accordance with Section 22 0813, Testing Piping Systems.

R. Insulate piping in accordance with Section 22 0713, Plumbing and HVAC Insulation.

S. Label piping in accordance with Section 22 0554, Identification for Plumbing, HVAC, and Fire Piping and Equipment.

END OF SECTION

FOR LANL USE ONLY

This project specification is based on LANL Master Specification 23 2300, rev. 2, dated September 15, 2009.

SECTION 23 2500

HVAC WATER TREATMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Cleaning of HVAC piping systems.

B. Chemical water treatment of closed HVAC systems.

1.2 RELATED SECTIONS

A. Section 01 2500, "Substitution Procedures."

B. Section 01 3545, "Water Discharge Requirements."

C. Section 01 4000, "Quality Requirements."

D. Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

E. Section 22 0813, "Testing Piping System."

1.3 ABBREVIATIONS AND ACRONYMS, DEFINITIONS, AND REFERENCES

A. Refer to Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

1.4 SUBCONTRACTOR REQUIREMENTS

A. Notify LANL Subcontract Technical Representative (STR) at 5 working days in advance to witness cleaning (flushing) and water treatment activity.

B. Do not fill or flush piping systems until source of water supply is approved by LANL STR.

C. Do not clean or chemically treat piping systems until systems have been successfully pressure tested.

D. For discharge requirements of water used for flushing and water treatment, comply with Section 01 3545, "Water Discharge Requirements."

E. Notify LANL STR immediately in the event of any accidental discharge.

F. Do not place piping systems in service until LANL STR approves cleaning and chemical treatment composition are approved as described in Paragraph 1.5C.

1.5 LANL STR REQUIREMENTS

A. For discharge requirements of water used for flushing and water treatment, comply with Section 01 3545, "Water Discharge Requirements."

B. Verify proper cleaning, flushing, chemical concentration and circulation.

C. Immediately after receiving list of chemicals to be used from subcontractor, including chemical composition, submit copy to the LANL Water Quality Group for approval.

1.6 SUBMITTALS

Submit the following in accordance with the requirements of Exhibit I:

A. Catalog data of flushing and chemical water treatment chemicals and equipment including electrical characteristics and connection requirements.

B. Manufacturer's Installation Instructions showing placement of equipment in systems, piping configuration, and connection requirements.

C. Manufacturer's Certification of products to meet or exceed specified requirements.

D. Operation and Maintenance data on equipment, procedures, and treatment program. Include instructions on test procedures including target concentrations.

E. Submit material list of all chemicals to be used, including chemical composition, to LANL STR 30 days prior to using chemicals. Do not begin chemical treatment until chemicals have been approved by the LANL Water Quality Group.

F. Manufacturers Field Reports: Indicate start-up of treatment systems when completed and operating properly. Indicate analysis of system water after cleaning and after treatment.

1.7 QUALIFICATIONS OF CHEMICAL SUPPLIER

A. Company specializing in performing the Work of this section with minimum 10 years experience and approved by chemical manufacturer.

B. Personnel using biocide products shall have a New Mexico Department of Agriculture (NMDA) pesticide applicator license.

1.8 QUALITY ASSURANCE

A. Work identified in this section shall be done under a Quality Assurance program in accordance with Section 01 4000, "Quality Requirements."

B. Biocide products shall be registered with the EPA, with the registration number clearly shown on drum labels.

PART 2 PRODUCTS

2.1 PRODUCT OPTIONS AND SUBSTITUTIONS

A. Alternate products may be accepted; follow Section 01 2500, "Substitution Procedures."

2.2 MATERIAL SAFETY DATA SHEETS

A. Maintain on site Material Safety Data Sheets (MSDS) for chemical products.

2.3 SYSTEM CLEANER

A. Manufacturer: Garratt-Callahan.

B. Treatment Chemical: Formula 248-L, alkaline liquid blend of phosphates, silicates, iron oxide chelants, dispersants, and surface active agents.

2.4 CLOSED LOOP WATER TREATMENT (HEATING WATER, CHILLED WATER, PROCESS COOLING WATER, AND HEAT RECOVERY WATER)

A. Chemical Pot Feeder: Griswold Water Systems, Model DB-5-GE-CS-A, 5 gallon capacity, steel construction, ASME code stamped, rated for 600 psi and 250

degree F, include inlet/outlet valve package (VP-75) and funnel package (FP-75), with option of adding a filter bag.

B. Treatment Chemical: Garratt-Callahan, Formula 1015-L, corrosion and scale inhibitor based on phosphorate and orthophosphate. Furnish 1 year's supply.

2.5 SYSTEM FILL

A. Propylene Glycol: Industrial grade with corrosion inhibitors and environmental-stabilizer additives for mixing with water in systems indicated to contain antifreeze or glycol solutions.

PART 3 EXECUTION

3.1 INSTALLATION

A. Subcontractor shall furnish water treatment system supplied by the water treatment manufacturer and install per manufacturer's recommendation.

3.2 TEST AND INSPECTION

A. Perform piping pressure test before water treatment to avoid possible discharge of chemicals due to pipe or joint failure during a pressure test. Refer to Section 22 0813, "Testing Piping System."

B. Inspect field-assembled components and equipment installation, including piping and electrical connections.

C. Inspect piping and equipment to determine that systems and equipment have been cleaned, flushed, and filled with water, and are fully operational before introducing chemicals for water-treatment system.

3.3 PRE OPERATION CLEANING (CLOSED LOOP SYSTEM)

A. Prior to startup, clean system with Formula 248-L, following the written procedures furnished by the chemical supplier.

1. Ensure water filters, instrumentation, gages, flow transmitters, and similar items are removed or protected. Provide a temporary bypass or plugs as required.

3.4 CHARGE SYSTEMS

A. Fill systems indicated to have antifreeze or glycol solutions with the following concentrations:

1. Chilled water piping: Minimum 43 percent propylene glycol.

2. Heat recovery water piping: Minimum 43 percent propylene glycol.

3.5 DEMONSTRATION

A. Furnish two eight hour training course for operating personnel, instruction to include installation, care, maintenance, testing, and operation of water treatment systems. Arrange course at start up of systems.

3.6 CHEMICAL SUPPLIER WATER TREATMENT SERVICE PROGRAM

A. Provide consulting services for a period of 1 year from the time of startup which shall include:

1. Installation and startup recommendations.

2. Field water analysis and recommendations.

3. Quarterly lab analysis on treated systems for metals, microorganisms, and standard analysis.
4. Training of plant personnel in proper feed and control.
5. Minimum monthly service calls.
6. Log sheets and record forms.

END OF SECTION

SECTION 23 3101

HVAC DUCTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Ductwork, duct cleaning, duct sealing, duct testing, flexible ducts, flexible duct connections, and duct liner.

1.2 RELATED SECTIONS

A. Section 01 2500, "Substitution Procedures."

B. Section 01 4000, "Quality Requirements."

C. Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

D. Section 01 4444, "Offsite Welding & Joining Requirements."

E. Section 01 4455, "Onsite Welding & Joining Requirements."

F. Section 22 0548, "Vibration and Seismic Controls for Plumbing, Piping and Equipment."

G. Section 22 0713, "Plumbing and HVAC Insulation."

1.3 ABBREVIATIONS AND ACRONYMS, DEFINITIONS, AND REFERENCES

A. Refer to Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

1.4 LANL PERFORMANCE REQUIREMENTS

A. Structural Performance: Duct hangers and supports and seismic restraints shall withstand the effects of gravity and seismic loads and stresses within limits and under conditions described in ASCE/SEI 7. Loads shall be in accordance with Section 22 0548, "Vibration and Seismic Controls for Plumbing, Piping and Equipment."

1.5 SUBMITTALS

Submit the following in accordance with the requirements of Exhibit I:

A. Catalog data for duct materials, flexible duct/connectors, sealing materials.

B. Shop drawings indicating duct layout with pressure classification and sizes, fittings, hangers and supports, seismic restraints, seam and joint construction, connections to equipment such as coils, etc., for pressure class ducts 2 inches and greater.

C. Test Reports indicating pressure tests performed. Include date, section tested, test pressure, and leakage rate, following SMACNA HVAC Air Duct Leakage Test Manual.

D. Inspection and test procedures required by ASME AG-1 Section SA and TA for process area and fume hood exhaust ductwork.

E. Submit material test reports for Duct Materials sheets, shapes, plates and flanges described in paragraph 2.3.

F. Submit certificates of Conformance for fasteners described in paragraph 2.3

G. Test Reports required by ASME AG-1 Section SA and TA for process area and fume hood exhaust ductwork.

H. Certificates shall be submitted showing conformance with the applicable standards for ductwork materials, brazing materials, mill-rolled reinforcing and supporting materials, welding procedures, shop test procedures and reports.

I. Certifications of welders and qualified welding procedures per Section 01 4444, "Offsite Welding & Joining Requirements" and Section 01 4455, "Onsite Welding & Joining Requirements."

1.6 QUALITY ASSURANCE

A. Work identified in this section shall be done under a Quality Assurance program in accordance with Section 01 4000, "Quality Requirements."

B. Construct ductwork in accordance with SMACNA - HVAC Duct Construction Standards - Metal and Flexible, and NFPA 90A.

C. Manufacture, inspect, test and ship process area and fume hood exhaust ductwork under a quality assurance program meeting the requirements of ASME AG-1, Article SA-8000.

D. Qualify welding processes and welding operators in accordance with AWS D1.1 "Structural Welding Code - Steel" for hangers and supports and AWS D9.1 "Sheet Metal Welding Code".

E. Welders Certification and Qualified Procedure Standards shall be in accordance with Section IX of ASME B&PV Code.

F. Fiberboard duct is not acceptable duct material except when used for fabricating return air sound traps.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum 3 years experience.

B. Installer: Company specializing in performing work of this section with minimum 3 years experience approved by manufacturer.

1.8 INSPECTIONS AND TESTS

A. Inspect and test the process area and fume hood exhaust ductwork installation in accordance with the requirements of ASME AG-1, Article SA-5000, "Inspection and Testing" and Article TA-4300, "Duct, Housing, and Frame Acceptance Tests".

1.9 DELIVERY, STORAGE, AND HANDLING

A. Packaging, shipping, receiving, storage, and handling of the process area and fume hood exhaust ductwork shall be in accordance with the requirements of ASME AG-1, Article SA-7000.

1.10 ENVIRONMENTAL REQUIREMENTS

A. Do not install duct sealant when temperatures are less than those recommended by sealant manufacturers.

B. Maintain temperatures during and after installation of duct sealant.

1.11 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

PART 2 PRODUCTS

2.1 PRODUCT OPTIONS AND SUBSTITUTIONS

A. Alternate products may be accepted; follow Section 01 2500, "Substitution Procedures."

2.2 DUCT MATERIALS – SUPPLY, RETURN, AND NON-PROCESS AREA EXHAUST DUCTWORK

A. Galvanized Steel Ducts: ASTM A 653 galvanized steel sheet, lock-forming quality, having G90 zinc coating in conformance with ASTM A 90.

B. Fasteners: Rivets, bolts, or sheet metal screws.

C. Hanger Rod: ASTM A 36; steel, threaded both ends, threaded one end, or continuously threaded.

D. Hanger Straps: ASTM A 653 galvanized steel having G90 zinc coating in conformance with ASTM A 90.

E. Structural Steel Members: ASTM A 36 steel.

2.3 DUCT MATERIALS - PROCESS AREA AND FUME HOOD EXHAUST DUCTWORK

A. Ductwork materials and ductwork support materials for the process area and fume hood exhaust ductwork shall meet the requirements of ASME AG-1, Article SA-3000.

B. Comply with ASTM A 167/A 167M or ASTM A 240/A 240M, Type 304 or 304L, cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B or No. 2D. Submit material test reports.

C. Reinforcement Shapes and Plates: ASTM A 276/A 276M, steel plates, shapes, and bars; Stainless-steel Type 304 or 304L. Submit material test reports.

D. Flanges: Flanges shall be fabricated of minimum 1/4 in. thick stainless-steel plate or angle, round flanges shall match the dimensions specified in SMACNA Round Industrial Duct Construction Standards, Class 1. Rectangular flanges shall be fabricated in accordance with SMACNA Rectangular Industrial Duct Construction Standards, Class 1. Plate, shapes or bars shall be Type 304 or 304L-series stainless-steel meeting the requirements of ASTM A 276/A 276M. Flange material shall match the duct material. Submit material test reports.

E. Fasteners: Stainless-steel bolts, cap screws, and washers shall be used on all stainless-steel materials. Bolts, cap screws, and washers shall meet the requirements of ASTM A 193/A 193M, Grade B8. Nuts shall be heavy hex nuts meeting the requirements of ASTM A 194/A 194M, Grade 8. Bolts and cap screws shall be grade marked. Submit material test reports or Certificate of Conformance.

F. Anti-galling compound: Loctite® 8013 or 8009 shall be applied where stainless-steel bolts are used

G. Sealant and Gaskets: General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

H. Flange Gaskets: 1/8" thick, ASTM D1056, Grade 2C3 or 2C4, Neoprene, or EPDM polymer with polyisobutylene plasticizer. Flange bolt torques shall be identified on the drawings and in accordance with gasket manufacturer's recommendations.

2.4 DUCTWORK FABRICATION – SUPPLY, RETURN, AND NON-PROCESS AREA EXHAUST DUCTWORK

A. Fabricate ductwork, duct access doors and support in accordance with SMACNA *HVAC Duct Construction Standards - Metal and Flexible.* Furnish duct material, gages, reinforcing, and sealing for design pressure class indicated. Fabricate seismic bracing in accordance with Section 22 0548, "Vibration and Seismic Controls for Plumbing, Piping and Equipment."

B. Construct T's, bends, and elbows with minimum radius 1-1/2 times centerline duct width. Where not possible and where rectangular elbows are used, provide airfoil turning vanes constructed and installed in accordance with SMACNA Standards. Vanes are not required in return air sound trap elbows and transfer ducts.

C. Fabricate continuously welded round duct fittings two gages heavier than duct gages indicated in SMACNA Standard.

D. Provide, at minimum, rectangular 45 degree entry fittings for rectangular ducts and 45 degree wye takeoffs for round ducts.

E. Duct sizes noted are inside clear dimensions.

F. No variation of duct configuration or sizes other than those of equivalent or lower loss coefficient is permitted except by written permission from LANL STR. Round ducts installed in place of rectangular ducts shall be sized in accordance with ASHRAE table of equivalent rectangular and round ducts.

G. Increase duct size gradually, not exceeding 15 degree divergence wherever possible. Do not exceed 30-degree divergence upstream of equipment. Do not exceed 45-degree convergence downstream of equipment.

2.5 DUCTWORK FABRICATION - PROCESS AREA AND FUME HOOD EXHAUST DUCTWORK

A. Fabricate process area and fume hood exhaust ductwork and supports in accordance with ASME AG-1, Article SA, Service Level C, and Table SA-C-1300, SMACNA Round Industrial Duct Construction Standards, Class 1, and SMACNA Rectangular Industrial Duct Construction Standards, Class 1. Pressure Classification negative 30-in water gauge. Fabricate seismic bracing in accordance with Section 22 0548, "Vibration and Seismic Controls for Plumbing, Piping and Equipment."

B. Construct bends, and elbows with minimum radius 1-1/2 times centerline duct width. Where not possible and where rectangular elbows are used, provide single thickness turning vanes constructed and installed in accordance with SMACNA Standards.

C. Provide, at minimum, rectangular 45 degree entry fittings for rectangular ducts and 45 degree wye takeoffs for round ducts, unless shown otherwise on drawings.

D. Duct sizes noted are inside clear dimensions.

E. Increase duct size gradually, not exceeding 15 degree divergence wherever possible. Do not exceed 30-degree divergence upstream of equipment. Do not exceed 45-degree convergence downstream of equipment.

2.6 FLEXIBLE DUCTS (INSULATED, LOW TO HIGH PRESSURE)

A. Manufacturer: Flexmaster, Type 5B.

B. Duct assembly of a trilaminate of aluminum foil, fiberglass, and aluminized polyester, mechanically locked (no adhesives) into an aluminum helix formed on the ducts outside surface, insulation encased in a fire retardant protective barrier, duct UL listed 181 class 1, and complies with NFPA 90A.

1. Pressure Rating: 6 inches w.g. positive, 5 inches w.g. negative through 16 inches diameter, 1 inch w.g. negative for 18 inches and 20 inches diameter.

2. Rated Velocity: 5500 fpm.

3. Temperature Rating: Minus 20 degrees F to plus 250 degrees F.

4. Insulation: Fiberglass, K-factor (thermal conductivity) of approximately 0.24 BTU•in/hr•ft2•F at mean temperature of 75 degrees F, minimum R-6.

2.7 FLEXIBLE CONNECTIONS (EXPOSED TO SUN AND WEATHER)

A. Manufacturer: Ventfabrics, Ventlon.

B. Heavy glass fiber (coated with duPont's Hypalon), fire retardant, UL 214, and complies with NFPA-90A.

1. Pressure Rating: 10 inches w.g., negative and positive.

2. Temperature Rating: Minus 10 degrees F to plus 275 degrees F.

3. Weight: 26 oz/sq yd plus or minus 2 ounces.

2.8 FLEXIBLE CONNECTIONS (INDOOR) – SUPPLY, RETURN, AND NON-PROCESS AREA EXHAUST DUCTWORK

A. Manufacturer: Ventfabrics, Ventglas.

B. Heavy glass fiber (coated with duPont's neoprene), fire retardant, UL Standard 214, and complies with NFPA-90A.

1. Pressure Rating: 10 inches w.g. negative and positive.

2. Temperature Rating: Minus 20 degrees F to plus 200 degrees F.

3. Weight: 30 oz/sq yd plus or minus 3 ounces.

2.9 FLEXIBLE CONNECTIONS - PROCESS AREA AND FUME HOOD EXHAUST DUCTWORK

A. Manufacturer: Proco, Style 520-EE, 6-in. face to face flange dimension.

B. Flexible duct connections for the process area and fume hood exhaust ductwork shall meet the requirements of ASME AG-1, Article SA-4410, "Flexible Connections" and NFPA-90A.

C. Flexible connectors shall be U-type flange connectors of nominal 3/16-in. thickness manufactured with a minimum of one ply of reinforced fabric vulcanized into an EPDM elastomer. No splices shall be made in the corner areas. Provide connectors with 3/8-in thick retainer bars.

1. Maximum pressure rating shall exceed ± 30-in. w.g.
2. Temperature rating shall exceed 250 degrees F.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify sizes of equipment connection before fabricating transitions.

3.2 INSTALLATION – SUPPLY, RETURN, AND NON-PROCESS EXHAUST DUCTWORK

A. Install, seal, and support ductwork in accordance with SMACNA HVAC Duct Construction Standards-Metal and Flexible.

B. During construction, install temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.

C. Use double nuts and lock washers on threaded rod supports.

D. Connect flexible ducts to metal ducts with draw bands.

E. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

F. Install balancing dampers with indicating type locking quadrant where noted on drawing. Inspect and ensure that the construction of balancing dampers, including the hand quadrant, is of good quality prior to installation.

1. Dampers are not required upstream or downstream of CAV boxes serving only one diffuser.
2. Do not use splitter dampers.
3. Locate balancing dampers as far as possible (recommend no closer than 5 feet) from air terminals to avoid excessive noise.

G. Install flexible connections with minimum 1 inch slack immediately adjacent to equipment in ducts associated with fans and motorized equipment.

H. Limit flexible ductwork to diffusers, terminal units, or light troffer boots, to 5 feet in length.

1. Do not install flexible ductwork upstream of CAV boxes.

I. Install duct access doors for inspection and cleaning upstream of filters, coils, automatic dampers, rectangular elbows with turning vanes, and equipment as indicated on drawings. Provide minimum 8 X 8 inch size for hand access, 18 x 18 inch size or 18 inch x the duct height/width less 2 inches for shoulder access.

1. Install duct access door upstream of fire damper, size 18 x 18 min., 24 x 24 max.

J. Where indicated, weld duct joints and seams in accordance with AWS D9.1.

K. Repair damaged galvanized ductwork surfaces (welds, scratches, etc.) by applying minimum 2 coats of a zinc base paint.

L. Provide duct drops to diffuser same size as diffuser neck size.

M. Provide UL/FM approved through-penetration firestop system when penetrating fire-rated barriers (i.e., walls, floors, etc).

N. Install openings in ductwork where required to accommodate thermometers and controllers. Install pitot tube openings for testing of systems. Install pitot tube complete with metal can with spring device or screw to prevent air leakage. Where openings are provided in insulated ductwork, install insulation material inside metal ring.

O. Insulate ductwork in accordance with Section 22 0713, "Plumbing and HVAC Insulation."

3.3 INSTALLATION - PROCESS AREA AND FUME HOOD EXHAUST DUCTWORK

A. Install and support process area and fume hood exhaust ductwork in accordance with ASME AG-1, Article SA, Service Level C, and SMACNA Round and Rectangular Duct Construction Standards, Class 1.

B. During construction, install temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.

C. Use double nuts and lock washers on threaded rod supports.

D. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

E. Provide flexible connections with minimum 1 inch slack immediately adjacent to equipment in ducts associated with fans and motorized equipment.

F. Construction of duct access doors and/or panels shall meet the requirements of AG-1, Article SA, Section SA-4430.

G. Provide UL/FM approved through-penetration firestop system when penetrating fire-rated barriers (i.e., walls, floors, etc).

3.4 CLEANING

A. After completing system installation and inspection, clean duct systems in accordance with National Air Duct Cleaners Association (NADCA) specifications

1. The cleaning agency shall be a certified member of NADCA, or shall be certified by a nationally recognized program and organization.

3.5 DUCTWORK MATERIAL SCHEDULE

A. Fabricate ducts from galvanized steel except for the following air systems:

Air System	Material
Process Area Exhaust	Stainless Steel, Type 304 or 304L
Fume Hood Exhaust	Stainless Steel, Type 304 or 304L

3.6 DUCTWORK PRESSURE CLASSIFICATION

A. Construct each duct system for a minimum pressure classification of 1 inch w.g., and as follows:

1. Supply Ducts: 3 inch w.g. pressure duct from air handling unit to CAV terminal unit.

2. Supply Ducts: 2 inches pressure duct from CAV terminal unit to diffuser.

3. Return Ducts: 2 inches w.g., negative pressure.

4. Non-Process Area Exhaust Ducts: 2 inches w.g., negative pressure.

5. Process Area and Fume Hood Exhaust Ducts:

a. Fabrication pressure classification 30 inches w.g., negative pressure, Class 1.

b. Normal operating pressure 18 inches w.g., negative pressure.

c. Leak Test pressure 20 inches w.g., negative pressure.

d. Structural Capability Test pressure 25 inches w.g.

3.7 DUCT SEALING – SUPPLY, RETURN, AND NON-PROCESS AREA EXHAUST DUCTORK

A. Seal duct seams and joints in accordance to the duct pressure classification as described in SMACNA HVAC Duct Construction Standards-Metal and Flexible.

B. Seal joints between duct sections and duct seams with welds, gaskets, mastic adhesives, mastic plus embedded fabric systems, or tape.

1. Sealants, Mastics and Tapes: Conform to UL 181A. Provide products bearing appropriate UL 181A markings.

2. Do not provide sealing products not bearing UL approval markings.

C. Do not use pressure-sensitive sealant on ducts with a pressure class of 1 inch w.g. or greater.

3.8 DUCT SEALING – PROCESS AREA AND FUME HOOD EXHAUST DUCTWORK

A. Seal duct seams and joints in accordance to the duct pressure classification as described in AG-1, Article SA-4300. All joints and seams shall be welded construction with flanged joints and gaskets and flanged joints and gaskets at connections to flanged equipment and dampers

3.9 DUCT LEAKAGE – SUPPLY, RETURN, AND NON-PROCESS AREA EXHAUST DUCTWORK

A. Leak test ducts with a duct pressure class in excess of 4 inches w.g. (over 3 in. up to 4 in. w.g.)

B. Perform leakage tests in accordance with the SMACNA HVAC Duct Leakage Test Manual, using tests forms equivalent to those outlined in manual.

C. The entire duct systems need not to be tested. Tests may be made for only representative sections provided these sections represent at least 25 percent of the total installed duct area for the tested pressure class.

D. Maximum Allowable Leakage: Comply with the following requirements

1. Leakage Classification 3 for round and flat oval ducts.
2. Leakage Classification 6 for rectangular ducts.

E. Remake leaking joints and retest to ensure leakage is less than the minimum allowed.

3.10 TESTING AND INSPECTION - PROCESS AREA AND FUME HOOD EXHAUST DUCTWORK

A. Perform acceptance tests on the process area and fume hood exhaust ductwork in accordance with ASME AG-1, Table TA-4310.

B. Visual Inspection: Inspect ductwork, supports, and housings in accordance with ASME AG-1 Section SA-5200 and TA-4320. Submit a visual inspection report.

C. HEPA filter Frame Inspection: Inspect HEPA filter frames in accordance with ASME AG-1 Section FG-5000. Submit HEPA filter frame inspection reports.

D. Structural Capability Tests: Perform a Structural capability test of the ductwork in accordance with ASME AG-1 Section SA-5400 and Section TA-4331 at pressures indicated in the "Duct Pressure Classification". The SUBCONTRACTOR shall conduct tests that will be witnessed by the CONTRACTOR prior to delivery to the work site. Also, a test of the completed exhaust system shall be conducted by the SUBCONTRACTOR following installation of the ducting covered in this performance specification. Submit structural capability test procedure and report for the both tests.

E. Leakage Tests: Comply with ASME AG-1 Section SA-5300 and Table SA-B-1310, Class I, ESF systems and Section TA-4332. The SUBCONTRACTOR shall conduct tests that will be witnessed by the CONTRACTOR prior to delivery to the work site. Also, a test of the complete exhaust system shall be conducted by the SUBCONTRACTOR following installation of the ducting covered in this performance specification. Submit leakage test procedures and report for the both tests.

F. Test the following systems:

1. Exhaust Ducts: Test all duct sections prior to delivery.
2. Process Exhaust system: Test all duct sections, including HEPA filter housings up to the inlet of the exhaust fans after installation.

G. Conduct tests at static pressures equal to Leak test pressure of system or section being tested. Do not pressurize systems above maximum design operating pressure.

H. Duct system will be considered defective if it does not pass tests and inspections. Prepare and submit test and inspection reports.

I. Integrated System Test. Prepare and submit a written procedure for the integrated system test for approval. The Integrated System Test shall be in accordance with ASME AG-1, Section TA-4900 "Integrated System Tests", perform tests on the fans in accordance with Section TA-4910, dampers in accordance with Section TA-4920, and HEPA filter housings in accordance with TA-4940. Submit the test results in accordance with Section TA-6300 "Documentation".

J. At the conclusion of the Integrated System Test, final prefilters, and HEPA filters shall be installed in the housings and the HEPA Filter bank In-Place leak test procedure shall be performed. Prepare and submit a written procedure for the In-Place Leak testing in Accordance with ASME AG-1 Appendix TA-VI. Perform the test in accordance with ASME AG-1 Article TA-VI-4000, submit the test results in accordance with ASME AG-1 Section TA-6300 "Documentation".

END OF SECTION

FOR LANL USE ONLY

This project specification is based on LANL Master Specification 23 3101, Rev. 0, dated September 1, 2009.

SECTION 23 3225

BAG-IN/BAG-OUT HOUSINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Isolation Dampers.

B. Filter Housings.

1.2 RELATED SECTIONS

A. Section 01 4000, "Quality Requirements."

B. Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

C. Section 22 0548, "Vibration and Seismic Controls for Plumbing, Piping and Equipment."

D. Section 23 3101, "HVAC Ducts."

E. Section 23 4133, "High-Efficiency Particulate Filtration."

1.3 ABBREVIATIONS AND ACRONYMS, DEFINITIONS, AND REFERENCES

A. Refer to Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

1.4 LANL-PERFORMED WORK

A. LANL is responsible for having installed HEPA filters in-place tested.

1.5 SUBMITTALS

Submit the following in accordance with the requirements of Exhibit I:

A. Filter Housing

1. Catalog data.

2. Certificate of Conformance (CoC) that is signed or otherwise authenticated by responsible managers within the supplying organization and that certifies the conformance of end-items to order requirements. CoC must include:

   a. Certification that the housings have been designed, manufactured and constructed in accordance with the manufacturer's QA plan.
   b. Statement that the housings meet the leak test requirements.
   c. PO number.
   d. Any approved changes, waivers, or deviations from this specification.

3. Copy of the housing manufacturer's QA plan identifying procurement, fabrication, test & inspection, material traceability and nonconformity controls for approval.

4. Certification documentation showing that the housings meet the design requirements, including Qualification and Test Acceptance reports, and material requirements of Section 2.2 and 2.3. Examples of such documents include: supplier performance test information, inspection reports, justification for design integrity, drawings, etc. Certifications that

unit meets ASME N509-2002, ASME N510-2007 requirements and ASME AG-1, 2009.

5. Purchased item identified by part number.
6. Any approved changes, waivers, or deviations from this specification.
7. Installation instructions.
8. Warranty documentation guarantee against failure in proper use or operation caused by defective materials and/or workmanship for a period of one year from the date of acceptance.
9. Materials/part lists.
10. Shop drawings.

B. Isolation Dampers

1. Certificate of Conformance (CoC) that is signed or otherwise authenticated by responsible managers within the supplying organization and that certifies the conformance of end-items to order requirements. CoC must include:
   a. Certification that the dampers have been designed, manufactured and constructed in accordance with the manufacturer's QA plan.
   b. Statement that the housings meet the leak test requirements.
   c. PO number.
   d. Any approved changes, waivers, or deviations from this specification.
2. Copy of the damper manufacturer's QA plan identifying procurement, fabrication, test & inspection, material traceability and nonconformity controls for approval.
3. Certification documentation showing that the dampers meet the design requirements, including Qualification and Test Acceptance reports, and material requirements of Section 2.1. Examples of such documents include: supplier performance test information, inspection reports, justification for design integrity, drawings, etc. Certifications that unit meets ASME N509-2002, ASME N510-2007 requirements and ASME AG-1, 2009.
4. Purchased item identified by part number.
5. Any approved changes, waivers, or deviations from this specification.
6. Installation instructions.
7. Warranty documentation guarantee against failure in proper use or operation caused by defective materials and/or workmanship for a period of one year from the date of acceptance.
8. Materials/part lists.
9. Shop drawings.

1.6 MAINTENANCE

A. Extra Materials: Furnish temporary prefilters to be used during construction.

1.7 QUALITY ASSURANCE AND QUALITY CONTROL

A. Work identified in this section shall be done under a Quality Assurance program in accordance with Section 01 4000, "Quality Requirements."

1.8 PACKAGING, SHIPPING, RECEIVING, STORAGE, AND HANDLING

A. Filter Housings

1. Package, ship and store filter housings per the requirements of ASME AG-1, Article HA-7000 and in accordance with ASME NQA-1, Subpart 2.2. The level of protection:

a. Packaging: Level D.
b. Shipping: Comply with ASME AG-1, Article HA-7300.
c. Receiving: Comply with ASME AG-1, Article HA-7400.
d. Storage: Level D and comply with ASME AG-1, Articles HA-7510, HA-7511, and HA-7512.

2. Receiving at the job site or intermediate locations, where additional work is to be performed or for long term storage, shall be in accordance with the provisions of ASME AG-1, Articles HA-7400 and HA-7500.

B. Isolation Dampers

1. Package, ship and store isolation dampers per the requirements of ASME AG-1, Article DA-7000 and in accordance with ASME NQA-1. The level of protection shall comply with Level C.

1.9 DESIGN PRESSURES

A. Normal Operating pressure; Negative 18 inches w.g.

B. Leak Test Pressure; Negative 20 inches w.g.

C. Structural Capability Test Pressure; Negative 25 inches w.g.

1.10 INSPECTIONS AND TESTS

A. Inspect and test the process area HEPA filter housing installation in accordance with the requirements of ASME AG-1, Article HA-5000, "Inspection and Testing" and Article TA-4300, "Duct, Housing, and Frame Acceptance Tests".

B. Inspect and test the process area isolation damper installation in accordance with the requirements of ASME AG-1, Article DA-5000, "Inspection and Testing" and Article TA-4200, "Damper Acceptance Tests"

PART 2 PRODUCTS

2.1 ISOLATION DAMPERS

A. Materials shall be equivalent to or exceed the requirements in ASME AG-1, Table DA 3100. Allowable stress levels for frames, blades, shafts, and linkages shall comply ASME AG-1, Article AA-4000. Bearing material shall comply with ASME AG-1, Article DA-4250. Seal materials shall comply with ASME AG-1, Article DA-4260. Isolation dampers shall be leakage class (zero leakage) in accordance with ASME AG-1 Appendix DA-I. Isolation dampers shall be shipped separately.

B. Visual Inspection.

1. Perform a Visual Inspection in accordance with ASME AG-1, Sections DA-5200 and TA-4220. Submit Visual Inspection procedures and reports.

C. Structural Capability Test:

1. Perform a Structural Capability test in accordance with ASME AG-1, Sections DA-5500, TA-4231, and TA-4232 on the completed damper frame and blade prior to the final pressure decay leak test. Submit certifications of the Structural Capability test.

D. Pressure Decay Leak Test:

1. Factory leak test each completed damper assembly to minus 20 in. w.g. in accordance with ASME AG-1, Sections DA-5130, DA-5141, TA-4233, TA-4234, and TA-4235. Leak test acceptance criteria, damper shall be leakage class (zero leakage) at design pressure in accordance with ASME AG-1 Appendix DA-I. Rectify and retest any deficiency and work affected by such deficiency. Submit certifications of leak test.

E. Provide nameplate in accordance with ASME AG-1, Article DA-9000.

2.2 FILTER HOUSINGS (FOR LABORATORY FUME HOODS)

A. Manufacturers

1. Flanders/CSC, BG housing, gasket seal.
2. Charcoal Services Corp.
3. AAF/Snyder General, 6119 Series.

B. Filter Train Assembly

1. Arrangement: Provide two 1 high x 1 wide filter housing assemblies with side access doors on the left side of one and the right side of the other looking in direction of air flow. The housing configuration with housings assembled in direction of air flow is as follows; 12-in. round isolation damper in the horizontal direction, transition section, HEPA filter section for gasket type 24-in. x 24-in. x 11-1/2-in. HEPA filter, transition section, and 12-in. round isolation damper in the horizontal direction. The filter train assembly shall be built up of factory leak tested subsection housings that are no larger than 1 high x 1 wide. Weld joints airtight and conform to standard welding procedures per ASME AG-1.

C. Containment Housing (for HEPA filters)

1. Construction: Construct housing from Type 304 and 304L stainless steel with a 2B mill finish. Provide housing with 100% seam-welds in accordance with ASME AG-1, Article HA-4300 on joints across the pressure boundaries and reinforce to withstand an 18 in. w.g. positive or negative pressure normal operating pressure. Wire brush and clean welds to remove discoloration and weld splatter. Joints and seams which are part of the filter sealing surface, flange connections and bag-out rings shall be ground smooth and free of burrs and sharp edges. Factory weld housings, transitions, base, and lifting lugs to form one unit. Provide type 300 series stainless steel miscellaneous mechanical components. Manufacture housings in accordance with ASME AG-1, Section HA.

2. Access Doors: Provide removable, separate, access doors for each tier of filters. Use solid silicone or neoprene gaskets that seal the door to the housing wall while maintaining clearance between the bag-out flange and the inside door surface. Door gasket shall be a molded gasket fitted to the door. Use door gasket material of extra firm (21-29 PSI by compression/deflection) density closed cell silicone sponge conforming to MIL-R-46089 with skin surface finish or ASTM D1056 grade 2C3, 2C4 or 30-40 Shore-A-durometer neoprene. Provide stainless steel door latches that pivot away after release and remain attached to the housing or door. Use 300 series stainless steel bolts with nuts made from a precipitation hardening (PPH) grade of stainless steel, treated substantially harder than the bolt. Metal pockets for instruction manuals are optional.

3. Smooth Inlet Design: On the upstream side of each filter position, provide a smooth inlet design with a minimum 3/4 in. deep recess around the upstream perimeter of the filter to limit the buildup of contaminants in crevices or filter frames.

4. Filter Locking Mechanism: Provide a filter locking mechanism with a replaceable locking tray in the HEPA housing having a total clamping load of about 1400 lbs. per 24 in. by 24 in. HEPA filter (per ERDA 76-21 4.3.4).

5. Filter Removal Rod: Provide housings with two or more filters per access door with a replaceable removal rod to draw the filters to the change out position.

6. Bag In/Out: Provide each filter access door with a bag-out port inside the access door which is hemmed on its outer edges to prevent tearing of the bag. Provide two continuous ribs on the outside of the port to hold the bag's elastic shock cord and the safety strap during the bag-out operation. The turned edge on the port is not considered a rib. Provide each housing with two, 8 mil, transparent PVC glove bags for each bag-out port. Incorporate mittens into the bag. Provide bag with stock number rolled into the hem for easy identification when reordering. Provide bag with a smooth finish to prevent from sticking to itself and provide a nylon safety strap with each bag-out port to prevent the bag from slipping off during the bag-out procedure. Provide a cinching strap with each bag-out port to tie off the slack in the bag while the exhaust system is operating. Provide a banding kit to facilitate in the secure clamping off of the bag between the housing and the spent filter.

7. Filter Removal Tray: Provide one filter removal tray for each size of HEPA filter to aid in the change-out operation.

8. Filter Gasket Type – The filter gasket sealing area in the filter housing must be compliant with the type of filter chosen in Section 23 4133, "High-Efficiency Particulate Filtration."

D. Acceptance Testing: Acceptance testing shall be conducted in accordance with ASME AG-1, Section TA-4600 "Moisture Separator, Prefilter, HEPA filter Bank Acceptance tests and Table TA-4610.

E. Visual Inspection.

1. Perform a Visual Inspection in accordance with ASME AG-1, Sections HA 5200 and TA-4620. Submit Visual Inspection procedures and reports.

F. System Functional Tests: Perform system functional tests in accordance with ASME AG-1, Sections TA-4630 and TA-4640. Submit System Functional test procedures and reports.

G. Structural Capability Test:

1. Perform a Structural Capability test in accordance with ASME AG-1, Sections HA-5500 and TA-4331 on the completed filter train prior to the final pressure decay leak test. Submit certifications of the Structural Capability test.

H. Pressure Decay Leak Test:

1. Factory leak test each housing and completed filter train assembly by the pressure decay method to minus 20 in. w.g. in accordance with ASME AG-1, Sections HA-5300 and TA-4332. Leak test to acceptance criteria of a maximum of 0.2 percent of housing volume per hour at design pressure. Rectify and retest any deficiency and work affected by such deficiency. Submit certifications of leak test.

I. Air Flow testing

1. Factory shall perform air flow distribution testing in accordance with ASME AG-1, Sections HA-5600, TA-4632 and Mandatory Appendix TA-IV. Submit certifications for Air flow distribution testing.

2. Factory shall perform Air-Aerosol mixing uniformity tests in accordance with ASME AG-1, Sections HA-5700, TA-4633, and Mandatory Appendix TA-V. Manufacturer may submit previously approved uniformity tests for similar installations. Submit certifications for Air-Aerosol mixing uniformity tests.

3. Factory shall perform sampling manifold testing in accordance with ASME AG-1, Section HA-5800. Manufacturer may submit previously approved sampling manifold tests for similar installations. Submit certifications for sampling manifold tests.

J. Miscellaneous

1. Static-Pressure Ports: Locate static-pressure ports on the front or top of the housing upstream and downstream of each filter bank. Provide 1/4-in. NPT ports with cap, type 304 stainless steel.

2. Quality Assurance: Comply with ASME NQA-1.

3. Lifting Lugs: Provide Type 304 or Type 304L stainless steel lifting lugs with a 2 in. diameter lifting eye.

4. Custom-Engraved Plates: Include plates with the housing model number, and the original order number with minimum 1/8 in. letter height. Fabricate custom-engraved plates from polished stainless steel and permanently weld to the housing. Nameplates shall comply with ASME AG-1, Section HA-9000 and AA-9120.

5. Seismic Qualification: in accordance with Section 22 0548, "Vibration and Seismic Controls for Plumbing, Piping and Equipment."

6. Transition to Ductwork: Provide inlet and outlet transitions welded or bolted to the housing with a 2 in. x 2 in. x 3/16 in. minimum x angle ring flange with predrilled mounting holes and shipped with gaskets. If the

transition is bolted, the spacing shall be the manufacturer's standard bolt-hole pattern, not to exceed 4 in. between bolt holes on center. Transition to be capable of withstanding up to 15 in. w.g. positive pressure and 25-in. w.g. negative pressure. Provide gasket materials of closed cell neoprene, 1/4 in. thick, ASTM D1056 Specification for Flexible Cellular Materials - Sponge or Expanded Rubber, EPDM or neoprene Grade 2C3, 2C4 or 30-40 Shore-A-durometer.

7. Drains: Each filter housing shall be provided with 1-in. Type 304 or type 304L stainless steel drain, piped to a plugged ball valve.

8. Provide nameplate in accordance with ASME AG-1, Article HA-9000.

2.3 FILTER HOUSINGS (FOR ROTARY FILTER DRUMING ENCLOSURE)

A. Manufacturer

1. Flanders/CSC, GRF1-G-304 housing, gasket seal.

B. Filter Train Assembly

1. Arrangement: Provide one filter housing assembly, with access door. The housing configuration with housings assembled in direction of air flow is as follows; 3-in. round isolation damper in the vertical direction, HEPA filter housing, and 3-in. round isolation damper in the vertical direction. .

C. Containment Housing (for HEPA filter)

1. Construction: Construct housing from Type 304 and 304L stainless steel with a 2B mill finish. Provide housing with 100% seam-welds in accordance with ASME AG-1, Article HA-4300 on joints across the pressure boundaries and reinforce to withstand an 18 in. w.g. positive or negative pressure normal operating pressure. Wire brush and clean welds to remove discoloration and weld splatter. Joints and seams which are part of the filter sealing surface, flange connections and bag-out rings shall be ground smooth and free of burrs and sharp edges. Factory weld housings, transitions, base, and lifting lugs to form one unit. Provide type 300 series stainless steel miscellaneous mechanical components. Manufacture housings in accordance with ASME AG-1, Section HA.

2. Access Door: Provide removable access door. Use solid silicone or neoprene gaskets that seal the door to the housing wall while maintaining clearance between the bag-out flange and the inside door surface. Door gasket shall be a molded gasket fitted to the door. Use door gasket material of extra firm (21-29 PSI by compression/deflection) density closed cell silicone sponge conforming to MIL-R-46089 with skin surface finish or ASTM D1056 grade 2C3, 2C4 or 30-40 Shore-A-durometer neoprene. Provide stainless steel door latches that pivot away after release and remain attached to the housing or door. Use 300 series stainless steel bolts with nuts made from a precipitation hardening (PPH) grade of stainless steel, treated substantially harder than the bolt. Metal pockets for instruction manuals are optional.

3. Baffle Plate Design: Provide a permanently welded 300 series stainless steel baffle plate. The plate shall divert the air entering the housing twice before reaching the filter element, creating a turbulent mixture suitable for in-place testing.

4. Filter Locking Mechanism: Provide a spring loaded filter sealing clamp. The filter sealing clamp shall be designed to operate through the change-out bag and shall have a positive stop in the sealed position. The clamps shall be constructed of 300 series stainless steel.

5. Bag In/Out: Provide each filter access door with a bag-out port inside the access door which is hemmed on its outer edges to prevent tearing of the bag. Provide two continuous ribs on the outside of the port to hold the bag's elastic shock cord and the safety strap during the bag-out operation. The turned edge on the port is not considered a rib. Provide each housing with two, 8 mil, transparent PVC glove bags for each bag-out port. Incorporate mittens into the bag. Provide bag with stock number rolled into the hem for easy identification when reordering. Provide bag with a smooth finish to prevent from sticking to itself and provide a nylon safety strap with each bag-out port to prevent the bag from slipping off during the bag-out procedure. Provide a cinching strap with each bag-out port to tie off the slack in the bag while the exhaust system is operating. Provide a banding kit to facilitate in the secure clamping off of the bag between the housing and the spent filter.

6. Filter Gasket Type – The filter gasket sealing area in the filter housing must be compliant with the type of filter chosen in Section 23 4133, "High-Efficiency Particulate Filtration."

D. Acceptance Testing: Acceptance testing shall be conducted in accordance with ASME AG-1, Section TA-4600 "Moisture Separator, Prefilter, HEPA filter Bank Acceptance tests and Table TA-4610.

E. Visual Inspection.

1. Perform a Visual Inspection in accordance with ASME AG-1, Sections HA 5200 and TA-4620. Submit Visual Inspection procedures and reports.

F. System Functional Tests: Perform system functional tests in accordance with ASME AG-1, Sections TA-4630 and TA-4640. Submit System Functional test procedures and reports.

G. Structural Capability Test:

1. Perform a Structural Capability test in accordance with ASME AG-1, Sections HA-5500 and TA-4331 on the completed filter train prior to the final pressure decay leak test. Submit certifications of the Structural Capability test.

H. Pressure Decay Leak Test:

1. Factory leak test housing and the completed filter train assembly by the pressure decay method to minus 20 in. w.g. in accordance with ASME AG-1, Sections HA-5300 and TA-4332. Leak test to acceptance criteria of a maximum of 0.2 percent of housing volume per hour at design pressure. Rectify and retest any deficiency and work affected by such deficiency. Submit certifications of leak test.

I. Air Flow Testing

1. Factory shall perform air flow distribution testing in accordance with ASME AG-1, Sections HA-5600, TA-4632 and Mandatory Appendix TA-IV. Submit certifications for Air flow distribution testing.

2. Factory shall perform Air-Aerosol mixing uniformity tests in accordance with ASME AG-1, Sections HA-5700, TA-4633, and Mandatory Appendix TA-V. Manufacturer may submit previously approved uniformity tests for similar installations. Submit certifications for Air-Aerosol mixing uniformity tests.

3. Factory shall perform sampling manifold testing in accordance with ASME AG-1, Section HA-5800. Manufacturer may submit previously approved sampling manifold tests for similar installations. Submit certifications for sampling manifold tests.

J. Miscellaneous

1. Static-Pressure Ports: Locate static-pressure ports on the side of the housing upstream and downstream of each filter bank. Provide 1/4-in. NPT ports with cap, type 304 stainless steel.

2. Quality Assurance: Comply with ASME NQA-1.

3. Custom-Engraved Plates: Include plates with the housing model number, and the original order number with minimum 1/8 in. letter height. Fabricate custom-engraved plates from polished stainless steel and permanently weld to the housing. Nameplates shall comply with ASME AG-1, Section HA-9000 and AA-9120.

4. Seismic Qualification: in accordance with Section 22 0548, "Vibration and Seismic Controls for Plumbing, Piping and Equipment."

5. Connections: Provide inlet and outlet transitions welded or bolted to the housing with a 2 in. x 2 in. x 3/16 in. minimum x angle ring flange with predrilled mounting holes and shipped with gaskets. If the transition is bolted, the spacing shall be the manufacturer's standard bolt-hole pattern, not to exceed 4 in. between bolt holes on center. Transition to be capable of withstanding up to 15 in. w.g. positive pressure and 25-in. w.g. negative pressure. Provide gasket materials of closed cell neoprene, 1/4 in. thick, ASTM D1056 Specification for Flexible Cellular Materials - Sponge or Expanded Rubber, EPDM or neoprene Grade 2C3, 2C4 or 30-40 Shore-A-durometer.

6. Drains: Each filter housing shall be provided with 1/2-in. Type 304 or type 304L stainless steel drain, piped to a plugged ball valve.

7. Provide nameplate in accordance with ASME AG-1, Article HA-9000.

PART 3 EXECUTION

3.1 EXAMINATION

A. Field Conditions: Examine areas and conditions under which air filters and filter housings will be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION

A. Filter Housing: Install per manufacturer's instructions and as indicated on the Drawings.

B. Filters: Install in accordance with manufacturer's instructions and recognized industry practices. LANL will furnish, test, and install HEPA filters.

C. Fan Operation: Do not operate fan system until filters are in place. Replace temporary filters used during construction.

D. Integrated Structural Capability Testing, Leak Testing, and Integrated System Test will be performed following system installation in accordance with Section 23 3100, "HVAC Duct and Casings."

END OF SECTION

FOR LANL USE ONLY

This project specification is based on LANL Master Specification 23 3225, Rev. 2, dated November 3, 2011.

SECTION 23 3300

AIR DUCT ACCESSORIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Backdraft and pressure relief dampers.

B. Manual volume (balancing) dampers.

C. Control dampers.

D. Flange connectors.

E. Duct-mounted access doors.

F. Duct accessory hardware.

1.2 RELATED SECTIONS

A. Section 01 2500, "Substitution Procedures."

B. Section 01 4000, "Quality Requirements."

C. Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

D. Section 25 5000, "Integrated Automated Facility Controls."

E. Section 26 0700, "Induction Motors – 500HP and Smaller."

1.3 ABBREVIATIONS AND ACRONYMS, DEFINITIONS, AND REFERENCES

A. Refer to Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

1.4 SUBMITTALS

Submit the following in accordance with the requirements of Exhibit I:

A. Product data including materials, dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and applicable electrical characteristics and wiring diagrams. Submit the following as applicable:

1. Leakage, pressure drop, maximum operating pressure and velocity, and maximum back pressure data.

2. Damper pressure drop ratings based on tests and procedures performed in accordance with AMCA 500-D or AMCA 510 for custom design, heavy duty or severe service dampers.

B. Shop drawings for shop fabricated assemblies duct accessories: Include dimensions, weights, loads, and required clearances; fire and smoke damper installation including sleeves, and method of field assembly into duct systems and other construction.

C. Damper Schedule: Include as applicable damper identification number, damper type, damper size, damper orientation, airflow, pressure rating, leakage rating, fire rating, smoke rating, actuator type, manufacturer, and model number.

D. Manufacturer's Installation Instructions: Submit for Fire and Combination Smoke and Fire Dampers.

E. Certification showing conformance with the applicable standards for duct accessories materials, brazing materials, mill-rolled reinforcing and supporting materials, welding procedures, shop test procedures and reports.

F. Certification of welders and qualified welding procedure for off-site welding.

G. Manual Control Valve Dampers:

1. Visual Inspection.

a. Perform a Visual Inspection in accordance with ASME AG-1, Section DA-5200 and Section TA-4220. Submit Visual Inspection procedures and reports.

2. Structural Capability Test:

a. Perform a Structural Capability test in accordance with ASME AG-1, Section DA-5500, Section TA-4231, and Section TA-4232, on the completed damper frame and blade prior to the final pressure decay leak test. Submit certifications of the Structural Capability test.

3. Pressure Decay Leak Test:

a. Factory leak test each completed damper assembly to minus 20 in. w.g. in accordance with ASME AG-1, Section DA-5130, Section DA-5141, Section TA-4233, Section TA-4234, and Section TA-4235. Frame leak test acceptance criteria, damper shall be leakage class (zero leakage) and seat leakage acceptance criteria shall be Leakage Class II at design pressure in accordance with ASME AG-1, Appendix DA-I. Rectify and retest any deficiency and work affected by such deficiency.

4. Submit Seat leakage, frame leakage, and pressure drop ratings in accordance with ASME AG-1, Section DA-4130.

5. Submit documentation required by ASME AG-1, Subsection DA-4212.2.

6. Submit certifications of materials in accordance with ASME AG-1, Section DA 3300.

H. Automatic Isolation Dampers

1. Visual Inspection.

a. Perform a Visual Inspection in accordance with ASME AG-1, Section DA-5200 and Section TA-4220. Submit Visual Inspection procedures and reports.

2. Structural Capability Test:

a. Perform a Structural Capability test in accordance with ASME AG-1, Section DA-5500, Section TA-4231, and Section TA-4232, on the completed damper frame and blade prior to the final pressure decay leak test. Submit certifications of the Structural Capability test.

3. Pressure Decay Leak Test:

   a. Factory leak test each completed damper assembly to minus 20 in. w.g. in accordance with ASME AG-1, Section DA-5130, Section DA-5141, Section TA-4233, Section TA-4234, and Section TA-4235. Frame leak test acceptance criteria, damper shall be leakage class (zero leakage) and seat leakage acceptance criteria shall be Leakage Class II at design pressure in accordance with ASME AG-1, Appendix DA-I. Rectify and retest any deficiency and work affected by such deficiency.

4. Submit Seat leakage, frame leakage, and pressure drop ratings in accordance with ASME AG-1, Section DA-4130.

5. Submit documentation required by ASME AG-1, Subsection DA-4212.2.

6. Submit certifications of materials in accordance with ASME AG-1, Section DA-3300.

1.5 QUALITY ASSURANCE

A. Work identified in this section shall be done under a Quality Assurance program in accordance with Section 01 4000, "Quality Requirements."

B. Construct duct accessories in accordance with SMACNA - HVAC Duct Construction Standards - Metal and Flexible, NFPA 90A, NFPA 90B, and NFPA 92A.

C. Qualify welding processes and welding operators in accordance with AWS D9.1, "Sheet Metal Welding Code".

D. Dampers tested, rated and labeled in accordance with the latest UL requirements, and pressure drop ratings based on tests and procedures performed in accordance with AMCA 500-D or AMCA 510.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Package and ship ASME AG-1 dampers per the requirements of ASME AG-1, Article DA-7000, and in accordance with ASME NQA-2, Protection Level B.

B. Storage: Store materials in a dry area indoor, protected from damage.

C. Handling: Handle and lift dampers in accordance with manufacturer's instructions. Protect materials and finishes during handling and installation to prevent damage.

D. Protect dampers from damage to operating linkages and blades.

PART 2 PRODUCTS

2.1 PRODUCT OPTIONS AND SUBSTITUTIONS

A. Comply with Section 01 2500, "Substitution Procedures."

2.2 MATERIALS

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A653

1. Galvanized Coating Designation: G90 Zinc coating.
2. Exposed-Surface Finish: Mill phosphatized.

C. Stainless-Steel Sheets: Comply with ASTM A 167/A 167M, ASTM A 240/A 240M, or ASTM A 480/A 480M, Type 304 or 304L, and having a No. 2 finish for concealed ducts and 2B finish for exposed ducts.

D. Reinforcement Shapes and Plates:

1. Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials carbon steel bars and shapes meeting the requirements of ASTM A 36/A 36, galvanized in accordance with ASTM A 123, G90 coating, or galvanized sheet steel meeting the requirements of ASTM A 653/A 653M G90 coating.
2. Stainless-steel reinforcement where installed on stainless-steel; Stainless steel bars and shapes meeting the requirements of ASTM A276 Type 304 or 304L, and sheet meeting the requirements of ASTM A 167/A 167M, ASTM A 240/A 240M, or ASTM A 480/A 480M, Type 304 or 304L.

E. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.3 MANUAL VOLUME DAMPERS (SUPPLY, RETURN, AND NON-PROCESS EXHAUST SYSTEM)

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Air Balance Inc.; a division of Mestek, Inc.
2. American Warming and Ventilating; a division of Mestek, Inc.
3. Flexmaster U.S.A., Inc.
4. McGill AirFlow LLC.
5. METALAIRE, Inc.
6. Nailor Industries Inc.
7. Pottorff; a division of PCI Industries, Inc.
8. Ruskin Company.
9. Trox USA Inc.
10. Vent Products Company, Inc.

B. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.

C. Suitable for horizontal or vertical applications.

D. Frames:

1. Channel shaped.
2. Galvanized, 0.064 inch (1.62 mm) thick.
3. Mitered and welded corners.
4. Flanges for attaching to walls and flangeless frames for installing in ducts.

E. Blades:

1. Multiple or single blade.
2. Parallel- or opposed-blade design.
3. Stiffen damper blades for stability.

4. Galvanized, roll-formed steel, 0.064 inch (1.62 mm) thick.

F. Blade Axles: Nonferrous metal.

G. Bearings:

1. Molded synthetic.

2. Dampers in ducts with pressure classes of 3-inch w.g. (750 Pa) or less shall have axles full length of damper blades and bearings at both ends of operating shaft.

H. Blade Seals: Neoprene.

I. Jamb Seals: Cambered stainless steel.

J. Tie Bars and Brackets: Galvanized steel.

K. Accessories:

1. Include locking device to hold single-blade dampers in a fixed position without vibration.

2.4 MANUAL VOLUME CONTROL DAMPERS (PROCESS EXHAUST SYSTEM)

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. American Warming and Ventilating; a division of Mestek, Inc.
2. Flanders-CSC
3. Greenheck Fan Corporation.
4. Ruskin Company.

B. Dampers shall meet the requirements of ASME AG-1, Section DA. "Dampers and Louvers." Frame Leakage class (zero leakage) and blade leakage class II (moderate leakage) rating in accordance with ASME AG-1, Appendix DA-I, with linkage outside the airstream and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.

C. Dampers shall be designed for a minimum pressure of minus 30-in w.g.

D. Frames: Steel Channel, material shall be stainless steel Type 304 or 304L and be listed in ASME AG-1, Table DA-3110.

E. Blades: Fabricated of the same material as the frame, minimum 1/4-in. thick.

F. Bearings: Grease lubricated ball bearings mounted outboard of the damper frame.

G. Shaft: Continuous, stainless steel.

H. Shaft seals: external adjustable double packing gland shaft seal.

I. Provide with lockable hand quadrant.

2.5 AUTOMATIC VOLUME CONTROL DAMPERS (PROCESS EXHAUST SYSTEM)

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. American Warming and Ventilating; a division of Mestek, Inc.
2. Flanders-CSC

3. Greenheck Fan Corporation.
4. Ruskin Company.

B. Dampers shall meet the requirements of ASME AG-1, Section DA, "Dampers and Louvers." Frame Leakage class (zero leakage) and blade leakage class II (moderate leakage) rating in accordance with ASME AG-1, Appendix DA-I, with linkage outside the airstream and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.

C. Dampers shall be designed for a minimum pressure of minus 30-in w.g.

D. Frames: Steel Channel, material shall be stainless steel Type 304 or 304L and be listed in ASME AG-1, Table DA-3110.

E. Blades: Fabricated of the same material as the frame, minimum 1/4-in. thick.

F. Bearings: Grease lubricated ball bearings mounted outboard of the damper frame.

G. Shaft: Continuous, stainless steel.

H. Shaft seals: external adjustable double packing gland shaft seal.

I. Damper Motors: Modulating action, fail in last position.

J. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 26 0700, "Induction Motors – 500HP and Smaller."

1. Motor Sizes: Large enough so driven load will not require motor to operate in service factor range above 1.0.

2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Section 25 5000, "Integrated Automated Facility Controls."

3. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.

4. Electrical Connection: 115 V, single phase, 60 Hz.

5. Manual override.

2.6 AUTOMATIC ISOLATION DAMPERS (PROCESS EXHAUST SYSTEM)

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. American Warming and Ventilating; a division of Mestek, Inc.
2. Flanders-CSC
3. Greenheck Fan Corporation.
4. Ruskin Company.

B. Dampers shall meet the requirements of ASME AG-1, Section DA, "Dampers and Louvers." Frame Leakage class (zero leakage) and blade leakage class (zero leakage) rating in accordance with ASME AG-1, Appendix DA-I, with linkage outside the airstream and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.

C. Dampers shall be designed for a minimum pressure of minus 30-in w.g and plus 30-in. w.g.

D. Frames: Steel Channel, material shall be stainless steel Type 304 or 304L and be listed in ASME AG-1, Table DA-3110.

E. Blades: Fabricated of the same material as the frame, minimum 1/4-in. thick.

F. Bearings: Grease lubricated ball bearings mounted outboard of the damper frame.

G. Shaft: Continuous, stainless steel.

H. Shaft seals: external adjustable double packing gland shaft seal.

I. Damper Motors: Two-Position, fail closed.

J. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 26 0700, "Induction Motors – 500HP and Smaller."

1. Motor Sizes: Large enough so driven load will not require motor to operate in service factor range above 1.0.
2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Section 25 5000, "Integrated Automated Facility Controls."
3. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
4. Electrical Connection: 115 V, single phase, 60 Hz.
5. Spring Return or battery backup.
6. NEMA 4 enclosure.
7. Manual override.

K. Visual Inspection.

1. Perform a Visual Inspection in accordance with ASME AG-1, Section DA-5200 and Section TA-4220. Submit Visual Inspection procedures and reports.

L. Structural Capability Test:

1. Perform a Structural Capability test in accordance with ASME AG-1, Section DA-5500, Section TA-4231, and Section TA-4232, on the completed damper frame and blade prior to the final pressure decay leak test. Submit certifications of the Structural Capability test.

M. Pressure Decay Leak Test:

1. Factory leak test each completed damper assembly to minus 20 in. w.g. in accordance with ASME AG-1, Section DA-5130, Section DA-5141, Section TA-4233, Section TA-4234, and Section TA-4235. Frame and seat leak test acceptance criteria, damper shall be leakage class (zero leakage) at design pressure in accordance with ASME AG-1, Appendix DA-I. Rectify and retest any deficiency and work affected by such deficiency.

N. Submit Seat leakage, frame leakage, and pressure drop ratings in accordance with ASME AG-1, Section DA-4130.

O. Submit documentation required by ASME AG-1, Subsection DA-4212.2.

P. Submit certifications of materials in accordance with ASME AG-1, Section DA-3300.

2.7 FLANGE CONNECTORS (SUPPLY, RETURN AND RESTROOM EXHAUST SYSTEM)

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Ductmate Industries, Inc.
2. Nexus PDQ; Division of Shilco Holdings Inc.
3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Description: Add-on or roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.

C. Material: Galvanized steel.

D. Gauge and Shape: Match connecting ductwork.

2.8 DUCT-MOUNTED ACCESS DOORS

A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, Figure 7-2, "Duct Access Doors and Panels" and Figure 7-3, "Access Doors - Round Duct." Fabricate doors airtight and suitable for duct pressure class.

B. Frame: Minimum 22 gauge galvanized sheet steel, with bend-over installation tabs and foam gaskets.

C. Door: Double wall, galvanized sheet steel and thickness as indicated for duct pressure class, with sealing gaskets and quick fastening locking devices.

1. Hinges and Latches: 1" x 1" butt or continuous piano hinge and cam latches.

2. Insulation: For insulated ductwork, furnish with minimum 1 inch thick fiberglass insulation.

D. Number of Hinges and Locks:

1. Less than 12 inches square: Secure with sash locks.

2. Up to 18 inches Square: Furnish two hinges and two sash locks.

3. Up to 24 x 48 inches: Three hinges and two compression latches with outside and inside handles.

4. Larger Sizes: Four hinges and two compression latches with outside and inside handles.

5. Access panels with sheet metal screw fasteners are not acceptable.

2.9 DUCT ACCESSORY HARDWARE

A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.

B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify ducts and equipment installations are ready for accessories.

B. Verify rated walls are ready for fire damper installation.

C. Verify duct access door location prior to fabrication.

3.2 INSTALLATION

A. Install duct accessories in accordance with NFPA 90A and NFPA 92A, and in accordance with manufacturer's installation instructions at the locations shown on the drawings. Follow SMACNA HVAC Duct Construction Standards-Metal and Flexible for duct construction and pressure class.

B. Install duct accessories of materials suited to duct materials or as described in PART 2 of this section:

1. Use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts.
2. Stainless-steel accessories in stainless-steel ducts.

C. Install backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan and where indicated on drawings.

D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.

1. To minimize duct noise generated by volume dampers, SMACNA recommends locating dampers at least two duct diameters from fittings and as far away as possible from outlets.
2. Install galvanized steel volume dampers in galvanized steel ducts.
3. Install stainless steel volume dampers in stainless steel ducts.

E. Set dampers to fully open position before testing, adjusting, and balancing.

F. Install test holes at fan inlets and outlets and elsewhere as indicated.

G. Install flexible connectors to connect ducts to equipment.

H. For fans developing static pressures of 5-inch w.g. (1250 Pa) and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

I. Connect terminal units to supply ducts directly.

J. Connect flexible ducts to metal ducts with adhesive plus sheet metal screws.

K. Install duct test holes where required for testing and balancing purposes.

L. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch (6-mm) movement during start and stop of fans.

M. Install duct access doors for inspection and cleaning upstream of equipment as indicated on drawings. Access doors shall be accessibly located. Provide minimum 8 X 8 inch size for hand access, 18 X 18 inch size or 18 inch x the duct height/width less 2 inches for shoulder access. Install duct access door at the following locations in the supply duct:

1. Downstream of each CAV box.

2. At each change in main duct direction greater than 45° and at maximum spacing of every 50 feet of straight duct.

3.3 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Operate dampers to verify full range of movement.

2. Inspect locations of access doors and verify that purpose of access door can be performed.

END OF SECTION

FOR LANL USE ONLY

This project specification is based on LANL Master Specification 23 3300, Rev. 0, dated June 1, 2010.

SECTION 23 3400

HVAC FANS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Centrifugal fans.

1.2 PERFORMANCE REQUIREMENTS

A. AMCA Compliance: Comply with AMCA performance requirements and bear the AMCA-Certified Ratings Seal.

B. HVAC fans and associated motors shall perform satisfactorily in the following service conditions:

1. Elevation: 7,500 feet above sea level.
2. Maximum ambient temperature: 104 degrees F.
3. Minimum ambient temperature: Minus 20 degrees F.
4. 24-hour average temperature: not exceeding 86 degrees F.
5. Fan load shall not exceed the altitude and temperature de-rated capacity of the motor. (Refer to Table 5020-4 in ESM Chapter 7, Section D5020.)
6. Maximum solar heat gain: 110 W/sq ft.

C. Seismic Protection and Performance: The seismic protection and performance of HVAC fans shall be in accordance with Section 22 0548, "Vibration and Seismic Controls for Plumbing Piping and Equipment."

D. Delegated Design: Design vibration isolation and seismic-restraint details, including comprehensive engineering analysis by a professional engineer licensed in the State of NM, using performance requirements and design criteria indicated.

1.3 RELATED SECTIONS

A. Section 01 4000, "Quality Requirements."

B. Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

C. Section 03 3053, "Miscellaneous Cast-in-Place Concrete."

D. Section 22 0548, "Vibration and Seismic Controls for Plumbing, Piping and Equipment."

E. Section 22 0554, "Identification for Plumbing, HVAC, and Fire Piping and Equipment."

F. Section 23 3300, "Air Duct Accessories."

G. Section 26 0519, "Low Voltage Electrical Power Conductors and Cables."

H. Section 26 0526, "Grounding and Bonding for Electrical Systems."

I. Section 26 0700, "Induction Motors – 500HP and Smaller."

1.4 ABBREVIATIONS AND ACRONYMS, DEFINITIONS, AND REFERENCES

A. Refer to Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

1.5 SUBMITTALS

Submit the following in accordance with the requirements of Exhibit I:

A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated.

1. Certified fan performance curves with system operating conditions indicated.

2. Certified fan sound-power ratings.

3. Motor ratings and electrical characteristics, plus motor and electrical accessories.

4. Material thickness and finishes, including color charts

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.

2. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, and base weights.

C. Field quality-control test reports.

D. Factory test reports.

E. Certification of Materials.

F. Operation and maintenance data.

1.6 QUALITY ASSURANCE

A. Work identified in this section shall be done under a Quality Assurance program in accordance with Section 01 4000, "Quality Requirements."

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Performance Ratings: Conform to AMCA 210 and bear AMCA Certified Rating Seal.

D. Sound Ratings: AMCA 301, tested to AMCA 300, and bear AMCA Certified Sound Rating Seal.

E. UL Compliance: UL listed and labeled, designed, manufactured, and tested in accordance with UL 705.

F. Balance Quality: Conform to AMCA 204.

G. NEMA Compliance: Motors and electrical accessories shall comply with NEMA MG-1.

1.7 INSPECTIONS AND TESTS (FE-5309 AND FE-5310 ONLY)

A. Inspection and testing of fans shall be in accordance with the requirements of ASME AG-1, Article BA-5000, except seismic testing is not required.

B. All fans with motors and drives mounted by the manufacturer shall be completely assembled and test run as a unit at the specified operating speed prior to shipment.

C. Each wheel shall be statically and dynamically balanced in accordance with ASME AG-1 Section BA-4160 and Table BA-4162 or ANSI/AMCA 204-96 "Balance Quality and Vibration Levels for Fans" to Fan Application Category BV-3, Balance Quality Grade G6.3 whichever is most stringent..

D. Balance readings shall be taken by electronic-type equipment in the axial, vertical, and horizontal directions on each of the bearings.

E. Submit test results and reports.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Store materials in a dry area indoors, protected from damage and in accordance with manufacturer's instructions.

B. Package and ship ASME AG-1 exhaust fans per the requirements of ASME AG-1 Article BA-7000 and in accordance with ASME NQA-2, Protection Level C. Storage shall be in accordance with ASME NQA-2, Storage Level 2.

1.9 WARRANTY

A. The equipment manufacturer shall provide, at no additional cost, a standard parts warranty that covers a period of one year from unit start-up or 18 months from shipment, whichever occurs first.

1.10 EXTRA MATERIALS

A. Furnish two sets of belts for each belt driven fans.

PART 2 PRODUCTS

2.1 AIRFOIL CENTRIFUGAL FANS (FE-5309 AND FE-5310)

A. Basis-of-Design Product: Subject to compliance with requirements including all ASME AG-1 requirements identified herein, provide the product indicated on Drawings or a comparable product.

B. Description: Factory-fabricated, -assembled, -tested, and -finished, belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor, drive assembly, and support structure.

C. Materials: Carbon steel coated with manufacturer's standard protective coating rated for outdoor use. Materials shall meet the Requirements of ASME AG-1 Article BA-3000. Submit Certification of materials.

D. Housings: Formed panels to make curved-scroll housings with shaped cutoff; with doors or panels to allow access to internal parts and components. Housing shall be continuously welded.

1. Panel Bracing: Steel angle- or channel-iron member supports for mounting and supporting fan scroll, wheel, motor, and accessories.
2. Spun inlet cone with flange.
3. Outlet flange.

E. Airfoil Wheels:

1. Single-width-single-inlet construction with curved inlet flange.
2. Heavy backplate.
3. Hollow die-formed, airfoil-shaped blades continuously welded at tip flange and backplate.
4. Cast-iron or cast-steel hub riveted to backplate and fastened to shaft with set screws.

F. Shafts: Statically and dynamically balanced and selected for continuous operation at maximum rated fan speed and motor horsepower, with final alignment and belt adjustment made after installation.

1. Turned, ground, and polished hot-rolled steel with keyway. Ship with a protective coating of lubricating oil.
2. Designed to operate at no more than 70 percent of first critical speed at top of fan's speed range.

G. Grease-Lubricated Shaft Bearings: Self-aligning, pillow-block-type, tapered roller bearings with double-locking collars and two-piece, cast-iron housing.

1. Ball-Bearing Rating Life: ABMA 9, L-10 at 200,000 hours.
2. Roller-Bearing Rating Life: ABMA 11, L-10 at 200,000 hours.
3. Provide extended lube lines.

H. Belt Drives: Factory mounted, with final alignment and belt adjustment made after installation.

1. Service Factor minimum 1.5 based on Fan Motor Size.
2. Fan Pulleys: Cast iron or cast steel with split, tapered-bushing; dynamically balanced at factory.
3. Motor Pulleys: Adjustable pitch for use with motors through 5 hp; fixed pitch for use with larger motors. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.
4. Belts: Oil resistant, nonsparking, and nonstatic; matched sets for multiple belt drives.
5. Belt Guards: Fabricate to comply with OSHA and SMACNA requirements of diamond-mesh wire screen welded to steel angle frame or equivalent, prime coated. Secure to fan or fan supports without short circuiting vibration isolation. Include provisions for adjustment of belt tension, lubrication, and use of tachometer with guard in place.
6. Motor Mount: Adjustable for belt tensioning.

I. Accessories:

1. Scroll Access Doors: Shaped to conform to scroll, bolted with gaskets.
2. Scroll Drain Connection: NPS 1-1/2" steel welded tank flange (FPT) to low point of fan scroll with plug.
3. Companion Flanges: Rolled flanges for duct connections of same material as housing.
4. Shaft Seals: Airtight seals installed around shaft on drive side of single-width fans.
5. Shaft guards.
6. Evase.

J. Motors: Comply with requirements in Section 26 0700, "Induction Motors – 500HP and Smaller."

1. Enclosure Type: Totally enclosed, fan cooled.
2. CSA Labeled.
3. Labeled for VFD use.
4. NEMA MG-1.
5. Premium Efficiency.

K. Structural Base: Free standing, isolated base, factory Mounted.

L. Vibration Isolators: Restrained seismic spring isolators having a static deflection of 2 inches.

2.2 CENTRIFUGAL WALL VENTILATORS (FE-5323)

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Acme Engineering & Manufacturing Corporation.
2. Aerovent; a division of Twin City Fan Companies, Ltd.
3. Carnes Company.
4. Greenheck Fan Corporation.
5. Hartzell Fan Incorporated.
6. JencoFan.
7. Loren Cook Company.
8. PennBarry.

B. Galvanized-steel and fiberglass housings are also available from some manufacturers.

1. Housing: Heavy-gage, removable, spun-aluminum, dome top and outlet baffle; venturi inlet cone.

C. Fan Wheel: Aluminum hub and wheel with backward-inclined blades.

D. Belt Drives:

1. Resiliently mounted to housing.
2. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
3. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.

4. Pulleys: Cast-iron, adjustable-pitch motor pulley.

5. Fan and motor isolated from exhaust airstream.

E. Accessories:

1. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through internal aluminum conduit.

2. Bird Screens: Removable, 1/2-inch (13-mm) mesh, aluminum or brass wire.

3. Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in wall sleeve; factory set to close when fan stops.

4. Capacities and Characteristics: As Scheduled on Drawings.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install centrifugal fans level and plumb.

B. Support floor-mounting units using restrained spring isolators having a static deflection of 2 inch. Vibration- and seismic-control devices are specified in Section 22 0548, "Vibration and Seismic Controls for Plumbing, Piping and Equipment."

1. Secure vibration and seismic controls to concrete bases using anchor bolts cast in concrete base or plate welded to embedment plates.

C. Install floor-mounting units on concrete bases designed to withstand, without damage to equipment, the seismic force required by authorities having jurisdiction. Concrete, reinforcement, and formwork requirements are specified in Section 03 3053, "Miscellaneous Cast-in-Place Concrete."

D. Install units with clearances for service and maintenance.

E. Label fans according to requirements specified in Section 22 0554, "Identification for Plumbing, HVAC, and Fire Piping and Equipment."

3.2 CONNECTIONS

A. Duct installation and connection requirements are specified in other Division 23 sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Section 23 3300, "Air Duct Accessories."

B. Install ducts adjacent to fans to allow service and maintenance.

C. Ground equipment according to Section 26 0526, "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Section 26 0519, "Low Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Verify that shipping, blocking, and bracing are removed.
2. Verify that unit is secure on mountings and supporting devices and that connection to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
3. Verify that cleaning and adjusting are complete.
4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
5. Adjust belt tension.
6. Adjust damper linkages for proper damper operation.
7. Verify lubrication for bearings and other moving parts.
8. Verify that manual and automatic volume control dampers in connected ductwork systems are in fully open position.
9. Remove and replace malfunctioning units and retest as specified above.

B. Replace damaged and malfunctioning controls and equipment.

C. Prepare test and inspection reports.

3.4 SCHEDULES

A. See Equipment Schedule on drawings.

END OF SECTION

FOR LANL USE ONLY

This project specification is based on LANL Master Specification 23 3400, Rev. 0, dated November 23, 2010.

SECTION 23 3600

AIR TERMINAL UNITS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Shutoff, single-duct air terminal units.

1.2 RELATED SECTIONS

A. Section 01 4000, "Quality Requirements."

B. Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

C. Section 22 0554, "Identification for Plumbing, HVAC, and Fire Piping and Equipment."

D. Section 23 2113, "Hydronic Piping."

E. Section 23 3101, "HVAC Ducts."

F. Section 23 3300, "Air Duct Accessories."

G. Section 25 5000, "Integrated Automated Facility Controls."

1.3 ABBREVIATIONS AND ACRONYMS, DEFINITIONS, AND REFERENCES

A. Refer to Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

1.4 LANL PERFORMANCE REQUIREMENTS

A. Structural Performance: Hangers and supports, and seismic restraints shall withstand the effects of gravity and seismic loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and ASCE/SEI 7 and DOE-STD-1020.

1.5 SUBMITTALS

Submit the following in accordance with the requirements of Exhibit I:

A. Product Data: For each type of the following products, including rated capacities, furnished specialties, sound-power ratings, and accessories.

1. Air terminal units.
2. Liners and adhesives.
3. Sealants and gaskets.
4. Seismic-restraint devices.

B. Shop Drawings: For air terminal units. Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Wiring Diagrams: For power, signal, and control wiring.
3. Hangers and supports, including methods for duct and building attachment, seismic restraints, and vibration isolation.

C. Operation and Maintenance Data: For air terminal units to include in emergency, operation, and maintenance manuals.

1. Instructions for resetting minimum and maximum air volumes.
2. Instructions for adjusting software set points.

1.6 QUALITY ASSURANCE

A. Work identified in this section shall be done under a Quality Assurance program in accordance with Section 01 4000, "Quality Requirements."

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2004, Section 5, "Systems and Equipment" and Section 7, "Construction and System Start-Up."

PART 2 PRODUCTS

2.1 SHUTOFF, SINGLE-DUCT AIR TERMINAL UNITS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Trane VCWF or comparable product by one of the following:

1. Anemostat Products; a Mestek Company.
2. Carnes.
3. Environmental Technologies, Inc.
4. Krueger.
5. METALAIRE, Inc.
6. Nailor Industries Inc.
7. Phoenix Controls Corporation.
8. Price Industries.
9. Titus.
10. Trane; a business of American Standard Companies.
11. Trox USA Inc.; a subsidiary of the TROX GROUP.
12. Tuttle & Bailey.
13. Warren Technology.

B. Configuration: Volume-damper assembly inside unit casing with control components inside a protective metal shroud.

C. Casing: 0.034-inch (0.85-mm) steel double wall.

1. Casing Lining: Adhesive attached, 1-inch- (25-mm-)] thick, coated, fibrous-glass duct liner complying with ASTM C 1071, and having a maximum flame-spread index of 25 and a maximum smoke-developed index of 50, for both insulation and adhesive, when tested according to ASTM E 84.

   a. Cover liner with nonporous foil and metal.

2. Air Inlet: Round or rectangular stub connection or S-slip and drive connections for duct attachment.

3. Air Outlet: S-slip and drive connections.

4. Access: Removable panels for access to parts requiring service, adjustment, or maintenance; with airtight gasket.

5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.

D. Volume Damper: Galvanized steel with peripheral gasket and self-lubricating bearings.

1. Maximum Damper Leakage: ARI 880 rated 1 percent of nominal airflow at 4-inch w.g. inlet static pressure.

2. Damper Position: Normally closed.

E. Attenuator Section: 0.034-inch (0.85-mm) steel sheet.

1. Lining: Adhesive attached, 1-inch- (25-mm-) thick, coated, fibrous-glass duct liner complying with ASTM C 1071, and having a maximum flame-spread index of 25 and a maximum smoke-developed index of 50, for both insulation and adhesive, when tested according to ASTM E 84.

a. Cover liner with nonporous foil and metal.

2. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.

F. Hydronic Coils: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch (2.5 mm), and rated for a minimum working pressure of 200 psig (1380 kPa) and a maximum entering-water temperature of 220 deg F (104 deg C). Include manual air vent and drain valve.

G. Direct Digital Controls: Bidirectional damper operators and microprocessor-based controller and room sensor. Control devices shall be compatible with temperature controls specified in Section 25 5000, "Integrated Automated Facility Controls," and shall have the following features:

1. Damper Actuator: 24 V, powered closed/powered open.

2. Terminal Unit Controller: Pressure-independent, variable-air-volume controller with electronic airflow transducer with multipoint velocity sensor at air inlet, factory calibrated to minimum and maximum air volumes, and having the following features:

a. Occupied and unoccupied operating mode.
b. Remote reset of airflow or temperature set points.
c. Adjusting and monitoring with portable terminal.
d. Communication with temperature-control system specified in Section 25 5000, "Integrated Automated Facility Controls."

3. Room Sensor: Wall mounted with temperature set-point adjustment and access for connection of portable operator terminal.

H. Control Sequence:

1. Suitable for operation with duct pressures between 0.25- and 3.0-inch w.g. (60- and 750-Pa) inlet static pressure.

2. System-powered, wall-mounted thermostat.

2.2 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

C. Steel Cables: Galvanized steel complying with ASTM A 603.

D. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

E. Air Terminal Unit Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

F. Trapeze and Riser Supports: Steel shapes and plates for units with steel casings; aluminum for units with aluminum casings.

2.3 SEISMIC-RESTRAINT DEVICES

A. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to authorities having jurisdiction.

1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.

B. Channel Support System: Shop- or field-fabricated support assembly made of slotted steel channels rated in tension, compression, and torsion forces and with accessories for attachment to braced component at one end and to building structure at the other end. Include matching components and corrosion-resistant coating.

C. Restraint Cables: ASTM A 603, galvanized steel cables with end connections made of cadmium-plated steel assemblies with brackets, swivel, and bolts designed for restraining cable service; with an automatic-locking and clamping device or double-cable clips.

D. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.

E. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.4 SOURCE QUALITY CONTROL

A. Factory Tests: Test assembled air terminal units according to ARI 880.

1. Label each air terminal unit with plan number, nominal airflow, maximum and minimum factory-set airflows, coil type, and ARI certification seal.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install air terminal units according to NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."

B. Install air terminal units level and plumb. Maintain sufficient clearance for normal service and maintenance.

C. Install wall-mounted thermostats.

3.2 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Where practical, install concrete inserts before placing concrete.
2. Do not use powder-actuated concrete fasteners for seismic restraints.

C. Hangers Exposed to View: Threaded rod and angle or channel supports.

D. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.3 SEISMIC-RESTRAINT-DEVICE INSTALLATION

A. Install hangers and braces designed to support the air terminal units and to restrain against seismic forces required by applicable building codes. Comply with ASCE/SEI 7 and DOE-STD-1020.

B. Select seismic-restraint devices with capacities adequate to carry present and future static and seismic loads.

C. Install cables so they do not bend across edges of adjacent equipment or building structure.

D. Install cable restraints on air terminal units that are suspended with vibration isolators.

E. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction.

F. Attachment to Structure: If specific attachment is not indicated, anchor bracing and restraints to structure, to flanges of beams, or to upper truss chords of bar joists.

3.4 CONNECTIONS

A. Install piping adjacent to air terminal unit to allow service and maintenance.

B. Hot-Water Piping: In addition to requirements in Section 23 2113, "Hydronic Piping," connect heating coils to supply with shutoff valve, strainer, flexible connection, and union or flange; and to return with union or flange, flexible connection, control valve, and balancing valve.

C. Connect ducts to air terminal units according to Section 23 3101, "HVAC Ducts."

3.5 IDENTIFICATION

A. Label each air terminal unit with plan number, nominal airflow, and maximum and minimum factory-set airflows. Comply with requirements in Section 22 0554, "Identification for Plumbing, HVAC, and Fire Piping and Equipment," for equipment labels and warning signs and labels.

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:

1. After installing air terminal units and after electrical circuitry has been energized, test for compliance with requirements.

2. Leak Test: After installation, fill water coils and test for leaks. Repair leaks and retest until no leaks exist.

3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Air terminal unit will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.7 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

2. Verify that inlet duct connections are as recommended by air terminal unit manufacturer to achieve proper performance.

3. Verify that controls and control enclosure are accessible.

4. Verify that control connections are complete.

5. Verify that nameplate and identification tag are visible.

6. Verify that controls respond to inputs as specified.

END OF SECTION

SECTION 23 3713

DIFFUSERS, REGISTERS, AND GRILLES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Rectangular and square ceiling diffusers.

B. Perforated diffusers.

C. Adjustable bar registers.

D. Security registers.

E. Fixed face registers and grilles.

1.2 RELATED SECTIONS

A. Section 01 2500, "Substitution Procedures."

B. Section 01 4000, "Quality Requirements."

C. Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

1.3 ABBREVIATIONS AND ACRONYMS, DEFINITIONS, AND REFERENCES

A. Refer to Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

1.4 SUBMITTALS

Submit the following in accordance with the requirements of Exhibit I:

A. Product Data: For each type of product indicated, include the following:

1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.

2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

B. Samples for Initial Selection: For diffusers, registers, and grilles with factory-applied color finishes.

C. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:

1. Ceiling suspension assembly members.

2. Method of attaching hangers to building structure.

3. Size and location of initial access modules for acoustical tile.

4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

5. Duct access panels.

D. Source quality-control reports.

1.5 QUALITY ASSURANCE AND QUALITY CONTROL

A. Work identified in this section shall be done under a Quality Assurance Program in accordance with Section 01 4000, "Quality Requirements."

PART 2 PRODUCTS

2.1 PRODUCT OPTIONS AND SUBSTITUTIONS

A. Comply with Section 01 2500, "Substitution Procedures."

2.2 CEILING DIFFUSERS

A. Rectangular and Square Ceiling Diffusers:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. A-J Manufacturing Co., Inc.
b. Anemostat Products; a Mestek company.
c. Carnes.
d. Hart & Cooley Inc.
e. Krueger.
f. METALAIRE, Inc.
g. Nailor Industries Inc.
h. Price Industries.
i. Titus.
j. Tuttle & Bailey.

2. Devices shall be specifically designed for variable-air-volume flows.

3. Material: Steel.

4. Finish: Baked enamel, white.

5. Face Size: 24 by 24 inches.

6. Face Style: Four-cone.

7. Mounting: Surface/duct.

8. Pattern: Adjustable.

B. Perforated Diffuser:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. Air Research Diffuser Products, Inc.
b. A-J Manufacturing Co., Inc.
c. Anemostat Products; a Mestek company.
d. Carnes.
e. Hart & Cooley Inc.
f. Krueger.
g. METALAIRE, Inc.
h. Nailor Industries Inc.
i. Price Industries.
j. Titus.

k. Tuttle & Bailey.
l. Warren Technology.

2. Devices shall be specifically designed for variable-air-volume flows.
3. Material: Steel backpan and pattern controllers, with steel face.
4. Finish: Baked enamel, white.
5. Module Size: Shown on Drawings.
6. Duct Inlet: Round.
7. Duct Inlet Size: Shown on Drawings.
8. Face Style: Flush.
9. Mounting: Surface mount.
10. Pattern Controller: Adjustable with louvered pattern modules at inlet.

C. Perforated Diffuser:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. Air Research Diffuser Products, Inc.
b. A-J Manufacturing Co., Inc.
c. Anemostat Products; a Mestek company.
d. Carnes.
e. Hart & Cooley Inc.
f. Krueger.
g. METALAIRE, Inc.
h. Nailor Industries Inc.
i. Price Industries.
j. Titus.
k. Tuttle & Bailey.
l. Warren Technology.

2. Devices shall be specifically designed for variable-air-volume flows.
3. Material: Steel backpan and pattern controllers, with steel face.
4. Finish: Baked enamel, color selected by Architect.
5. Face Size: 24 by 24 inches.
6. Duct Inlet: Round.
7. Duct Inlet Size: Shown on Drawings
8. Face Style: Flush.
9. Mounting: T-Bar Lay-In.
10. Pattern Controller: Adjustable with louvered pattern modules at inlet.

D. Perforated Diffuser (Low Velocity for Wet Chemistry Laboratory):

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

   a. Air Research Diffuser Products, Inc.
   b. A-J Manufacturing Co., Inc.
   c. Anemostat Products; a Mestek company.
   d. Carnes.
   e. Hart & Cooley Inc.
   f. Krueger.
   g. METALAIRE, Inc.
   h. Nailor Industries Inc.
   i. Price Industries.
   j. Titus.
   k. Tuttle & Bailey.
   l. Warren Technology.

2. Devices shall be specifically designed for variable-air-volume flows.

3. Material: Steel backpan and pattern controllers, with steel face.

4. Finish: Baked enamel, color selected by Architect.

5. Face Size: 24 by 24 inches.

6. Duct Inlet: Round.

7. Duct Inlet Size: Shown on Drawings

8. Face Style: Below finished ceiling no greater than 5/8 in.

9. Mounting: T-Bar Lay-In.

10. Pattern Controller: internal to unit in the lower air dampening chamber.

E. Perforated Return Diffuser:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

   a. Air Research Diffuser Products, Inc.
   b. A-J Manufacturing Co., Inc.
   c. Anemostat Products; a Mestek company.
   d. Carnes.
   e. Hart & Cooley Inc.
   f. Krueger.
   g. METALAIRE, Inc.
   h. Nailor Industries Inc.
   i. Price Industries.
   j. Titus.
   k. Tuttle & Bailey.
   l. Warren Technology.

2. Material: Steel backpan with steel face.

3. Finish: Baked enamel, color selected by Architect.

4. Face Size: Shown on Drawings.

5. Duct Inlet: Rectangular.

6. Duct Inlet Size: Shown on Drawings

7. Face Style: Flush.

8. Mounting: T-Bar Lay-in.

F. Perforated Return Diffuser:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. Air Research Diffuser Products, Inc.
b. A-J Manufacturing Co., Inc.
c. Anemostat Products; a Mestek company.
d. Carnes.
e. Hart & Cooley Inc.
f. Krueger.
g. METALAIRE, Inc.
h. Nailor Industries Inc.
i. Price Industries.
j. Titus.
k. Tuttle & Bailey.
l. Warren Technology.

2. Material: Steel backpan with steel face.

3. Finish: Baked enamel, color selected by Architect.

4. Face Size: Shown on Drawings.

5. Duct Inlet: Round.

6. Duct Inlet Size: Shown on Drawings

7. Face Style: Flush.

8. Mounting: Surface mount.

2.3 REGISTERS AND GRILLES

A. Fixed Face Register:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. A-J Manufacturing Co., Inc.
b. Anemostat Products; a Mestek company.
c. Carnes.
d. Dayus Register & Grille Inc.
e. Hart & Cooley Inc.
f. Krueger.
g. METALAIRE, Inc.
h. Nailor Industries Inc.
i. Price Industries.
j. Titus.
k. Tuttle & Bailey.

2. Material: Steel.

3. Finish: Baked enamel, color selected by Architect.

4. Face Blade Arrangement: Fixed Horizontal spaced 3/4 inch apart, 45 degree deflection.

5. Frame: 1-1/4 inches wide.

6. Mounting Frame: Frame size and style shown on drawing.

7. Mounting: Countersunk screw.

B. Fixed Face Register:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. A-J Manufacturing Co., Inc.
b. Anemostat Products; a Mestek company.
c. Carnes.
d. Dayus Register & Grille Inc.
e. Hart & Cooley Inc.
f. Krueger.
g. METALAIRE, Inc.
h. Nailor Industries Inc.
i. Price Industries.
j. Titus.
k. Tuttle & Bailey.

2. Material: Type 304 Stainless Steel.

3. Finish: #3 satin.

4. Face Blade Arrangement: Fixed Horizontal spaced 1/2 inch apart, 45 degree deflection.

5. Frame: 1-3/8 inches wide.

6. Mounting Frame: Frame size and style shown on drawing.

7. Mounting: Countersunk screw.

2.4 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, *Method of Testing for Rating the Performance of Air Outlets and Inlets.*

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install diffusers, registers, and grilles level and plumb.

B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Contractor for a determination of final location.

C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING

A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION

SECTION 23 3816

FUME HOODS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Laboratory Fume Hoods, including constant airflow volume open bypass hoods. Equipment provisions for ADA and ABA compliance are specified where applicable.

B. Products Supplied

1. Based on fume hood design, furnish and install all fume hoods and related understructures as specified and/or as shown on design drawings.

2. Furnish and deliver all service outlets, accessory fittings, electrical receptacles and switches, as listed in this specification, equipment schedules, or as shown on design drawings.

3. Pre-install fittings for attachment to the fume hood superstructure at the factory.

4. Pre-plumb plumbing fixtures mounted on the fume hood superstructures per Paragraph 2.3K. Pre-wire electrical fixtures per Paragraph 2.3L.

1.2 RELATED SECTIONS

A. Section 01 1116, "Work by Owner."

B. Section 01 2500, "Substitution Procedures."

C. Section 01 4000, "Quality Requirements."

D. Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

E. Section 01 6000, "Product Requirements."

F. Section 01 7700, "Closeout Procedures."

G. Section 13 4800, "Sound, Vibration, and Seismic Control."

1.3 ABBREVIATIONS AND ACRONYMS, DEFINITIONS, AND REFERENCES

A. Refer to Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

1.4 LANL DESIGN AND PERFORMANCE REQUIREMENTS

A. Fume hoods shall be Type A.

B. Fume hoods specifically function as ventilated, enclosed work spaces designed to capture, confine, and exhaust fumes, vapors, and particulate matter produced or generated within the enclosure.

C. Face velocities of fume hoods are established on the basis of the toxicity or hazard of the materials used or the operations conducted within the fume hood. Hoods will be designed to meet air flow requirements in ACFM (not SCFM) per the ACGIH Ventilation Manual 26th edition. A categorization of fume hood types based on face velocities and materials handled is as follows:

1. Chemical Fume Hoods for areas operating under a Hazard Communication Plan. The recommended average face velocity is 138 FPM.

2. Specific-Purpose Walk-In Hoods designed for enclosing a complex drum bagging station. The recommended average face velocity is 40 FPM.

D. Provide fume hoods of types listed below with airfoil design to ensure maximum operating efficiency and containment. Foil sections at the front fascias of the hood minimize the eddying of air currents at the hood face opening while the rear baffle system minimizes turbulence in the rear and upper portion of the hood interior.

E. Hood operates on a once through airflow mode with no air recirculation back to any operating zone. Configure the hood such that no equipment can be placed within the first six inches inside the hood or placed in a way that will create an undesirable air current.

F. Provide fume hoods with consistent and safe airflow through the hood face. Ensure that variations of face velocity do not exceed +20% of the average face velocity at any designated measuring point for the empty hood.

G. Assure minimal SPL via adequate baffle slot area and exhaust collar configuration.

H. Maximum allowable variation throughout the range of baffle adjustment is +5% for exhaust CFM, static pressure, and average face velocity at any baffle position.

I. Provide "dead man" features that would automatically return valves, controls, and switches to a safe position for those valves, controls, and switches affecting processes that could create hazards due to operator inattention or incapacitation.

J. Ensure that the average illumination of the work surface is 80 foot-candles minimum. The work surface is defined as the area inside the superstructure, from side to side and from face of baffle to the inside face of the sash.

K. For fume hood interior materials, use only materials with a flame spread rating of less than 25 when tested in accordance with NFPA 255 or as otherwise specified.

L. Minimum dimensions: See Drawings. Verify that the hood will pass through a standard 3 ft x 7 ft doorframe with doorstops or the smallest access way the hood will need to be moved through.

M. Fume Hood Types

1. Constant Airflow Volume Open Bypass Hood:

a. This type of hood exhausts a constant airflow volume regardless of the sash position and will automatically bypass air above and below the sash opening as the sash is lowered.

b. This type of hood permits balancing of the room ventilating system by maintaining a constant volume of hood exhaust airflow.

c. The upper bypass functions automatically by opening as the sash is lowered and allows air to enter the hood through a low impedance grille.

d. The lower bypass, located below the bottom airfoil sill, directs air in a manner that continuously purges the work surface.

e. The bypass system design must limit face velocity to not more than three and one-half times the face velocity with the sash fully open.

f. Isotope Hood: Designed for handling radioactive isotopes.

g. Bench Hood: A fume hood that is located on a work surface.

N. Seismic Design

1. Depending upon the quantity and characteristics of the materials being contained and the location of the fume hood installation within the LANL facility, fume hoods must be designed to withstand a DBE.

2. Ensure that the fume hood and its anchorage are in accordance with applicable performance category requirements stated in Section 13 4800, "Sound, Vibration, and Seismic Control" and other LANL Technical Area-specific documents.

1.5 SUBMITTALS

A. Submit in accordance with the requirements in Exhibit I:

B. Product Data

1. Catalog or manufacturer's data for each fume hood component and associated equipment specified. Include design features, configurations, total CFM flow capacity, component dimensions, weight, furnished accessories, standard materials, construction details, utility and service requirements, and colors for each type of fume hood.

2. Materials/parts list

C. Shop Drawings

1. Shop drawings indicating component dimensions, tolerances, equipment locations, large scale plans, elevations, ends, cross sections, mechanical/electrical rough-in and anchor placement dimensions, clearances for maintenance and operation, size and location of field connections, construction details, utility requirements, service run spaces, and materials used

2. Wiring diagrams

D. Samples

1. Hood interior lining, 6" x 6" sample.

2. Hood enclosure of color selected, 6" x 6" sample.

3. Work surfaces, 6" x 6" sample.

4. Other pre-finished equipment and accessories, 6" x 6" or appropriately sized sample.

5. Operation signs, placards, and/or instruction plates that will be attached to hood.

E. Test Reports and Certificates

1. Provide certification (CoC or other equivalent document) that the fume hood was designed and factory tested in accordance with ASHRAE Standard 110.

2. Provide UL Standards for Safety listing for the fume hood superstructure.

3. Provide test reports on each size and type of hood verifying conformance to specified parameters and regulations. A test report accompanies each hood as part of the installation and usage package. Include performance data curves and documentation that fume hoods meet the performance requirements described in ASHRAE Standard 110 and this specification.

4. Provide certification that the fume hood has been through start-up procedures and that it is functioning properly.

5. Provide test report on operation of installed fume hood after installation.

F. Manufacturer's Instructions

1. Manufacturer's installation and assembly instructions showing the field installation of parts, components, equipment, and other similar items.

2. Written instructions providing details on proper operation and maintenance.

G. Closeout Submittals

1. Submit in accordance with Section 01 7700, "Closeout Procedures."

1.6 QUALITY ASSURANCE

A. Work identified in this section shall be done under a Quality Assurance program in accordance with Section 01 4000, "Quality Requirements."

B. Use products of a company that has:

1. Manufactured at least 50 fume hoods of the same type and size specified.

2. Five years or more experience in the manufacture of laboratory fume hoods, casework, and equipment of type specified.

3. Records of manufacturing facility, testing facility, assembly, and quality control procedures available for LANL inspection.

4. A QA program meeting the requirements of 10 CFR 830.122.

C. Provide fume hoods with performance conforming to related ANSI, ASHRAE, UL, and LANL requirements specified in Paragraph 1.4 of this section.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Transport, handle, store, and protect product in accordance with the requirements of Section 01 6000, "Product Requirements."

B. Deliver equipment to site in manufacturer's original, unopened containers and packaging, with labels clearly indicating equipment name, part numbers, quantities, and manufacturer.

1.8 WARRANTY

A. The selected manufacturer warrants all products sold to be free from defects in material and workmanship for a period of one-year minimum, or greater as negotiated within subcontract, (beginning with date of acceptance). LANL shall provide notification to the manufacturer's representative of any defective product and provide the manufacturer a reasonable opportunity to inspect the goods. LANL shall not return defective products without written shipping instructions and authorization from the manufacturer.

1.9 COMMISSIONING

A. Provide labor, materials, and equipment to perform the commissioning process.

PART 2 PRODUCTS

2.1 PRODUCT OPTIONS AND SUBSTITUTIONS

A. Comply with Section 01 2500, "Substitution Procedures."

2.2 MANUFACTURERS

A. Listed below are companies with suitable experience specializing in the design and manufacture of laboratory fume hoods. Other companies may qualify provided they have suitable experience performing similar work:

1. Fisher Hamilton Incorporated: SafeAire II Fume Hoods
2. Kewaunee Scientific Corporation: Supreme Air Fume Hoods

B. Supply all equipment in accordance with this specification. The offering of a product differing in materials and construction from this specification requires written approval from LANL and must demonstrate equivalent or superior performance. Obtain alternate product approval no less than seven (7) days before the proposal deadline.

C. LANL reserves the right to reject qualified or alternate proposals and to award based on product value where such action assures equivalent or greater integrity of product.

2.3 MANUFACTURED UNITS

A. Fume Hood Superstructure Frame:

1. A freestanding rigid frame structure of steel angle provided to support exterior and interior liner and baffle panels.
2. Exterior steel panels can be removed without disassembly of the frame structure and inner liner panels.

B. Fume Hood Interior Walls:

1. Provide double walled ends that maximize interior working area. The area between the double walled ends houses the remote control valves, sash counterbalance weights, electrical receptacles, and wiring.
2. To allow for plumbing and electrical system maintenance and replacements, provide removable interior liner access panels that can be removed without disassembly of the superstructure frame and exterior steel panels.

3. Contour the front vertical fascia section at the front leading edge to provide a streamlined hood air entrance section and ensure smooth even flow of air into the hood. The vertical fascias house the required service controls, electrical switches and receptacles.

4. Provide hood interior end panels and sash track flush with the fascia to prevent eddy currents and back flow of air.

C. Fume Hood Exteriors:

1. Construct from cold rolled steel with component parts screwed together to allow removal of the end panels, front end and top fascia pieces, and airfoil strips for replacement or to afford access to the plumbing lines, service fittings, and electrical components.

2. Weld spacers or reinforcements to the exterior parts as required.

D. Fume Hood Finish:

1. Pre-treat steel component parts after welding/fabrication, but before final assembly, to provide a uniform fine-grained crystalline phosphate surface that will enhance both the final finish bond and final finish resistance to humidity, corrosion, and corrosive chemicals.

2. Physically and chemically clean the steel by degreasing and washing with an alkaline cleaner then follow with a complete metallic phosphate solution spray treatment. After the phosphate treatment, completely dry the steel.

3. Apply a corrosion-resistant primer base coat using an electro-deposition dip procedure to guarantee complete paint coverage. Powder-coat or solvent-based spray paints are unacceptable for the initial base paint coat. Cure the coating by baking at elevated temperatures to provide maximum properties of corrosion and wear resistance.

4. Provide an acid, alkali, and solvent resistant final topcoat finish on both exterior and interior surfaces of all parts.

E. Fume Hood Airfoil:

1. Provide an integral airfoil, streamlined similar to the sides, at the bottom of the hood opening. Provide a nominal 1" open space between the airfoil and the top front edge of the work surface to direct an airflow stream across the work surface, to prevent the back flow of air, and to purge the work surface airspace of contaminants. Extend the airfoil back under the sash, so that the sash does not close the 1-inch opening.

2. Fabricate the airfoil from 12-gauge-minimum steel to provide rigidity and to resist denting and flexing.

3. For walk-in hoods, provide a stop located at the bottom of the sash track that will ensure a nominal 1-inch opening between the bottom of the sash and the floor.

F. Fume Hood Top Panel:

1. The top front panel of the hood may have an integral 1/4" thick laminated safety float glass or polycarbonate vision panel located directly above the sash opening and in such a manner as to allow viewing the top interior

portion of the hood without having the operator stoop or place their face inside the hood.

2. For Constant Airflow Volume Open Bypass Hoods:

   a. Provide an integral grille that will bypass airflow at the top of the sash opening. The bypass will operate passively and will not rely on mechanical or electrical means to perform its function.

G. Fume Hood Baffles:

1. Provide a baffle system with three horizontal slots designed to facilitate airflow distribution through the hood. Position horizontal slots at the low, mid, and upper sections of the hood interior back wall. Baffles may be adjustable or fixed depending on system specification and intended application. Ensure that the baffle system design does not allow back flow of air through a hood when the hood sash is closed.

2. Ensure that a fixed baffle system accommodates the airflow management requirements for specified contaminant properties. Provide acid-resistant labeling indicating the specific contaminant properties that the baffle system is configured for (i.e. lighter than air or heavier than air gases or fumes, high heat generation processes, or general conditions).

3. For an adjustable baffle system, provide adjustability that will accommodate the airflow management requirements for various contaminant properties. As a minimum, provide adjustability for the top and bottom slots. When specified, provide a single-point remote baffle adjustment device that will allow convenient and prompt adjustment from either the hood exterior or from no further than 6" into the hood. Locate the baffle adjustment device such that it will not require the entry of the operator's head into the hood and so that it will be accessible by both able bodied and wheelchair bound operators. Provide acid-resistant labeling indicating proper baffle adjustment position for various contaminant properties.

4. Provide removable baffles to facilitate cleaning.

5. Provide baffles made of the same material as the fume hood liner.

H. Fume Hood Duct Collar:

1. Provide stainless steel bell-mouthed duct collar(s) located in the hood plenum chamber.

I. Fume Hood Lighting:

1. Fluorescent Light Fixtures:

   a. Ensure that all fixtures are UL approved and labeled.

   b. Provide fluorescent lights with T-8 bulbs.

   c. Provide electronic ballast for fluorescent light fixtures.

   d. Isolate the fluorescent light fixtures from the hood interior by a 1/4" thick tempered glass, safety glass, or polycarbonate panel sealed from the hood cavity. Ensure that bulb replacement is accomplished from the hood exterior only.

e. Provide fluorescent light fixtures in the top of the hood. Locate lighting power switch so that it is operable by both able bodied and wheelchair operators. The minimum illumination at the work surface is to be 80 foot-candles.

J. Fume Hood Sash

1. Provide a vertical, horizontal, or combination sash as specified.
2. Produce sash frame from 18-gauge steel with mitered and welded corners ground smooth to provide a complete unit with no visible joints. Use replaceable plastic guides for the sash frames that will operate in stainless steel sash guides to prevent metal-to-metal contact.
3. Provide sash tracks set flush with the interior liner panels to minimize turbulence.
4. Produce the sash glass from 1/4" laminated safety float glass or polycarbonate panels. Use polycarbonate panels on fume hoods used for hydrofluoric acid operations or for other operations where this is a better choice than glass.
5. Set glass/polycarbonate panels into deep form extruded polyvinyl chloride, or equivalent, channels internally interlocked with the outer member sealing and retaining the glazing.
6. Provide rubber bumper stops for the sash to open and close against.
7. Counterbalance System:
   a. Counter balance up/down moving (vertical or combination) sashes with a weight and cable/chain system designed to prevent sash tilting and binding during operation. Permit one finger operation at any point on the sash pull.
   b. Ensure that the system will hold the sash at any position without creep and will prevent sash drop in the event of cable/chain failure.
   c. Provide stainless steel sash cables operating on ball bearing pulleys/sheaves. Provide stainless steel sash chains operating on ball bearing sprockets.
   d. Do not use spring type counterbalances.

K. Fume Hood Plumbing Services

1. Provide all plumbing fittings factory installed and piped between the valve, outlet, and service inlet. Provide inlet piping with a labeled single-point connection located on the hood exterior for each valve and route to a point that will best suit rough-in locations shown on the design drawings.
2. Provide remote controlled valves, as selected, located within the end panels and actuated by chrome plated or plastic 4-armed handles attached to brass extension rods that project through control panels located in the hood vertical fascias. Furnish the valve handles with color-coded and labeled service indicators.
3. Locate all services so that they are reachable by both able bodied and wheelchair bound operators.

4. For interior fittings supplying gases and water, provide nylon panel flanges and nylon angle serrated hose connectors, color-coded to match services. For distilled water interior fittings, provide tin lined bronze panel flanges and angle serrated hose connectors with white color-coding. For steam interior fittings, provide cast bronze flanges and angle serrated hose connectors with a chemical resistant metallic bronze finish. Provide water goosenecks in cast bronze with a chemical resistant metallic bronze finish.

L. Fume Hood Electrical Services

1. Pre-wire the hood superstructure so single 120 VAC branch circuit powers receptacles, lighting, and alarm and provide a UL label certifying acceptable wire gauge, connections, fixtures, and wire color coding.

2. Provide 120 V, specification grade, 20 amp, duplex GFCI receptacles mounted on the vertical fascia.

3. Locate all frequently operated services so that they are reachable by both able bodied and wheelchair bound operators.

M. Fume Hood Monitors and Alarms

1. Provide a safety monitoring and alarm system that monitors:

   a. Hood face velocity and provides audible and visual alarms when face velocity drops below or rises above IHS-IH specified face velocities. See LIHSM Chapter 39.

   b. Hood exhaust duct static pressure and provides audible and visual alarms when pressure limits are exceeded.

   c. The audible alarm is mutable via a panel mounted manually operated switch that is accessible by both able bodied and wheelchair bound operators. The visual alarm continues to flash as long as the alarm condition exists.

2. Face Velocity Alarm:

   a. Monitors the actual face velocity of the hood regardless of sash position and is UL approved and labeled.

3. Low Static Pressure Alarm:

   a. Monitors the static pressure in the exhaust duct above the hood regardless of sash position and is UL approved and labeled.

4. Passive Indicating Devices

   a. Equip each hood with a manometer or other passive pressure-measuring device to provide the user visual indication that the hood is operating within acceptable parameters.

   b. Provide a passive airflow indicating device to provide the user visual indication that the hood is providing adequate airflow and operating within acceptable parameters.

   c. Locate passive indicating devices so that they are easily and readily visible to both able bodied and wheelchair bound operators.

N. Isotope Hoods

1. A fume hood with integral work surface, coved corners, linings impermeable to radioactive materials, and structure reinforced to support lead shielding bricks.

2. Provide interior construction that prevents radioactive material buildup and allows complete cleaning.

3. Fabricate hood interior lining, including end panel and back panel, from 14-gauge, type 304 or 316 stainless steel with a No. 4 finish. Fabricate the inside back and end panels in a seamless, welded, wrap around design that is welded to the work surface. Fabricate all vertical and horizontal corners and seamless joints between inside back, end panels, and work surfaces with 1/2" internal radius. Grind all welds flush and blend to a No. 4 finish. Reinforce the entire stainless steel hood interior to provide a completely rigid, welded together, self-supporting assembly. Provide the hood end liners without access openings.

4. Fabricate hood work surface from 14 gauge, type 304 or 316 stainless steel with a No. 4 finish in the form of a watertight pan 1/2" deep with a 6" wide safety ledge at the front edge. Reinforce the work surface to support a uniform maximum loading of 200 pounds per square foot.

5. When water service is supplied, provide a cup drain flush with the recessed portion of the work surface.

6. Fabricate baffles and top panel from 16 gauge, type 304 or 316 stainless steel with a No. 4 finish. Fasten the baffle to the hood interior with stainless steel screws. Provide easily removable baffles to facilitate cleaning of the baffles and the area behind the baffles.

2.4 SOURCE QUALITY CONTROL

A. Containment Performance Testing

1. Purpose: To pre-qualify the performance of the bidder's laboratory fume hood before award of subcontract or before acceptance of the hood after award of subcontract.

2. Test Method

a. Conduct pre-qualification testing of fume hoods per ASHRAE Standard 110 at the bidder's fume hood test facility. Conduct tests in the ASHRAE defined AM mode by personnel cognizant of the recommended test procedures. Refer to ASHRAE Standard 110 for specific requirements, procedures, and qualification criteria.

b. Use the following tests to judge the performance of the fume hood:

1) Face Velocity Test,
2) Flow Visualization Test,
3) Large Volume Flow Test,
4) Tracer Gas Test, and
5) Sash Movement Test.

PART 3 EXECUTION

3.1 EXAMINATION

A. Certify to LANL that building conditions are conducive to the installation of a finished goods product, including all critical dimensions.

B. Inspect areas and conditions, with installer present, for compliance with requirements for installation tolerances and other conditions affecting the performance of the fume hood. Ensure the area is free of undesirable air currents (i.e., > 40 fpm vertical and horizontal cross drafts with respect to the hood face) that would adversely affect hood performance.

C. Inspect utility rough-ins to verify actual locations of connections prior to beginning installation.

D. Check and verify that no irregularities exist that would affect quality of execution of work specified.

E. Formally notify LANL in writing if existing conditions will affect acceptable results.

3.2 INSTALLATION

A. Reference SEFA 2-1999 for fume hood installation information and guidelines.

B. Arrange installation of fume hoods to provide access space for service and maintenance.

C. Coordinate work with the schedule and requirements of other work being performed in the area at the same time both with regard to mechanical and electrical connections to and in the fume hoods and the general construction work.

D. Coordinate work between LANL and the manufacturer/subcontractor per Section 01 1116, "Work by Owner." Final plumbing and electrical connections are the responsibility of those subcontractors fulfilling requirements of sections in those Divisions.

E. Assemble and install fume hoods in accordance with approved shop drawings and manufacturer's installation instructions. Ensure that fume hood assembly and installation are performed by or supervised by fume hood manufacturer personnel.

F. Install fume hoods, plumb, level, square, with no distortion, and securely anchored to building and adjacent furniture in proper location.

G. Install fume hood equipment to provide maximum safety and continuity of operation in the event of seismic activity per requirements defined in Paragraph 1.4N.

H. Secure work surfaces to casework and equipment components with material and procedures recommended by the manufacturer.

I. Install accessories and fittings in accordance with manufacturer's recommendations.

3.3 FIELD QUALITY CONTROL

A. Site Tests, Inspection

1. Arrange for a factory authorized service representative to inspect the field assembly and installation of the fume hoods, including piping, ductwork, and electrical connections; and to prepare a written report on findings with recommended corrective actions.

2. Conduct AI testing of fume hoods at LANL per ASHRAE Standard 110. Perform tests in field to verify proper operation of the fume hood before placing into service. Perform tests only after installation is complete, the building make-up air system is in operation, the building ventilation system has been balanced, all connections have been made, the doors and windows are in normal operating position, all other hoods and exhaust devices are operating at designed conditions, and written verification has been submitted that the aforementioned conditions have been met.

3. Modifications to the hood, placement of new large equipment, or equipment that creates heat or mechanical air disturbances that would alter the airflow characteristics within the hood require retesting for confinement capability before the hood is placed in service.

4. Correct any discrepancies, errant processes, or unsafe conditions disclosed by these tests before request of test procedures.

5. Project substantial completion shall be withheld until all required fume hood certification letters, tests, and reports have been submitted and approved.

B. Manufacturers' Field Services

1. Ensure that the fume hood manufacturer field tests 100% of the installed units per ASHRAE 110 to a control level of AI 0.01 ppm or better.

3.4 ADJUSTING

A. Adjust sash, baffles, fixtures, accessories, and other moving or operating parts for proper function and operation.

B. Repair or remove and replace defective work as directed by LANL.

C. Reference Section 01 7700, "Closeout Procedures," for additional detail.

3.5 CLEANING

A. Remove all debris, dirt, packing materials, and rubbish accumulated as a result of the installation of the fume hoods to an on-site container provided by LANL or others, leaving the premises clean and orderly.

B. Clean fume hood interior and exterior to remove foreign material and construction dirt.

C. Reference Section 01 7700, "Closeout Procedures," for additional detail.

3.6 DEMONSTRATION

A. Provide written and oral instructions that detail proper operation and maintenance.

B. Reference Section 01 7700, "Closeout Procedures," for additional detail.

3.7 PROTECTION

A. Provide necessary protective measures to prevent casework and equipment from being exposed to and damaged from other construction activity.

B. Advise LANL of procedures and precautions for protection of material, installed laboratory casework, and fixtures from damage by work of other trades.

END OF SECTION

FOR LANL USE ONLY

This project specification is based on LANL Master Specification 23 3816, Rev. 2, dated July 29, 2009.

SECTION 23 4100

PARTICULATE AIR FILTRATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Pleated panel filters.

B. Supported bag filters.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to this section.

1.3 RELATED SECTIONS

A. Section 01 4000, "Quality Requirements."

B. Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

1.4 ABBREVIATIONS AND ACRONYMS, DEFINITIONS, AND REFERENCES

A. Refer to Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

1.5 SUBMITTALS

Submit in accordance with the requirements in Exhibit I:

A. Product Data: For each type of product indicated. Include dimensions; operating characteristics; required clearances and access; rated flow capacity, including initial and final pressure drop at rated airflow; efficiency and test method; fire classification; furnished specialties; and accessories for each model indicated.

1.6 QUALITY ASSURANCE

A. ASHRAE Compliance:

1. Work identified in this section shall be done under a Quality Assurance Program in accordance with Section 01 4000, "Quality Requirements."

2. Comply with applicable requirements in ASHRAE 62.1, Section 4, "Outdoor Air Quality;" Section 5, "Systems and Equipment;" and Section 7, "Construction and Startup."

3. Comply with ASHRAE 52.1 for arrestance and ASHRAE 52.2 for MERV for methods of testing and rating air-filter units.

B. Comply with NFPA 90A and NFPA 90B.

1.7 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Provide one complete set(s) of filters for each filter bank.

PART 2 PRODUCTS

2.1 PLEATED PANEL FILTERS

A. Description: Factory-fabricated, self-supported, extended-surface, pleated, panel-type, disposable air filters with holding frames.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Flanders/FFI Pre Pleat 40 or comparable product by one of the following:

a. AAF International.
b. Airguard.
c. Camfil Farr.
d. Columbus Industries, Inc.
e. CRS Industries, Inc.; CosaTron Division.
f. D-Mark.
g. Filtration Group.
h. Flanders-Precisionaire.
i. Koch Filter Corporation.
j. Purafil, Inc.
k. Research Products Corp.
l. Tri-Dim Filter Corporation.

B. Filter Unit Class: UL 900, Class 2.

C. Media: Interlaced glass or synthetic fibers coated with nonflammable adhesive.

1. Adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2. Media shall be coated with an antimicrobial agent.

3. Separators shall be bonded to the media to maintain pleat configuration.

4. Welded wire grid shall be on downstream side to maintain pleat.

5. Media shall be bonded to frame to prevent air bypass.

6. Support members on upstream and downstream sides to maintain pleat spacing.

D. Filter-Media Frame: Cardboard frame with perforated metal retainer sealed or bonded to the media.

E. Capacities and Characteristics:

1. Thickness or Depth: 2 inches.

2. Dust Spot Efficiency: 30-35% percent when tested according to ASHRAE 52.1.

3. Initial Resistance: 0.28 at 500 fpm.

4. MERV Rating: 8 when tested according to ASHRAE 52.2.

2.2 SUPPORTED BAG FILTERS

A. Description: Factory-fabricated, dry, extended-surface, self-supported filters with holding frames in steel, basket-type retainers.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Flanders/FFI Precision Pak or comparable product by one of the following:

a. AAF International.
b. Airguard.
c. Camfil Farr.
d. Columbus Industries, Inc.
e. CRS Industries, Inc.; CosaTron Division.
f. D-Mark.
g. Filtration Group.
h. Flanders-Precisionaire.
i. Koch Filter Corporation.
j. Purafil, Inc.
k. Research Products Corp.

B. Filter Unit Class: UL 900, Class 2.

C. Media: Fibrous material constructed so individual pleats are maintained in tapered form under rated-airflow conditions by flexible internal supports.

1. Media shall be coated with an antimicrobial agent.

D. Filter-Media Frame: Corrosion-resistant steel.

E. Capacities and Characteristics:

1. Thickness or Depth: 15-inches

2. Dust Spot Efficiency: 85 percent when tested according to ASHRAE 52.1.

3. Initial Resistance: 0.44 in w.g. at 500 fpm.

4. MERV Rating: 13 when tested according to ASHRAE 52.2.

PART 3 EXECUTION

3.1 INSTALLATION

A. Position each filter unit with clearance for normal service and maintenance. Anchor filter holding frames to substrate.

B. Install filters in position to prevent passage of unfiltered air.

C. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing with new, clean filters.

D. Coordinate filter installations with duct and air-handling-unit installations.

3.2 CLEANING

A. After completing system installation and testing, adjusting, and balancing of air-handling and air-distribution systems, clean filter housings and install new filter media.

END OF SECTION

SECTION 23 4133

HIGH-EFFICIENCY PARTICULATE FILTRATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. ASME AG-1, Section FC HEPA Filters (Housings for these per Section 23 3225, "Bag-in/Bag-out Housings").

B. Auxiliary HEPA Filters and Housings.

1.2 RELATED SECTIONS

A. Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

B. Section 23 3225, "Bag-in/Bag-out Housings."

1.3 ABBREVIATIONS AND ACRONYMS, DEFINITIONS, AND REFERENCES

A. Refer to Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

1.4 APPLICABILITY

A. This specification applies to filters for use in air and gas streams with a 250 degrees F maximum continuous temperature.

B. This specification applies to the procurement of filters for U.S. Department of Energy (DOE) facilities at Los Alamos National Laboratory.

1.5 LANL PERFORMED WORK

A. LANL will do in-place penetration testing of HEPA filter(s) after successful installation in systems required to be tested.

B. LANL will perform receipt inspection on filters ordered by LANL organizations in accordance with Paragraph 3.1 of this section.

1.6 SYSTEM DESCRIPTION

A. Design Requirements

1. ASME AG-1, Section FC HEPA Filters

a. Design in accordance to ASME AG-1, Article FC-4000, Design

b. Type A

c. Number Designation: 7, 24-in by 24-in by 11-1/2-in deep, rated airflow 1,500 cfm at 1.3 in. water gauge.

2. Auxiliary HEPA Filters

a. Particle removal efficiency of 99.97 percent for 0.3 micrometers or better of an approved test aerosol.

b. Withstand a minimum pressure differential of 10 in. of water.

c. Pressure differential of less than 3 in. of water at a flow rate of 35 scfm.

d. Leak tightness: Bubble test all seams in pressure boundary.

e. End connection: 2-in Class 150 male NPT.

1.7 SUBMITTALS

Submit the following in accordance with the requirements of Exhibit I:

A. ASME AG-1, Section FC HEPA Filters

1. Certification documentation from an independent test facility indicating that HEPA filter model(s) have been successfully qualified in accordance with ASME AG-1, Article FC-5100 and Paragraph 1.8 of this section.

2. COC that is signed or otherwise authenticated by responsible managers within the supplying organization and that certifies the conformance of end-items to order requirements. The Certificate of Conformance shall include:

a. Copy of the HEPA filter manufacturer's QA plan identifying procurement, fabrication, test & inspection, material traceability and non-conformity controls for approval

b. Statement that the products are constructed in accordance with the requirements in ASME AG-1, Section FC, manufacturer's QA Plan and Paragraph 1.8 of this section.

c. Qualification and Acceptance Test reports.

d. Purchased item identified by model number.

e. Purchase Order (PO) number.

f. Any approved changes, waivers, or deviations from this specification.

3. Warranty documentation - guarantee against failure in proper use or operation caused by defective materials and/or workmanship for a period of 1 year from the date of acceptance.

B. Auxiliary HEPA Filters

1. Certificate of Conformance that is signed or otherwise authenticated by responsible managers within the supplying organization and that certifies the conformance of end-items to order requirements. The Certificate of Conformance shall include:

a. Copy of the HEPA filter manufacturer's QA plan identifying procurement, fabrication, test & inspection, material traceability and non-conformity controls for approval.

b. Certification that filters and filter media have been designed, manufactured, and constructed in accordance with manufacturer's QA Plan and Paragraph 1.8 of this section.

c. Certification documentation showing that the filter meets the design requirements of Paragraph 1.6, including material requirements of Section 2.3 of this section. Examples of such documents include: supplier performance test information, inspection reports, justification for design integrity, drawings, etc.

d. Certification that all custom-built filter housings are fabricated and leak tested to meet the requirements of this specification. Examples of such document include: personnel certification for welding, inspection and leak testing, leak test procedures and reports.

e. Purchased item identified by model number.

f. Statement that the filter housing meets the leak test requirements in Paragraph 1.6 of this section.

g. Purchase Order (PO) number.

h. Any approved changes, waivers, or deviations from this specification

2. Installation Instructions

3. Warranty documentation - guarantee against failure in proper use or operation caused by defective materials and/or workmanship for a period of 1 year from the date of acceptance.

1.8 QUALITY ASSURANCE AND TESTING

A. ASME AG-1 Section FC HEPA Filters

1. Seller's Quality Assurance Requirements

a. Manufacture, inspect, test and ship under a quality assurance program meeting the applicable requirements of 10 CFR 830.122.

2. Seller's Qualification Testing requirements

a. Maintain all qualification certificates for filter models provided under this specification.

B. Auxiliary HEPA Filters

1. Seller's Quality Assurance Requirements

a. Develop, implement, and maintain an approved QA system (including program/plan, procedures, and process control documents) in accordance with 10 CFR 830.122. If the seller's QA plan is not in accordance with 10 CFR 830.122, then a LANL approved QA plan based on appropriate industry consensus standards such as ISO 9001 is acceptable.

1.9 PACKAGING AND SHIPPING

A. Package and ship ASME AG-1, Section FC HEPA filters per the requirements for level B items in accordance with ASME NQA-1 and:

1. Place filter cartons on an oversized pallet and secured or crated to eliminate unit handling at carrier inter change points and avoid unnecessary damage.

2. Do not stack HEPA filters more than three high.

3. For large shipments, ship the entire shipment in a sealed dedicated trailer or rail car to provide an additional quality assurance of product shipping and handling.

4. Ship filters properly orientated, as indicated on shipping container.

B. Package and ship Auxiliary HEPA filters per the following requirements:

1. Do not stack filters more than three high. It is acceptable to stack filters more than three high, if the individual filter does not exceed 24 inches in size, but the stacked height cannot exceed 6-1/2 feet.

2. Ship filters properly orientated, in accordance with manufacturer's recommendation.

PART 2 PRODUCTS

2.1 PRODUCT OPTIONS AND SUBSTITUTIONS

A. No substitutions allowed.

2.2 MANUFACTURERS

A. ASME AG-1, Section FC HEPA Filters

1. The following is a list of some of the manufacturers with qualified nuclear grade HEPA filter products that may meet the requirements of this specification and ASME AG-1, Section FC. However, these manufacturers are not exempt from any seller requirements including the submission of qualification certification for approval.

a. AAF International (American Air Filter).
b. Camfil Farr, Inc.
c. Flanders Filters, Inc.

B. Auxiliary HEPA Filters

1. The following is a list of some of the manufacturers, in addition to those above, with HEPA equivalent or better filters that may meet the requirements of this specification. However, these manufacturers are not exempt from any seller requirements including the submission of qualification certification for approval.

a. AAF International (American Air Filter).
b. Camfil Farr, Inc.
c. Flanders Filters, Inc.

2.3 MATERIALS OF CONSTRUCTION

A. General

1. The following are not acceptable materials of construction:

a. Particle board
b. Asbestos
c. Cadmium-coated metals
d. Any material that generates EPA regulated wastes as specified in 40 CFR 261.

B. Filter Media

1. ASME AG-1, Section FC HEPA Filters

a. Manufacture silicate media in accordance with Article I-3000 of ASME AG-1, Appendix FC-I.

2. Auxiliary HEPA Filters

a. Non-woven glass fiber paper
b. Sintered metal, such as stainless steel, nickel and Hastelloy.
c. Ceramic
d. PTFE

C. Case

1. ASME AG-1, Section FC HEPA Filters

a. Type 304 or 316 stainless steel, minimum 14 gauge, conforming to ASTM A 240.

b. Plywood, 3/4 in. thick conforming to minimum grade A-C, APA PS-1 (Form V995). The grade shall be fire retardant treated. The plywood shall have a flame spread classification of 25 or less when tested in accordance with ASTM E 84.

D. Housing

1. Auxiliary HEPA Filters

a. Type 300 series stainless steel, minimum 16 gauge, conforming to ASTM A 240, ASTM A 479, ASTM A 269, or ASTM A 312.

b. Plywood, 3/4 in. thick conforming to minimum grade A-C, APA PS-1 (Form V995). The grade shall be fire retardant treated. The plywood shall have a flame spread classification of 25 or less when tested in accordance with ASTM E 84. This material is not allowed for circular filters.

E. Separators (when used)

1. Aluminum, minimum 0.0015 in. thickness with or without coating, conforming to ASME AG-1, Article FC-3160.

F. Adhesives

1. Used to splice the media, fasten gaskets to filter frame, and seal the filter pack or faceguards to the frame

a. Self-extinguishing in accordance with the spot-flame test of ASME AG-1, Article FC-5160 or UL 586.

G. Gaskets and Seals

1. ASME AG-1, Section FC HEPA Filters

a. Flat Gaskets – in accordance with DOE-STD-3020-2005 (Section 5.3.5.1).

2. Auxiliary HEPA Filters

a. Elastomer - in accordance with ASME AG-1, Article FK-3121.

H. Faceguards

1. Provide faceguards on each face of all filter number designations 4 through 8

2. Provide faceguards in accordance with ASME AG-1, Article FC-3140.

2.4 FABRICATION

A. General

1. ASME AG-1, Section FC HEPA Filters

a. Fabricate in accordance with ASME AG-1, Article FC-6000 and 10 CFR 830.122.

b. Filters with separators shall have the separators fully attached to the top and bottom of the case along the entire length of the separators.

c. Label each filter and shipping container in accordance with ASME AG-1, Article FC-9000.

2. Auxiliary HEPA Filters and housing

a. Fabricate in accordance with manufacturer's approved QA plan.

b. Assemble filter from materials designated in Paragraph 2.3 of this section.

c. Do not patch holes or tears in filter media.

d. Ensure that filter is free from foreign matter and damage.

e. Fabricate housing to [specify leak tightness].

f. Provide [specify end connections].

g. Label each filter with the following minimum information.

1) Manufacture's name
2) Model number
3) Serial number
4) Rated flow capacity
5) Pressure drop, in inches of water at 100% rated flow
6) Overall penetration at rated flow
7) UL label indicating successful testing per UL 586 if applicable.

2.5 SOURCE QUALITY CONTROL

A. Qualification and Acceptance Test Criteria

1. ASME AG-1, Section FC HEPA Filters

a. Perform qualification testing of filters and filter media by an independent test facility in accordance with ASME AG-1, Article FC-5100.

b. Perform factory production testing of aerosol penetration and resistance to air flow in accordance with ASME AG-1, Article FC-5200.

c. Perform acceptance testing of filter by an FTF (Air Techniques International Testing Laboratories, Suite 104, 1708 Whitehead Rd., Baltimore, MD 21207, phone 410-277-8981, fax 410-277-3448, email ATITL@atitest.com) in accordance with ASME AG-1, Article FC-5200 and DOE-STD-3025-99.

2. Auxiliary HEPA Filters

a. Perform qualification testing of filters by an independent test facility in accordance with ASME AG-1, Article FK-5000.

b. Perform factory production testing in the following categories:

1) Penetration – Test with DOE- approved aerosol and test method or the particle counter scanning method as described in IEST-RP-CC001.3. If penetration of 0.3 micrometers exceeds 0.03 percent, filter is not acceptable.

2) Resistance to airflow – The clean filter resistance to airflow shall meet the requirements of Paragraph 1.6A.2 of this section.

3) Leak testing – Perform helium leak test in accordance with ASTM E 499 or perform bubble leak testing in accordance with ASME Boiler and Pressure Vessel Code, Section V, Article 10.

c. Perform acceptance testing of filters by an FTF (Air Techniques International Testing Laboratories, Suite 104, 1708 Whitehead Rd., Baltimore, MD 21207, phone 410-277-8981, fax 410-277-3448, email ATITL@ atitest.com) in accordance with ASME AG-1, Article FK-5600.

PART 3 EXECUTION

3.1 EXAMINATION

A. Inspect all filters upon shipment receipt to LANL QA-RIT-WI-002.004. Verify documentation from Paragraph 1.7 is included and is complete.

3.2 STORAGE

A. Store ASME AG-1, Section FC HEPA filters per the requirements for level B items in accordance with ASME NQA-1 or in accordance with the manufacturer's requirements, whichever is more restrictive and :

1. Do not stack HEPA filters more than three high.

2. Store filters properly orientated, as indicated on shipping container.

3. Do not store filters for more than 10 years after manufacture date. If filter has been in storage for greater than 3 years, visually inspect gaskets for cracks, before installation.

B. Store auxiliary HEPA filters in accordance with the manufacturer's requirements and:

1. Do not stack filters more than three high. It is acceptable to stack filters more than 3 high if the individual filter does not exceed 24 in. in size, but the stacked height cannot exceed 6 ½ feet.

2. Store filters properly orientated, in accordance with manufacturer's recommendations.

3. Do not store filters for more than 10 years after manufacture date. If filter has been in storage for more than 3 years, visually inspect filter unit, especially seals for damage before installation.

3.3 INSTALLATION

A. Install per manufacturer's instructions.

3.4 FIELD QUALITY CONTROL

A. Test ASME HEPA filters after installation for penetration in accordance with LANL requirements.

B. Test Auxiliary HEPA filters (when required) after installation for penetration in accordance with LANL requirements.

C. Replace all filters that fail LANL in-place penetration test.

D. Notify Seller, SUP, and PS-1 of filter rejections and re-evaluate the future procurement status of that manufacturer and/or model.

PART 4 ATTACHMENTS

A. Attachment 1 – ASME AG-1, Section FC HEPA Filter – American Air Filter, Qualified Nuclear Grade HEPA Filters.

B. Attachment 2 – ASME AG-1, Section FC HEPA Filter – Camfill Farr, Qualified Nuclear Grade HEPA Filters.

C. Attachment 3 – ASME AG-1, Section FC HEPA Filter – Flanders Filters, Qualified Nuclear Grade HEPA Filters.

D. Attachment 4 – Auxiliary HEPA Filter – Flanders Filters.

ASME AG-1, Section FC HEPA Filter – American Air Filter, Qualified Nuclear Grade HEPA Filters

A. Model Number: 105-1332345-XXX. (Qualified on 1/28/2005. Qualification expires on 1/28/2010). Type A, Number Designation 1 through 7, and 9, but excluding 4.

1. Materials (Paragraphs 2.3B through 2.3H)

   a. Filter media –Lydall # 3398 or Hollingswoth & Vose # 7583

   b. Case – box type construction, 3/4 inch fire-retardant plywood

   c. Separator – corrugated aluminum or corrugated vinyl coated aluminum

   d. Adhesive – polyurethane

   e. Gasket – neoprene gasket on upstream face or neoprene gasket on downstream face or none

   f. Faceguard – galvanized hardware cloth on both faces or Type 304 SST hardware cloth on both faces

**ASME AG-1, Section FC HEPA Filter – Camfil Farr,
Qualified Nuclear Grade HEPA Filters**

A. Model Number: 02ES-24Z24Z06-4D-2-F-M-6B-0/00, Part Number 855211141 (Qualified on 8/22/2008. Qualification expires on 8/21/2013.) Type A, Number Designation 4.

1. Materials (Paragraphs 2.3B through 2.3H)

a. Filter media – micro glass, acrylic resin binder, qualified per ASME AG-1, Section FC-I.

b. Case – 14 gauge 304 SST

c. Separator – corrugated aluminum

d. Adhesive – fire retardant, phosphorus free 2 part polyurethane

e. Gasket – gel seal.

f. Faceguard – galvanized steel hardware cloth on both sides

B. Model Number: 02ES-24Z24Z06-BD-2-F-M-6B-0/00, Part Number 855211140 (Qualified on 12/2/2008. Qualification expires on 12/1/2013.) Type A, Number Designation 4.

1. Materials (Paragraphs 2.3B through 2.3H)

a. Filter media – micro glass, acrylic resin binder, qualified per ASME AG-1, Section FC-I.

b. Case – 14 gauge 304 SST

c. Separator – corrugated aluminum

d. Adhesive – fire retardant, phosphorus free 2 part polyurethane

e. Gasket – neoprene gasket

f. Faceguard – galvanized steel hardware cloth on both sides

C. Model Number: 02EH-24Z24Z12-BD-3-F-M-6B-0/00, Part Number 855211139 (Qualified on 8/22/2008. Qualification expires on 8/21/2013.) Type A, Number Designation 1 through 7, and 9, but excluding 4.

1. Materials (Paragraphs 2.3B through 2.3H)

a. Filter media – micro glass, acrylic resin binder, qualified per ASME AG-1, Section FC-I.

b. Case – 14 gauge 304 SST

c. Separator – corrugated aluminum

d. Adhesive – fire retardant, phosphorus free 2 part polyurethane

e. Gasket – gel seal on downstream face

f. Faceguard – galvanized steel hardware cloth on both sides

**ASME AG-1, Section FC HEPA Filter – Flanders Filters,
Qualified Nuclear Grade HEPA Filters**

A. Model Number: 0-007-C-04-00-NU-11-13-GG-FU5 (Qualified on 2/21/2007. Qualification expires on 2/21/2012.) Type A, Number Designation 1 through 6, and 9, but excluding 4.

1. Materials (Paragraphs 2.3B through 2.3H)

   a. Filter media – pleated flat sheet non-woven glass paper (boron silicate micro fiber), 99.97 percent minimum efficiency.

   b. Case – box-type construction, 3/4 in. fire-retardant plywood.

   c. Separator – corrugated aluminum.

   d. Adhesive – fire-retardant solid urethane.

   e. Gasket – neoprene on upstream face.

   f. Faceguard – galvanized steel hardware cloth on both faces.

B. Model Number: T-007-W-04-05-NU-51-13-GG-FU5 (Qualified on 3/15/2007. Qualification expires on 3/14/2012.) Type C, Number Designation 1 through 7, and 9, but excluding 4.

1. Materials (Paragraphs 2.3B through 2.3H)

   a. Filter media – 11 in. deep PUREFORM® filter pack, non-woven glass paper (boron silicate micro fiber), 99.97 percent minimum efficiency.

   b. Case – box-type construction, 3/4 in. fire-retardant plywood

   c. Separator – none.

   d. Adhesive – fire-retardant solid urethane.

   e. Gasket – BLUE-JEL® seal on upstream face.

   f. Faceguard – galvanized steel hardware cloth on both faces.

C. Model Number: 0-007-W-43-03-NU-11-23-GG-FU5 (Qualified on 9/15/2008. Qualification expires on 9/14/2014.) Type C, Number Designation: 1 through 7, and 9, but excluding 4.

1. Materials (Paragraphs 2.3B through 2.3H)

   a. Filter media – 11 in. deep PUREFORM® filter pack, non-woven glass paper (boron silicate micro fiber), 99.97 percent minimum efficiency.

   b. Case – bolted construction with double-turn flanges on both faces, 14 gauge Type 304 SST.

   c. Separator – none.

   d. Adhesive – fire-retardant solid urethane.

   e. Gasket – neoprene on upstream face.

   f. Faceguard – galvanized steel hardware cloth on both faces

D. Model Number: T-007-U-43-05-NU-51-23-GG-FU5 (Qualified on 6/11/2009. Qualification expires on 6/10/2014) Type C, Number Designation: 1 through 7, and 9, but excluding 4.

1. Materials (Paragraphs 2.3B through 2.3H)

   a. Filter media – 11 in. deep DYN-E2® filter pack, non-woven glass paper (boron silicate micro fiber), 99.97 percent minimum efficiency.

   b. Case – bolted construction with double-turn flange on one face and fluid seal groove on opposite face, 14 gauge Type 304 SST.

   c. Separator – none.

   d. Adhesive – fire-retardant solid urethane.

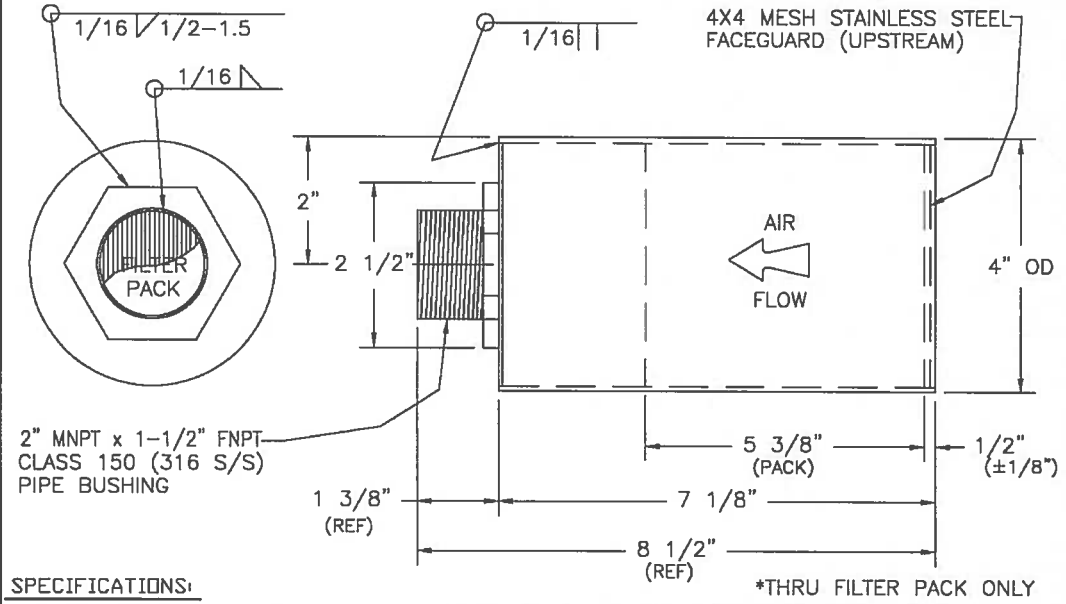
   e. Gasket – BLU-JEL® on upstream face.

   f. Faceguard – stainless steel hardware cloth on both faces.

Auxiliary HEPA Filter – Flanders Filters

A. Model number: 0-007-C-15-N1-NU-00-00-Z99436H. 4 inch round housing, open inlet with faceguard, 2" MNPT x 1-1/2" FNPT class 150 pipe bushing on outlet. See attached FLANDERS FILTERS drawing Z99436 Rev H.

B. Model Number: 0-007-C-15-N1-NU-00-22-Z03010B. 4 inch round housing, 2" MNPT x 1-1/2" FNPT class 150 pipe bushing on inlet, open outlet with faceguard. See attached FLANDERS FILTERS drawing Z03010 Rev B.



*THRU FILTER PACK ONLY

SPECIFICATIONS:

FILTER SHALL BE MODEL #0–007–C–15–N1–NU–00–21–Z99436H AS MANUFACTURED BY FLANDERS FILTERS. IT SHALL BE TESTED AND CERTIFIED TO BE NOT LESS THAN 99.97 % EFFICIENT, FOR PARTICLES OF CRITICAL SIZE 0.3 μm. THE INITIAL RESISTANCE TO AIR FLOW WILL BE A MAXIMUM *3.0 "W. G. AT *35 CFM
THE MAXIMUM OPERATING TEMPERATURE IS 250 °F MAX. R. H. 100 %.

A. FRAME HARDWARE NONE
B. MEDIUM FLATSHEET (ME–FN700) (PER ASME AG–1, SECTION FC)
C. PACK STYLE ALUMINUM SEPARATORS (PER ASME AG–1, SECTION FC)
D. FRAME MATERIAL 0.083 WALL 316L S/S TUBING (PER ASTM A269)/14 GA 316L S/S ENDPLATE (PER ASTM A240)
F. FRAME STYLE ONE (1) NIPPLE (PER MSS SP–114)
G. PACK TO FRAME SEALANT F.R. SOLID URETHANE (PER ASME AG–1, SECTION FC)
H. GASKET/SEAL MATERIAL NONE LOCATION NONE JOINT
I. FACEGUARD MATERIAL 4x4 MESH STAINLESS STEEL (PER ASTM E2016) LOCATION UPSTREAM

TESTING SPECIFICATIONS:

TEST DETAILS	TEST FLOWS	DESIGN QUALIFICATION
☒ Q–107 / DOP OR	☒ ENCAPSULATED	☐ ASME/AG–1 SECTION FC 3000
☐ DUAL LASER / PSL	☒ 100% FLOW	☐ ASME/AG–1 SECTION FC 4000
	☐ 20% FLOW	☐ ASME/AG–1 SECTION FC 5000
☐ OTHER	☐ OTHERS	☒ UL–586

CAUTION: WHEN AIRFLOW IS HORIZONTAL FILTER SHOULD BE INSTALLED WITH PLEATS RUNNING IN VERTICAL DIRECTION

NO PATCHING OF MEDIA

NOTE:

PRESSURE DECAY LEAK TEST HOUSING PER ASME N510–1995 AT A PRESSURE OF +10"WG MAXIMUM ACCEPTABLE LEAKAGE RATE IS 0.0005 SCFM PER CUBIC FOOT OF HOUSING VOLUME AT TEST PRESSURE

REV	DESCRIPTION	DATE	APPR
H	REVISED NOTE, BUSHING DESCRIPTION DELETED DUAL LASER/PSL; ADDED MAT'L SPECS	4/25/07 WEA	bl SW
G	ADDED MATERIAL SPECIFICATIONS DELETED ASME/AG–1; REVISED WELD	3/20/07 WEA	bl SW
F	ADDED FACEGUARD	12/7/05 WEA	bl SW
E	UPDATED TEST SPECIFICATIONS	1/24/05 WEA	SW ACL
D	UPDATED BORDER	10/15/03 WEA	SW XbW
C	ADDED UL586	1/28/02 WEA	ACL SW
B	DELETED WELD ON NIPPLE HEX NUT	12/20/01 WEA	ACL SW
A	WAS "IU",ME–F0711 MEDIUM	9/13/01 WEA	bl AL

FFI ITEM NO.: F0616140
FFI EXTRUSION NO.:

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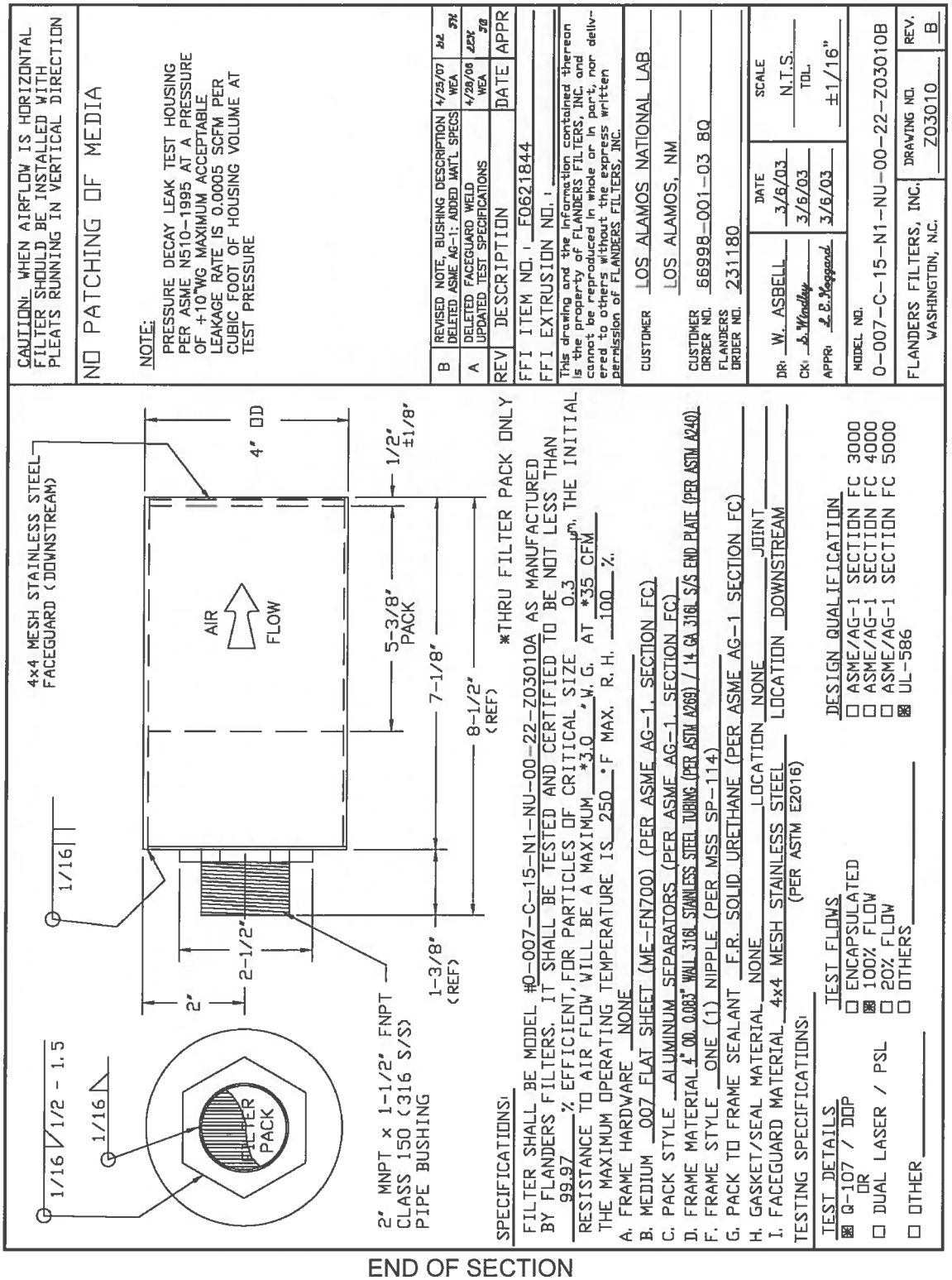
CUSTOMER: CLIMATEC, INC
PHOENIX, AZ
CUSTOMER ORDER NO.: NM991325JM
FLANDERS ORDER NO.: C994761

		DATE	SCALE
DR:	D. PRICE	12/20/99	N.T.S.
CK:	S. Windley	12/20/99	TOL.
APPR:	S. Klocke	12/22/99	±1/16"

MODEL NO.: 0–007–C–15–N1–NU–00–21–Z99436H

FLANDERS FILTERS, INC. WASHINGTON, N.C.	DRAWING NO. Z99436	REV. H



END OF SECTION

FOR LANL USE ONLY

This project specification is based on LANL Master Specification 23 4133, Rev. 1, dated June 11, 2008.

SECTION 23 5100

VENTS AND STACKS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Scope of Work: Provide design, shop drawings, project record drawings (as-built), fabrication, labor, transportation and supervision necessary to install and place into service Building Exhaust Stack and Listed double-wall vents.

B. Components: The building exhaust stack shall consist of, but not be limited to breeching, chimneys, and stacks; accessories and components.

1.2 RELATED SECTIONS

A. Section 01 2500, "Substitution Procedures."

B. Section 01 4000, "Quality Requirements."

C. Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

D. Section 05 5350, "Metal Gratings and Floor Plates."

E. Section 09 9100, "Painting."

1.3 ABBREVIATIONS AND ACRONYMS, DEFINITIONS, AND REFERENCES

A. Refer to Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

1.4 DESIGN

A. The Subcontractor is responsible for performing seismic, wind and gravity analysis and design calculations for the building exhaust stack in accordance with ASME STS-1, IBC 2009 Chapters 16,19 and 22; and ASCE 7-05 Chapter 15.

1. At a minimum, the following must be included in the design:

a. Wind: 100 mph, 3-sec-gust speed; as well as design for vortex shedding and fatigue on stack.

b. Seismic:

1) Design spectral response acceleration parameter: five-percent damped design spectral response acceleration at short periods, SDS = 0.75g, and at 1-second period, SD1 = 0.64 g.

2) Seismic Design Category (SDC) D.

3) Occupancy Category III / Importance Factor, I = 1.25

4) Mapped spectral acceleration for a 1-sec period S1=0.64 g.

c. Anchorage of the stack base to prevent uplift, sliding and overturning due to lateral forces on the stack. Post-installed anchors shall not be used to achieve anchorage to concrete foundation.

1.5 SUBMITTALS

Submit the following in accordance with the requirements of Exhibit I:

A. Product Data: For the following:

1. Type B vents.
2. Building Exhaust Stack
3. Stack Anchorage Devices

B. Calculations: Calculations shall be prepared in accordance with ASME STS-1, IBC 2009 Chapters 16, 19 and 22; and ASCE 7-05 Chapter 15; signed and sealed by the qualified professional engineer responsible for their preparation.

C. Shop Drawings: For vents and stacks. Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, methods of field assembly, components, stack strakes, hangers and seismic restraints, and location and size of each field connection.

2. Building Exhaust Stack design, drawings and details shall be signed and sealed by the qualified professional engineer responsible for their preparation.

3. Detailed Stack Anchorage Devices, their installation requirements and calculations signed and sealed by the qualified professional engineer responsible for their preparation.

D. Welding certificates.

E. Manufacturer Seismic Qualification Certification: Submit certification that factory-fabricated breeching, chimneys, and stacks; accessories; and components will withstand seismic forces defined. Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

2. Dimensioned Outline Drawings of Breeching, Chimneys, and Stacks: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of anchorage devices on which the certification is based and their installation requirements.

1.6 QUALITY ASSURANCE AND QUALITY CONTROL

A. Work identified in this section shall be done under a Quality Assurance Program in accordance with Section 01 4000, “Quality Requirements.”

B. Source Limitations: Obtain listed system components through one source from a single manufacturer.

C. Structural Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code--Steel," for hangers and supports and AWS D9.1/D9.1M, "Sheet Metal Welding Code," for shop and field welding of joints

and seams in vents, breechings, and stacks. All tubular connections shall be inspected per AWS D1.1 Table 6.1. All non-tubular components shall be inspected as Cyclically Loaded Nontubular Connections per AWS D1.1, Table 6.1.

D. Stack Welding: Qualify procedures and personnel according to ASME STS-1 or ASME B&PV Code, Section IX.

E. Personnel performing visual weld inspections shall be certified as a Certified-Welding Inspector or Certified Associate Welding Inspector in accordance with the requirements specified in AWS QC1.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Materials and Equipment: Protect materials and equipment from damage during shipping, storage and installation.

PART 2 PRODUCTS

2.1 PRODUCT OPTIONS AND SUBSTITUTIONS

A. Alternate products may be accepted; follow Section 01 2500, "Substitution Procedures."

2.2 LISTED TYPE B VENTS

A. Description: Double-wall metal vents tested according to UL 441 and rated for 480 deg F continuously for Type B, with neutral or negative flue pressure complying with NFPA 211.

B. Construction: Inner shell and outer jacket separated by at least a 1/4-inch airspace.

C. Inner Shell: ASTM B 209 (ASTM B 209M), Type 1100 aluminum.

D. Outer Jacket: Galvanized steel.

E. Accessories: Tees, elbows, increasers, draft-hood connectors, terminations, adjustable roof flashings, storm collars, support assemblies, thimbles, firestop spacers, and fasteners; fabricated from similar materials and designs as vent-pipe straight sections; all listed for same assembly.

1. Termination: Round chimney top designed to exclude minimum 98 percent of rainfall.

2.3 BUILDING EXHAUST STACK

A. The building exhaust stack is a free standing stack with access ladder and platform. See drawings for elevation, diameter, sample port locations, platform and ladder locations, and stack breeching.

B. Construction:

1. Fabricate stack, stack breaching, and stack base from Type 304 or 304L stainless steel sheet or plate, meeting the requirements of ASTM A 167 or ASTM A 240/ A 240M.

2. Fabricate stack reinforcement and flanged connections from stainless steel bars, and shapes Type 304 or 304L, meeting the requirements of ASTM A 276

C. Fasteners for the primary stack connections shall meet the requirements of ASTM A 193, Grade B8 (Class 2) nuts shall meet the requirements of ASTM A 194, Grade 8 Heavy Hex, washers shall be 300 series stainless steel. Submit certificates of conformance. Other connections shall meet the requirements of ASTM A 193, Grade B8 (Class 1 or 2) nuts shall meet the requirements of ASTM A 194, Grade 8 Heavy Hex, washers shall be 300-series stainless steel. Submit certificates of conformance.

D. Fasteners for connection of platform and ladder connections shall be carbon steel meeting the requirements of ASTM A 307 with ASTM A 563 nuts and washers conforming to ANSI B18.22.1.

E. Ladders and platforms shall be fabricated of carbon steel bars, plates, and shapes meeting the requirements of ASTM A 36/A 36M.

F. Ladders and platforms shall comply with ASME STS-1 and Title 29 – Labor, Occupational Safety and Health Administration, Part 1910 Occupational Safety and Health Standards.

G. Grating shall be galvanized steel, minimum1" by 3/16" long bearing bars 1-3/16" on center, ¼" cross bars on 2" centers and in accordance with Specification Section 05 5350, "Metal Gratings and Floor Plates."

H. Nozzles shall be Type 304 or 304L minimum schedule 10S, or as shown on drawings, pipe meeting the requirements of ASTM A 312 with Class 150 slip-on flanges meeting the requirements of ASTM A 182/A 182M.

I. Anchor bolts shall be ASTM F1554, Grade 36 (minimum). Submit Certificates for Conformance. Nuts shall be ASTM A563 Hex and washers shall conform to ASTM F436.

J. Gasket Materials

1. Suitable for air and thermal conditions of the exhaust system contents.

a. Nonmetallic, flat, asbestos free, 1/8-in. maximum thickness unless thickness or specified material is indicated.

1) Narrow-Face Type: ASME B16.21, for raised-face, Class 150, for carbon steel or stainless steel flanges.

2) Garlock "BLUE-GARD" 3000 series, 1/8-in. thick compressed gaskets with dimensions conforming to ASME B16.21, Table 1-5.

b. Flat face flanges and angle flanges, gaskets shall be asbestos free, 1/8-in. maximum thickness unless thickness or specific material is indicated. ASTM D2000, 2BA, EPDM rubber, Durometer 55-65 (Shore A).

1) Garlock Stye #564, 1/8-in. thick.

PART 3 EXECUTION

3.1 APPLICATION

A. Listed Type B Vents: Vents for certified gas appliances.

3.2 INSTALLATION OF LISTED VENTS

A. Locate to comply with minimum clearances from combustibles and minimum termination heights according to product listing or NFPA 211, whichever is most stringent.

B. Support vents at intervals recommended by manufacturer to support weight of vents and all accessories, without exceeding appliance loading.

C. Lap joints in direction of flow.

D. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finishes.

E. Provide temporary closures at ends of stacks that are not completed or connected to equipment.

3.3 INSTALLATION OF BUILDING EXHAUST STACK

A. Fabricate, examine, and install exhaust stack in accordance with ASME STS-1.

B. Locate in accordance with the Drawings.

C. Install platforms and ladders.

D. Paint all ferrous metals for exterior exposure in accordance with Section 09 9100, "Painting."

E. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finishes.

F. Provide temporary closures at ends of stack and breechings that are not completed or connected to equipment.

END OF SECTION

SECTION 23 5233

WATER-TUBE BOILERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Packaged, factory-fabricated and -assembled, forced-draft gas-fired, water-tube boilers, trim, and accessories for generating hot water.

1.2 RELATED SECTIONS

A. Section 01 2500, "Substitution Procedures."

B. Section 01 4000, "Quality Requirements."

C. Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

D. Section 22 0548, "Vibration and Seismic Controls for Plumbing, Piping and Equipment."

E. Section 23 5100, "Vents and Stacks," for recirculation duct materials.

F. Section 26 0526, "Grounding and Bonding for Electrical Systems."

G. Section 26 0519, "Low Voltage Electrical Power Conductors and Cables."

1.3 ABBREVIATIONS AND ACRONYMS, DEFINITIONS, AND REFERENCES

A. Refer to Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

1.4 SUBMITTALS

Submit the following in accordance with the requirements of Exhibit I:

A. Product Data: Include performance data, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings: For boilers, boiler trim, and accessories. Include plans, elevations, sections, details, and attachments to other work.

1. Wiring Diagrams: Power, signal, and control wiring.

C. Manufacturer Seismic Qualification Certification: Submit certification that boiler, accessories, and components will withstand seismic forces defined in Section 22 0548, "Vibration and Seismic Controls for Plumbing, Piping and Equipment."

D. Source quality-control test reports.

E. Field quality-control test reports.

F. Operation and maintenance data.

G. Warranty: Special warranty specified in this section.

1.5 QUALITY ASSURANCE

A. Work identified in this section shall be done under a Quality Assurance program in accordance with Section 01 4000, "Quality Requirements."

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. ASME Compliance: Fabricate and label boilers to comply with ASME Boiler and Pressure Vessel Code, Section IV.

D. ASHRAE/IESNA 90.1 Compliance: Boilers shall have minimum efficiency according to "Gas and Oil Fired Boilers - Minimum Efficiency Requirements."

E. I=B=R Compliance: Boilers shall be tested and rated according to HI's "Rating Procedure for Heating Boilers" and "Testing Standard for Commercial Boilers," with I=B=R emblem on a nameplate affixed to boiler.

F. UL Compliance: Test boilers for compliance with UL 795, "Commercial-Industrial Gas Heating Equipment." Boilers shall be listed and labeled by a testing agency acceptable to authorities having jurisdiction.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace drums, tubes, headers, cabinets, atmospheric gas burners, and pressure vessels of boilers that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Drums, Tubes, Headers, Cabinets, and Atmospheric Gas Burner: Five years from date of Substantial Completion, pro rata.

2. Warranty Period for Pressure Vessel: 25 years from date of Substantial Completion, for thermal shock.

PART 2 PRODUCTS

2.1 PRODUCT OPTIONS AND SUBSTITUTIONS

A. Alternate products may be accepted; follow Section 01 2500, “Substitution Procedures.”

2.2 FLEXIBLE WATER-TUBE BOILERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product.

B. Description: Factory-fabricated and -assembled, water-tube boiler with heat exchanger sealed pressure tight, built on a steel base; including insulated jacket, flue-gas vent, supply and return connections, and controls. Boiler to have an ASME Section IV H Stamp and an NBIC number and registration.

C. Heat-Exchanger Design: Bent steel tubes swaged into steel headers.

1. Limit tube configurations to two.

2. Accessible drain and blowdown tappings, both high and low, for surface and mud removal.

3. Accessible inspection ports in drum, mud legs, and tube manifolds.

4. Lifting lugs on top of boiler.

5. Built-in air separator.

D. Combustion Chamber: Combustion chamber shall have flame observation port(s).

E. Casing:

1. Insulation: Minimum 2 inch thick, mineral-fiber insulation surrounding the heat exchanger and combustion chamber.

2. Top Flue Connection: Constructed of aluminized steel.

3. Jacket: Zinc-coated rust resistant steel sheet casing.

4. Mounting base to secure boiler to concrete floor slab.

a. Seismic Fabrication Requirements: Fabricate mounting base and attachment to boiler, accessories, and components with reinforcement strong enough to withstand seismic forces defined in Section 22 0548, "Vibration and Seismic Controls for Plumbing, Piping and Equipment", when mounting base is anchored to building structure.

5. Control Compartment Enclosure: NEMA 250, Type 1A.

F. Barometric Damper: Galvanized-steel assembly with flue-gas thermometer.

G. Burner:

1. Burner: Welded construction with multivane, stainless-steel, flame-retention diffuser for natural gas.

2. Blower: Forward-curved, centrifugal fan integral to burner, directly driven by motor; with adjustable, dual-blade damper assembly and locking quadrant to set air-fuel ratio.

3. Gas Train:

a. Control devices and modulating control sequence shall comply with requirements in ASME CSD-1.

b. Gas train shall comply with Industrial Risk Insurers (IRI) requirements.

4. Pilot: Intermittent or Interrupted-electric-spark pilot ignition with 100 percent main-valve and pilot-safety shutoff with electronic supervision of burner flame.

5. Flue-Gas Recirculation: Burner connections shall be equipped for recirculating flue gas.

a. Maximum Oxides of Nitrogen Emissions: 30 ppm.

H. Trim:

1. Aquastat Controllers: Operating, firing rate, and high limit.

2. Safety Relief Valve: ASME rated with a HV stamp.

3. Pressure and Temperature Gage: Minimum 3-1/2-inch diameter, combination water-pressure and -temperature gage. Gages shall have operating-pressure and -temperature ranges so normal operating range is about 50 percent of full range.

4. Boiler Air Vent: Manual.

5. Drain Valve: Minimum NPS 3/4 hose-end gate valve.

I. Controls:

1. Boiler operating controls shall include the following devices and features:

a. Control transformer.

b. Set-Point Adjust: Set points shall be adjustable.

c. Sequence of Operation: Electric, factory-fabricated and field-installed panel to control burner firing rate to reset supply-water temperature inversely with outside-air temperature. At 0 deg F outside-air temperature, set supply-water temperature at 190 deg F; at 60 deg F outside-air temperature, set supply-water temperature at 160 deg F.

d. Include automatic, alternating-firing sequence for multiple boilers to ensure maximum system efficiency throughout the load range and to provide equal runtime for boilers.

2. Burner Operating Controls: To maintain safe operating conditions, burner safety controls limit burner operation.

a. High Cutoff: Manual reset stops burner if operating conditions rise above maximum boiler design temperature.

b. Low-Water Cutoff Switch: Electronic probe shall prevent burner operation on low water. Cutoff switch shall be manual reset type.

c. Blocked Vent Safety Switch: Manual-reset switch factory mounted on draft diverter.

d. Audible Alarm: Factory mounted on control panel with silence switch; shall sound alarm for above conditions.

e. A communication interface with building automation system shall enable building automation system operator to remotely control and monitor the boiler from an operator workstation. Control features available, and monitoring points displayed, locally at boiler control panel shall be available through building automation system.

2.3 ELECTRICAL POWER

A. Single-Point Field Power Connection: Factory-installed and -wired switches, motor controllers, transformers, and other electrical devices necessary shall provide a single-point field power connection to boiler.

1. House in NEMA 250, Type 1 enclosure.

2. Wiring shall be numbered and color-coded to match shop drawing wiring diagram provided with submittals.

3. Install factory wiring outside of an enclosure in a metal raceway.

4. Field power interface shall be fused disconnect switch.

5. Provide branch power circuit to each motor and to controls with disconnect switch.

6. Provide each motor with overcurrent protection.

2.4 CAPACITIES AND CHARACTERISTICS

A. Heating Medium: Hot water.

B. Design Pressure Rating: 160 psig.

C. Design Temperature Rating: 250 deg F.

D. Safety Relief Valve Setting: 60 psig.

E. Entering-Water Temperature: See drawings.

F. Leaving-Water Temperature: See drawings.

G. Design Water Flow Rate: See drawings.

H. Minimum Thermal Efficiency: 85 percent.

I. Gas Input: See drawings.

J. Nominal Output Capacity: See drawings.

K. Elevation: 7,500 ft above mean sea level.

L. Electrical Characteristics:

1. Volts: 120 V.
2. Phase: Single.
3. Hertz: 60.

2.5 SOURCE QUALITY CONTROL

A. Test and inspect factory-assembled boilers, before shipping, according to ASME Boiler and Pressure Vessel Code.

B. Burner and Hydrostatic Test: Factory adjust burner to eliminate excess oxygen, carbon dioxide, oxides of nitrogen emissions, and carbon monoxide in flue gas and to achieve combustion efficiency; perform hydrostatic test.

PART 3 EXECUTION

3.1 BOILER INSTALLATION (shall be in accordance with NBIC NB-23 Part 1.)

A. Install boilers level on concrete floor.

B. Install gas-fired boilers according to NFPA 54.

C. Assemble and install boiler trim.

D. Install electrical devices furnished with boiler but not specified to be factory mounted.

E. Install control wiring to field-mounted electrical devices.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 23 sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to boiler to allow service and maintenance.

C. Connect gas piping to boiler gas-train inlet with union. Piping shall be at least full size of gas train connection. Provide a reducer if required.

D. Connect hot-water piping to supply- and return-boiler tappings with shutoff valve and union or flange at each connection.

E. Install piping from safety relief valves to nearest floor drain.

F. Install piping from equipment drain connection to nearest floor drain. Piping shall be at least full size of connection. Provide an isolation valve if required.

G. Connect breeching to full size of boiler outlet. Comply with requirements in Section 23 5100, "Vents and Stacks," for venting materials.

H. Install flue-gas recirculation duct from vent to burner where required. Comply with requirements in Section 23 5100, "Vents and Stacks," for recirculation duct materials.

I. Ground equipment according to Section 26 0526, "Grounding and Bonding for Electrical Systems."

J. Connect wiring according to Section 26 0519, "Low Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:

1. Perform installation checks according to manufacturer's written instructions.
2. Leak Test: Hydrostatic test in accordance with 22 0813. - Remove pressure, then repair leaks and retest until no leaks exist.
3. Replace damaged and malfunctioning controls and equipment.

C. Remove and replace malfunctioning units and retest as specified above.

D. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other than normal occupancy hours for this purpose.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain boilers.

END OF SECTION

SECTION 23 6423

SCROLL WATER CHILLERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Packaged, air-cooled, electric-motor-driven, scroll water chillers.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section.

1.3 RELATED SECTIONS

A. Section 01 4000, "Quality Requirements."

B. Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

C. Section 03 3001, "Reinforced Concrete."

D. Section 23 2113, "Hydronic Piping."

1.4 ABBREVIATIONS AND ACRONYMS, DEFINITIONS, AND REFERENCES

A. Refer to Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

1.5 SUBMITTALS

Submit the following in accordance with the requirements of Exhibit I:

A. Product Data: Include refrigerant, rated capacities, operating characteristics, furnished specialties, and accessories.

1. Performance at ARI standard conditions and at conditions indicated.
2. Performance at ARI standard unloading conditions.
3. Minimum evaporator flow rate.
4. Refrigerant capacity of water chiller.
5. Oil capacity of water chiller.
6. Fluid capacity of evaporator.
7. Characteristics of safety relief valves.
8. Minimum entering condenser-air temperature
9. Performance at varying capacity with constant design entering condenser-air temperature. Repeat performance at varying capacity for different entering condenser-air temperatures from design to minimum in 10 deg F increments.
10. Characteristics (pump type, available head, motor size, pump nominal current, expansion tank volume, and pump flow control) of pump package.

B. Shop Drawings: Complete set of manufacturer's prints of water chiller assemblies, control panels, sections and elevations, and unit isolation. Include the following:

1. Assembled unit dimensions.
2. Weight and load distribution.

3. Required clearances for maintenance and operation.
4. Size and location of piping and wiring connections.
5. Wiring Diagrams: For power, signal, and control wiring.

C. Certificates: For certification required in "Quality Assurance" Article.

D. Source quality-control test reports.

E. Startup service reports.

F. Operation and Maintenance Data: For each water chiller to include in emergency, operation, and maintenance manuals.

G. Warranty: Sample of special warranty.

1.6 QUALITY ASSURANCE

A. Work identified in this section shall be done under a Quality Assurance program in accordance with Section 01 4000, "Quality Requirements."

B. ARI Certification: Certify chiller according to ARI 590 certification program.

C. ARI Rating: Rate water chiller performance according to requirements in ARI 550/590, "Water Chilling Packages Using the Vapor Compression Cycle."

D. ASHRAE Compliance: ASHRAE 15 for safety code for mechanical refrigeration.

E. ASHRAE/IESNA 90.1-2004 Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004, Section 6 - "Heating, Ventilating, and Air-Conditioning."

F. ASME Compliance: Fabricate and stamp water chiller heat exchangers to comply with ASME Boiler and Pressure Vessel Code, Section VIII.

G. Comply with NFPA 70.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Ship water chillers from the factory fully charged with refrigerant and filled with oil.

B. Package water chiller for export shipping.

1.8 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of water chillers that fail in materials or workmanship within specified period.

1. Compressor Warranty Period: Five years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 PACKAGED AIR-COOLED WATER CHILLERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

1. Carrier Corporation; a United Technologies company.
2. Trane.
3. York International Corporation.

C. Description: Factory-assembled and run-tested water chiller complete with base and frame, condenser casing, compressors, compressor motors and motor controllers, evaporator, condenser coils, condenser fans and motors, pump package, electrical power, controls, and accessories.

D. Cabinet:

1. Base: Galvanized-steel base extending the perimeter of water chiller. Secure frame, compressors, and evaporator to base to provide a single-piece unit.
2. Frame: Rigid galvanized-steel frame secured to base and designed to support cabinet, condenser, control panel, and other chiller components not directly supported from base.
3. Casing: Galvanized steel.
4. Finish: Coat base, frame, and casing with a corrosion-resistant coating capable of withstanding a 500-hour salt-spray test according to ASTM B 117.

Sound-reduction package designed to reduce sound level without affecting performance.

E. Compressors:

1. Description: Positive-displacement direct drive with hermetically sealed casing.
2. Each compressor provided with suction and discharge service valves, crankcase oil heater, and suction strainer.
3. Operating Speed: Nominal 3600 rpm for 60-Hz applications.
4. Capacity Control: On-off compressor cycling.
5. Oil Lubrication System: Automatic pump with strainer, sight glass, filling connection, filter with magnetic plug, and initial oil charge.

F. Compressor Motors:

1. Hermetically sealed and cooled by refrigerant suction gas.
2. High-torque, two-pole induction type with inherent thermal-overload protection on each phase.

G. Compressor Motor Controllers:

1. Across the Line: NEMA ICS 2, Class A, full voltage, nonreversing.

H. Refrigeration:

1. Refrigerant: HFC-410A. Classified as Safety Group A1 according to ASHRAE 34. Class I and Class II Ozone-Depleting Substances will not be allowed.

2. Refrigerant Compatibility: Parts exposed to refrigerants shall be fully compatible with refrigerants, and pressure components shall be rated for refrigerant pressures.

3. Refrigerant Circuit: Each circuit shall include a thermal-expansion valve, refrigerant charging connections, a hot-gas muffler, compressor suction and discharge shutoff valves, a liquid-line shutoff valve, a replaceable-core filter-dryer, a sight glass with moisture indicator, a liquid-line solenoid valve, and an insulated suction line.

4. Refrigerant Isolation: Factory install positive shutoff isolation valves in the compressor discharge line and the refrigerant liquid-line to allow the isolation and storage of the refrigerant charge in the chiller condenser.

I. Evaporator:

1. Brazed Plate:

a. Direct-expansion, single-pass, brazed-plate design.

b. Type 316 stainless-steel construction.

c. Code Compliance: Tested and stamped according to ASME Boiler and Pressure Vessel Code, Section VIII.

d. Fluid Nozzles: Terminate with mechanical-coupling end connections for connection to field piping.

2. Heater: Factory-installed and -wired electric heater with integral controls designed to protect the evaporator to minus 20 deg F.

J. Air-Cooled Condenser:

1. Plate-fin coil with integral subcooling on each circuit, rated at 450 psig.

a. Construct coils of copper tubes mechanically bonded to aluminum fins.

b. Hail Protection: Provide condenser coils with louvers, baffles, or hoods to protect against hail damage.

2. Fans: Direct-drive propeller type with statically and dynamically balanced fan blades, arranged for vertical air discharge.

3. Fan Motors: Totally enclosed nonventilating (TENV) or totally enclosed air over (TEAO) enclosure, with permanently lubricated bearings, and having built-in overcurrent- and thermal-overload protection.

4. Fan Guards: Steel safety guards with corrosion-resistant coating.

K. Pump Package:

1. Pump package includes: two high head pumps, VFD, expansion vessels, drainage valves, shut-off valves at entering and leaving connections.

2. The pump package is single point power integrated into the chiller unit power with a separate factory wired control panel. The control of the pump is integrated into the chiller controller. The CH530 displays evaporator pump starts and run-times. Freeze protection down to an ambient of -20 °F (-29 °C) is included as standard. The cold parts of the pump package will also be insulated.

3. Designed with one redundant pump, the chiller controls both pumps through a lead/lag and failure/recovery functionality.

4. A variable speed drive is installed in an additional panel to control the pump. The inverter is adjusted upon start up to balance the system flow and head requirements. The purpose is to save on wasted pump energy caused by a traditional balancing valve.

L. Electrical Power:

1. Factory-installed and -wired switches, motor controllers, transformers, and other electrical devices necessary shall provide a single-point field power connection to water chiller.

2. House in a unit-mounted, NEMA 250, Type 3R enclosure with hinged access door with lock and key or padlock and key.

3. Wiring shall be numbered and color-coded to match wiring diagram.

4. Install factory wiring outside of an enclosure in a raceway.

5. Field power interface shall be to circuit breaker with High Fault Rated Control Panel.

6. Provide branch power circuit to each motor and to controls with one of the following disconnecting means:

   a. NEMA KS 1, heavy-duty, fusible switch with rejection-type fuse clips rated for fuses. Select and size fuses to provide Type 2 protection according to IEC 60947-4-1.

   b. NEMA KS 1, heavy-duty, nonfusible switch.

   c. NEMA AB 1, motor-circuit protector (circuit breaker) with field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.

7. Provide each motor with overcurrent protection.

8. Overload relay sized according to UL 1995, or an integral component of water chiller control microprocessor.

9. Phase-Failure and Under-voltage: Solid-state sensing with adjustable settings.

10. Transformer: Unit-mounted transformer with primary and secondary fuses and sized with enough capacity to operate electrical load plus spare capacity.

    a. Power unit-mounted controls where indicated.

11. Control Relays: Auxiliary and adjustable time-delay relays.

12. Indicate the following for water chiller electrical power supply:

    a. Current, phase to phase, for all three phases.
    b. Voltage, phase to phase and phase to neutral for all three phases.
    c. Three-phase real power (kilowatts).
    d. Three-phase reactive power (kilovolt amperes reactive).
    e. Power factor.
    f. Running log of total power versus time (kilowatt hours).
    g. Fault log, with time and date of each.

M. Controls:

1. Stand-alone, microprocessor based.

2. Enclosure: Share enclosure with electrical power devices or provide a separate enclosure of matching construction.

3. Operator Interface: Keypad or pressure-sensitive touch screen. Multiple-character, backlit, liquid-crystal display or light-emitting diodes. Display the following:

   a. Date and time.
   b. Operating or alarm status.
   c. Operating hours.
   d. Outside-air temperature if required for chilled-water reset.
   e. Temperature and pressure of operating set points.
   f. Entering and leaving temperatures of chilled water.
   g. Refrigerant pressures in evaporator and condenser.
   h. Saturation temperature in evaporator and condenser.
   i. No cooling load condition.
   j. Elapsed time meter (compressor run status).
   k. Pump status.
   l. Anti-recycling timer status.
   m. Percent of maximum motor amperage.
   n. Current-limit set point.
   o. Number of compressor starts.

4. Control Functions:

   a. Manual or automatic startup and shutdown time schedule.

   b. Entering and leaving chilled-water temperatures, control set points, and motor load limit.

   c. Current limit and demand limit.

   d. External water chiller emergency stop.

   e. Anti-recycling timer.

   f. Automatic lead-lag switching.

5. Manual-Reset Safety Controls: The following conditions shall shut down water chiller and require manual reset:

   a. Low evaporator pressure or high condenser pressure.
   b. Low chilled-water temperature.
   c. Refrigerant high pressure.
   d. High or low oil pressure.
   e. High oil temperature.
   f. Loss of chilled-water flow.
   g. Control device failure.

6. Building Automation System Interface: Factory-installed hardware and software to enable building automation system to monitor, control, and display water chiller status and alarms.

   a. ASHRAE 135 (BACnet) communication interface with building automation system shall enable building automation system operator to remotely control and monitor the water chiller from an

operator workstation. Control features and monitoring points displayed locally at water chiller control panel shall be available through building automation system.

N. Insulation:

1. Material: Closed-cell, flexible elastomeric, thermal insulation complying with ASTM C 534, Type I, for tubular materials and Type II, for sheet materials.
2. Thickness: 3/4 inch.
3. Factory-applied insulation over cold surfaces of water chiller components.
   a. Adhesive: As recommended by insulation manufacturer and applied to 100 percent of insulation contact surface. Seal seams and joints.
4. Apply protective coating to exposed surfaces of insulation.

O. Accessories:

1. Factory-furnished, factory installed, chilled-water flow switches.
2. Factory-furnished, factory installed water strainer.
3. Individual compressor suction and discharge pressure gages with shutoff valves for each refrigeration circuit.
4. Factory-furnished neoprene isolators for field installation.
5. Comprehensive acoustic package.

P. Capacities and Characteristics:

1. Capacity: As scheduled on Drawings
2. Full-Load Efficiency:
   a. EER: 9.0
3. Part-Load Efficiency:
   a. IPLV: 15.1 EER.
4. Low Ambient Operation: Chiller designed for operation to 0 deg F.
5. High Ambient Operation: Chiller designed for operation to 115 deg F.
6. Evaporator Configuration: Integral to chiller.
7. Evaporator Pressure Rating: 150 psig.
8. Evaporator Fluid 43% propylene glycol 57% water mixture.
9. Evaporator Entering-Fluid Temperature: 55 deg F.
10. Evaporator Leaving-Fluid Temperature: 45 deg F.
11. Evaporator Fouling Factor: 0.0001 sq. ft. x h x deg F/Btu.
12. Condenser Entering-Air Temperature: 95 deg F.
13. Site Altitude: 7,500 feet.
14. Number of Refrigeration Circuits: Two.

15. Compressor Rated Load Amperes: Compressor A, 21.20 amps, Compressor B, 21.20 amps, Compressor D, 21.20 amps, Compressor E, 21.20 amps.

16. Compressor Locked-Rotor Amperes: Compressor A, 158.0 amps, Compressor B, 158.0 amps, Compressor D, 158.0 amps, Compressor E, 158.0 amps.

17. Controls Power Connection: Fed through integral transformer.

18. Chiller Power Input: 60.30 kW.

19. Chiller Minimum Circuit Ampacity: 118.7 A.

20. Chiller Maximum Overcurrent Protection Device: 125 A.

21. Pump Flow Rate: As required to meet minimum and maximum evaporator flow rates.

22. Pump Head: 67.27 ft H_2O.

23. Noise Rating: 89 dba at 3 feet when measured according to ARI 370.

2.2 SOURCE QUALITY CONTROL

A. Perform functional test of water chillers before shipping.

B. Factory performance test water chillers, before shipping, according to ARI 550/590, "Water Chilling Packages Using the Vapor Compression Cycle."

1. Allow Owner access to place where water chillers are being tested. Notify Owner 14 days in advance of testing.

C. Factory test and inspect evaporator according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1. Stamp with ASME label.

D. For water chillers located outdoors, rate sound power level according to ARI 370 procedure.

PART 3 EXECUTION

3.1 EXAMINATION

A. Before water chiller installation, examine roughing-in for equipment support, anchor-bolt sizes and locations, piping, and electrical connections to verify actual locations, sizes, and other conditions affecting water chiller performance, maintenance, and operations.

1. Water chiller locations indicated on Drawings are approximate. Determine exact locations before roughing-in for piping and electrical connections.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 WATER CHILLER INSTALLATION

A. Equipment Mounting: Install water chiller on concrete bases using elastomeric pads. Comply with requirements in Section 03 3001, "Reinforced Concrete."

1. Minimum Deflection: 1/4 inch.

2. Install epoxy-coated anchor bolts into structural concrete.

3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

4. Install anchor bolts to elevations required for proper attachment to supported equipment.

B. Maintain manufacturer's recommended clearances for service and maintenance.

C. Charge water chiller with refrigerant if not factory charged and fill with oil if not factory installed.

D. Install separate devices furnished by manufacturer and not factory installed.

3.3 CONNECTIONS

A. Comply with requirements in Section 23 2113, "Hydronic Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to chiller to allow service and maintenance.

C. Evaporator Fluid Connections: Connect to evaporator inlet with shutoff valve, strainer, flexible connector, thermometer, and plugged tee with pressure gage. Connect to evaporator outlet with shutoff valve, balancing valve, flexible connector, flow switch, thermometer, plugged tee with pressure gage, and drain connection with valve. Make connections to water chiller with a flange, or mechanical coupling.

D. Connect each drain connection with a union and drain pipe and extend pipe. Provide a shutoff valve at each connection.

3.4 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

B. Inspect field-assembled components, equipment installation, and piping and electrical connections for proper assemblies, installations, and connections.

C. Complete installation and startup checks according to manufacturer's written instructions and perform the following:

1. Verify that refrigerant charge is sufficient and water chiller has been leak tested.

2. Verify that pumps are installed and functional.

3. Verify that thermometers and gages are installed.

4. Operate water chiller for run-in period.

5. Check bearing lubrication and oil levels.

6. Verify proper motor rotation.

7. Verify static deflection of vibration isolators, including deflection during water chiller startup and shutdown.

8. Verify and record performance of water chiller protection devices.

9. Test and adjust controls and safeties. Replace damaged or malfunctioning controls and equipment.

D. Prepare a written startup report that records results of tests and inspections.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain water chillers. Video record the training sessions.

END OF SECTION

SECTION 23 7200

AIR-TO-AIR ENERGY RECOVERY EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

A. Air-to-air energy recovery units are hydronic systems and are covered through the following Division 23 sections:

1. Section 23 2113, "Hydronic Piping."
2. Section 23 2123, "Hydronic Pumps."
3. Section 23 8216, "Air Coils."

PART 2 PRODUCTS

A. Not Used.

PART 3 EXECUTION

A. Not Used.

END OF SECTION

SECTION 23 7333

INDOOR INDIRECT-FUEL-FIRED HEATING AND VENTILATING UNITS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Indirect-fired H&V units with the following accessories:

1. Gas furnace.

2. Chilled Water cooling package.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section.

1.3 RELATED SECTIONS

A. Section 01 4000, "Quality Requirements."

B. Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

C. Section 01 6000, "Product Requirements."

D. Section 22 0548, "Vibration and Seismic Controls for Plumbing, Piping and Equipment."

E. Section 23 1123, "Facility Natural-Gas Piping."

F. Section 23 2113, "Hydronic Piping."

G. Section 23 3101, "HVAC Ducts."

H. Section 23 3300, "Air Duct Accessories."

I. Section 23 4100, "Particulate Air Filtration."

J. Section 25 5000, "Integrated Automated Facility Controls."

K. Section 26 0519, "Low-Voltage Electrical Power Conductors and Cables."

L. Section 26 0526, "Grounding and Bonding for Electrical Systems."

M. Section 26 0700, "Induction Motors – 500HP and Smaller."

1.4 ABBREVIATIONS AND ACRONYMS, DEFINITIONS, AND REFERENCES

A. Refer to Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

1.5 SUBMITTALS

Submit the following in accordance with the requirements of Exhibit I:

A. Product Data: Include rated capacities, furnished specialties, and accessories.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, and methods of field assembly, components, and location and size of each field connection.

1. Wiring Diagrams: Power, signal, and control wiring.

C. Startup service reports.

D. Operation and Maintenance Data: For indirect-fired H&V units to include in emergency, operation, and maintenance manuals.

E. Warranty: Special warranty specified in this section.

1.6 QUALITY ASSURANCE

A. Work identified in this section shall be done under a Quality Assurance Program in accordance with Section 01 4000, "Quality Requirements."

B. Product Options: Drawings indicate size, profiles, and dimensional requirements of indirect-fired H&V units and are based on the specific system indicated. Refer to Section 01 6000, "Product Requirements."

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. Comply with NFPA 70.

E. ASHRAE/IESNA 90.1-2004 Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004, Section 6 - "Heating, Ventilating, and Air-Conditioning."

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to replace components listed below of indirect-fired H&V units that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Heat Exchangers: Manufacturer's standard, but not less than five years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. AbsolutAire, Inc.
2. Advanced Climate Technologies, Inc.
3. Air Dynamics Co.
4. Air Economy Corp.
5. Applied Air; Mestek, Inc.
6. ARES; Mars Air Products.
7. Bananza Air Management Systems Inc.; Div. of Rapid Engineering, Inc.
8. BessamAire, Inc.
9. Cambridge Engineering, Inc.
10. E. K. Campbell Co.; Mechanical Products Division of Thomas & Betts Corporation.

11. Captive-Air Systems, Inc.
12. CES Group; Ventrol Air Handling Systems, Inc.
13. Des Champs Laboratories Incorporated; a unit of Entrodyne Corporation.
14. Energy Jet U.S.
15. Engineered Air.
16. Greenheck.
17. Hastings Industries; Division of Eric, Inc.
18. Industrial Commercial Engineering.
19. Jackson & Church; Div. of Donlee Technologies Inc.
20. KING.
21. LC Systems.
22. Modine Mfg. Co.; Commercial HVAC&R Division.
23. Powrmatic, Inc.
24. Rapid Engineering, Inc.
25. Reznor-Thomas & Betts Corporation; Mechanical Products Division.
26. Sterling Gas; Mestek, Inc.
27. Temprite; Mestek, Inc.
28. Titan Air Incorporated.
29. Trane Company (The); Unitary Products Group.
30. Weather-Rite, Inc.

2.2 PACKAGED UNITS

A. Factory-assembled, prewired, self-contained unit consisting of cabinet, supply fan, controls, filters, chilled water cooling package, and indirect-fired gas furnace to be installed inside the building.

2.3 CABINET

A. Cabinet: Single-wall galvanized-steel panels, formed to ensure rigidity and supported by galvanized-steel channels or structural channel supports with lifting lugs.

B. Access Panels: Piano hinged with cam-lock fasteners for furnace and fan motor assemblies on both sides of unit.

C. Internal Insulation: Fibrous-glass duct lining, comply with ASTM C 1071, Type II, applied on furnace and fan sections only.

1. Thickness: 1 inch.
2. Insulation Adhesive: Comply with ASTM C 916, Type I.
3. Mechanical Fasteners: Galvanized steel suitable for adhesive attachment, mechanical attachment, or welding attachment to casing without damaging liner when applied as recommended by manufacturer and without causing air leakage.

D. Finish: Heat-resistant, baked enamel.

E. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.

2.4 SUPPLY-AIR FAN

A. Fan Type: Centrifugal, rated according to AMCA 210; statically and dynamically balanced, galvanized steel; mounted on solid-steel shaft with heavy-duty pillow-block bearings rated for L50 or 200,000 hours with external grease fittings.

B. Motor: Open dripproof, single-speed premium efficiency motor.

C. Drive: V-belt drive with matching fan pulley and adjustable motor sheaves and belt assembly.

D. Mounting: Fan wheel, motor, and drives shall be mounted in fan casing with elastomeric isolators.

2.5 AIR FILTERS

A. Comply with NFPA 90A.

B. Disposable Panel Filters: 2-inch- thick, factory-fabricated, flat-panel-type, disposable air filters with holding frames. Filters shall be in accordance with Section 23 4100, "Particulate Air Filtration."

2.6 INDIRECT-FIRED GAS FURNACE

A. Description: Factory assembled, piped, and wired; and complying with ANSI Z21.47, "Gas-Fired Central Furnaces," and NFPA 54, "National Fuel Gas Code."

1. AGA Approval: Designed and certified by and bearing label of AGA.

2. Burners: Aluminized steel with stainless-steel inserts.

a. Gas Control Valve: Modulating.
b. Fuel: Natural gas.
c. Minimum Combustion Efficiency: 80 percent.
d. Ignition: Electronically controlled electric spark with flame sensor
e. High-Altitude Model: For Project elevation 7,500 ft above sea level.

B. Power Vent: Integral, motorized centrifugal fan interlocked with gas valve.

C. Inside Unit External Housing: Steel cabinet with integral support inserts and removable bottom arranged to serve as drain pan.

D. Internal Casing: Aluminized steel, arranged to contain airflow, with duct flanges at inlet and outlet.

E. Heat Exchanger: Stainless steel.

F. Heat-Exchanger Drain Pan: Stainless steel.

G. Safety Controls:

1. Vent Flow Verification: Differential pressure switch to verify open vent.

2. Control Transformer: 24-V ac.

3. High Limit: Thermal switch or fuse to stop burner.

4. Gas Train: Regulated, redundant, 24-V ac gas valve assembly containing pilot solenoid valve, electronic-modulating temperature control valve, pilot filter, pressure regulator, pilot shutoff, and manual shutoff all in one body.

5. Purge-period timer shall automatically delay burner ignition and bypass low-limit control.

6. Gas Manifold: Safety switches and controls to comply with ANSI standards and IRI.

7. Airflow Proving Switch: Differential pressure switch senses correct airflow before energizing pilot.

8. Automatic-Reset, High-Limit Control Device: Stops burner and closes main gas valve if high-limit temperature is exceeded.

9. Safety Lockout Switch: Locks out ignition sequence if burner fails to light after three tries. Controls are reset manually by turning the unit off and on.

2.7 COOLING COIL PACKAGE

A. Cabinet: Single-wall, galvanized- or aluminized-steel panels, formed to ensure rigidity and supported by galvanized-steel channels or structural channel supports with lifting lugs and having a stainless-steel condensate pan with drain and overflow connections.

1. External Casing and Cabinet Finish: Baked enamel or powder coating over corrosion-resistant-treated surface in color to match fan section.

B. Coil: Chilled water coil shall meet the requirements of ARI 410.

2.8 CONTROLS

A. Factory-wired, fuse-protected control transformer, connection for power supply and field-wired unit to control panel.

B. Control Panel: Surface-mounted with engraved plastic cover, and the following lights and switches:

1. On-off-auto fan switch.
2. Automatic changeover.
3. Supply-fan operation indicating light.
4. Heating operation indicating light.
5. Thermostat.
6. Freezestat.
7. Supply Air smoke detector.
8. Cooling operation indicating light.
9. Dirty-filter indicating light operated by unit-mounted differential pressure switch.
10. Safety-lockout indicating light.

C. Refer to Drawings for sequence of operation.

D. DDC: Stand-alone control module for link between unit controls and DDC system. Control module shall be compatible with temperature-control system specified in Section 25 5000, "Integrated Automated Facility Controls."

1. Provide start and stop interface relay, and relay to notify DDC system alarm condition.

2. Provide hardware interface or additional sensors as follows:

a. Room temperature.
b. Discharge-air temperature.
c. Furnace operating.

2.9 MOTORS

A. Comply with requirements in Section 26 0700, "Induction Motors – 500HP and Smaller."

2.10 CAPACITIES AND CHARACTERISTICS

A. As Scheduled on Drawings.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting installation of indirect-fired H&V units.

B. Examine roughing-in for piping, ducts, and electrical systems to verify actual locations of connections before equipment installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install gas-fired units according to NFPA 54, "National Fuel Gas Code."

B. Install suspended units from spring hangers with minimum 1-inch static deflection; refer to Section 22 0548, "Vibration and Seismic Controls for Plumbing, Piping and Equipment."

C. Install controls and equipment shipped by manufacturer for field installation with indirect-fired H&V units.

3.3 CONNECTIONS

A. Piping Connections: Drawings indicate general arrangement of piping, fittings, and specialties. Install piping adjacent to machine to allow service and maintenance.

1. Gas Piping: Comply with requirements in Section 23 1123, "Facility Natural-Gas Piping." Connect gas piping with shutoff valve and union and with sufficient clearance for burner removal and service. Provide AGA-approved flexible connectors.

2. Chilled Water: Comply with requirements in Section 23 2113, "Hydronic Piping," for valves and accessories on piping connections to cooling coil section.

3. Condensate Drain: Comply with requirements in Section 23 2113, "Hydronic Piping," for traps and accessories on piping connections to cooling coil section.

B. Duct Connections: Duct installation requirements are specified in Section 23 3101, "HVAC Ducts." Drawings indicate the general arrangement of ducts. Connect supply ducts to indirect-fired H&V units with flexible duct connectors. Flexible duct connectors are specified in Section 23 3300, "Air Duct Accessories."

C. Ground equipment according to Section 26 0526, "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Section 26 0519, "Low-Voltage Electrical Power Conductors and Cables."

3.4 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

B. Complete installation and startup checks according to manufacturer's written instructions and perform the following:

1. Inspect for visible damage to furnace combustion chamber.
2. Inspect casing insulation for integrity, moisture content, and adhesion.
3. Verify that clearances have been provided for servicing.
4. Verify that controls are connected and operable.
5. Verify that filters are installed.
6. Purge gas line.
7. Inspect and adjust vibration isolators.
8. Verify bearing lubrication.
9. Inspect fan-wheel rotation for movement in correct direction without vibration and binding.
10. Adjust fan belts to proper alignment and tension.
11. Start unit according to manufacturer's written instructions.
12. Complete startup sheets and attach copy with Contractor's startup report.
13. Inspect and record performance of interlocks and protective devices; verify sequences.
14. Operate unit for run-in period recommended by manufacturer.
15. Perform the following operations for both minimum and maximum firing and adjust burner for peak efficiency:
    a. Gas Burner:
        1) Measure gas pressure at manifold.
        2) Measure combustion-air temperature at inlet to combustion chamber.
        3) Measure supply-air temperature and volume when burner is at maximum firing rate and when burner is off. Calculate useful heat to supply air.
16. Calibrate thermostats.

17. Adjust and inspect high-temperature limits.

18. Inspect dampers, if any, for proper stroke and interlock with return-air dampers.

19. Adjust thermostat to initiate cooling system and measure and record the following:

    a. Leaving-air, dry- and wet-bulb temperatures.
    b. Entering-air, dry- and wet-bulb temperatures.

20. Inspect controls for correct sequencing of heating, refrigeration, and normal and emergency shutdown.

21. Measure and record airflow. Plot fan volumes on fan curve.

22. Verify operation of remote panel, including pilot-operation and failure modes. Inspect the following:

    a. High-limit heat.
    b. Alarms.

23. After startup and performance testing, change filters, verify bearing lubrication, and adjust belt tension.

C. Remove and replace malfunctioning components that do not pass tests and inspections and retest as specified above.

D. Prepare written report of the results of startup services.

3.5 ADJUSTING

A. Adjust initial temperature set points.

B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain indirect-fired H&V units.

END OF SECTION

SECTION 23 7413

PACKAGED, OUTDOOR, CENTRAL-STATION AIR-HANDLING UNITS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Packaged rooftop air conditioning units up to 30 Tons.

1.2 RELATED SECTIONS

A. Section 01 2500, "Substitution Procedures."

B. Section 01 4000, "Quality Requirements."

C. Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

D. Section 01 6000, "Product Requirements"

E. Section 22 0548, "Vibration and Seismic Controls for Plumbing Piping and Equipment."

F. Section 23 2113, "Hydronic Piping."

G. Section 23 3101, "HVAC Ducts."

H. Section 23 4100, "Particulate Air Filtration."

I. Section 23 8216, "Air Coils."

J. Section 25 5000, "Integrated Automated Facility Controls."

K. Section 26 0700, "Induction Motors – 500HP and Smaller."

1.3 ABBREVIATIONS AND ACRONYMS, DEFINITIONS, AND REFERENCES

A. Refer to Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

1.4 SUBMITTALS

Submit the following in accordance with the requirements of Exhibit I:

A. Shop Drawings, Submit the following:

1. Assembly drawings showing unit dimensions, weight loading, required clearances, construction details, field connection details, and electrical characteristics and connection requirements.

B. Product Data: Submit data indicating:

1. Published Literature indicating cooling and heating capacities, ratings, gages, finishes of materials, electrical characteristics and connection requirements, controls, and accessories.

2. Data for filter media, filter performance data, filter assembly, and filter frames.

3. Performance and fan curves with specified operating point plotted, power, RPM.

4. Sound Power Level Data: Fan outlet and casing radiation at rated capacity.

5. Dampers: Include leakage, pressure drop, and sample calibration curves. Indicate materials, construction, dimensions, and installation details.

6. Electrical requirements indicating power supply wiring including wiring diagrams for interlock and control wiring. Indicate factory installed and field installed wiring.

C. Test Reports: Submit results of factory test at time of unit shipment.

D. Manufacturer's Installation Instructions: Submit assembly, support details, connection requirements, and include start-up instructions.

E. Manufacturer's Certificate: Certify products meet or exceed the requirements of this specification.

F. Manufacturer's Field Reports: Submit start-up report for each unit.

G. Operation and Maintenance Data: Submit manufacturer's descriptive literature, operating instructions, installation instructions, and maintenance and repair data.

1.5 QUALITY ASSURANCE

A. Work identified in this section shall be done under a Quality Assurance Program in accordance with Section 01 4000, "Quality Requirements."

B. Cooling Capacity: Rate in accordance with ARI 210/240 and ARI 340/360.

C. Sound Rating: Measure in accordance with ARI 270.

D. Energy Efficiency: Comply with the requirements of ASHRAE/IESNA 90.1.

E. Performance Requirements: Conform to minimum EER and IPLV prescribed by ASHRAE 90.1 when tested in accordance with ARI 210/240 and ARI 340/360.

F. Electrical: Meet the requirements of NFPA 70, Article 100.

G. Insulation and adhesives: Meet requirements of NFPA 90A.

H. Outside Air Damper Leakage: Test in accordance with AMCA 500.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum three years documented experience approved by manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Section 01 6000, "Product Requirements": Product storage and handling requirements.

B. Protect units from weather and construction traffic by storing in dry, roofed location.

C. Protect rooftop units from damage by storing off roof until roof mounting curbs are in place.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to replace components of RTUs that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Control Boards: Manufacturer's standard, but not less than three years from date of Substantial Completion.

1.9 EXTRA MATERIALS

A. Furnish one set of filters and fan belts for each unit.

PART 2 PRODUCTS

2.1 PRODUCT OPTIONS AND SUBSTITUTIONS

A. Alternate products may be accepted; follow Section 01 2500, "Substitution Procedures."

2.2 ROOFTOP AIR CONDITIONING UNITS, (SMALL CAPACITY) UP TO 25 TONS

A. Manufacturers:

1. Carrier Corp.
2. The Trane Company.
3. York International.

B. Product Description: Self-contained, packaged, factory assembled and prewired, consisting of roof curb, cabinet, supply fan, chilled water cooling coil, hot water heating coil, air filters, mixed air casing, controls, and accessories.

C. Configuration: Horizontal air delivery. As indicated on Drawings.

D. Roof Mounting Curb: 14 inch high, galvanized steel, channel frame with gaskets, nailer strips. Full perimeter type for mounting under entire unit.

E. Cabinet:

1. Designed for outdoor installation with weatherproof construction.
2. Panels: Constructed of steel with baked enamel finish meeting salt spray test in accordance with ASTM B117. Furnish access doors or removable access panels.
3. Insulation: Factory applied to exposed vertical and horizontal panels, glass fiber with edges protected from erosion.

F. Supply Fan: Forward curved centrifugal type, resiliently mounted with adjustable variable pitch motor pulley. Motor permanently lubricated with built-in thermal overload protection.

G. Chilled Water Cooling Coil:

1. Constructed of seamless copper tubes mechanically expanded into aluminum fins. Factory leak tested under water.
2. Galvanized drain pan and piping connection.
3. Furnish for multiple circuited units alternate row circuiting.
4. Furnish coil with corrosion resistant coating capable of withstanding salt spray test of 1000 hours in accordance with ASTM B117.

H. Hot Water Heating Coil:

1. Factory mounted.
2. Coil: Constructed of copper tubes expanded into aluminum fins. Factory leak tested under water.

3. Furnish factory installed piping package with modulating two-way control valve.

4. Furnish coil with corrosion resistant coating capable of withstanding salt spray test of 1000 hours in accordance with ASTM B117.

I. Air Filters:

1. Comply with NFPA 90A.

2. Disposable Panel Filters: 2-inch- thick, factory-fabricated, flat-panel-type, disposable air filters with holding frames. Filters shall be in accordance with Section 23 4100, "Particulate Air Filtration."

3. Bag Filters: 15-inch- thick, factory-fabricated, dry, extended-surface, self-supported filters with holding frames in steel, basket-type retainers. Filters shall be in accordance with Section 23 4100, "Particulate Air Filtration."

J. Mixed Air Casing:

1. Outside Air Damper Leakage: Maximum leakage rate of 3 cfm per square foot at 1inch water column pressure differential.

2. Outside Air Damper: Manual, for fixed outside air quantity. Furnish rain hood with screen.

K. Controls:

1. Furnish interface to Building Automation System specified in Section 25 5000, "Integrated Automated Facility Controls."

L. Accessories:

1. Disconnect Switch: Factory mounted, non-fused type, interlocked with access door, accessible from outside unit, with power lockout capability.

M. Capacity:

1. See equipment schedule on the drawings.

2.3 ROOFTOP AIR CONDITIONING UNITS, (MEDIUM CAPACITY) 25 TONS TO 60 TONS

A. Manufacturers:

1. Carrier Corp.
2. The Trane Company.
3. York International.

B. Product Description: Self-contained, packaged, factory assembled and wired, consisting of roof curb, cabinet, supply fan, variable frequency drive, chilled water cooling coil, hot water heating coil, air filters, heat recovery coil, outdoor air section, and controls.

C. Configuration: Horizontal air delivery. As indicated on Drawings.

D. Roof Mounting Curb: 14 inch high, galvanized steel, channel frame with gaskets, nailer strips. Full perimeter curb under entire unit.

E. Cabinet:

1. Designed for outdoor installation with weatherproof construction.

2. Panels: Steel with baked enamel finish meeting 500 hour salt spray test in accordance with ASTM B117. Furnish hinged access doors with handles and rubber gaskets at edges.

3. Insulation: Factory applied to exposed vertical panels, horizontal panels, and access doors.

4. Interior Surfaces: Sheet metal lined creating double wall construction.

F. Supply Fan:

1. Fan: statically and dynamically balanced, resiliently mounted.

2. Fan Drive: V-Belt type, Cast iron or steel sheaves, dynamically balanced, bored to fit shafts and keyed. Furnish solid shaft construction. Select Variable and adjustable pitch motor sheave to obtain required rpm with sheaves set at mid-position as recommended by manufacturer.

3. Drive Rating: Minimum 1.5 times nameplate rating of motor.

4. Fan Sheave: Adjustable.

5. Motor Sheave: Adjustable.

6. Fan motor: Three phase, NEMA MG-1 design B, continuously rated at 40 degrees C, open drip-proof NEMA T frame, with permanently lubricated bearings and integral overload protection. Provide motors in compliance with Section 26 0700, "Induction Motors – 500HP and Smaller." Provide inverter duty motors as required per the drawings.

7. Fan Assembly Mounting: Furnish spring-type vibration isolators.

G. Chilled Water Cooling Coil:

1. Constructed of seamless copper tubes mechanically expanded into aluminum fins. Factory leak tested under water.

2. Galvanized drain pan and piping connection.

3. Furnish for multiple circuited units alternate row circuiting.

4. Furnish coil with corrosion resistant coating capable of withstanding salt spray test of 1000 hours in accordance with ASTM B117.

H. Hot Water Heating Coil:

1. Factory mounted.

2. Coil: Constructed of seamless copper tubes mechanically expanded into aluminum fins. Factory leak tested under water.

3. Furnish factory installed piping package with modulating three-way control valve.

4. Freezestat: Factory mounted on discharge side of coil.

5. Furnish coil with corrosion resistant coating capable of withstanding salt spray test of 1000 hours in accordance with ASTM B117.

I. Air Filters: Bag filters with 85 percent average efficiency based on ASHRAE 52.1. Furnish 2 inch thick pre-filters. Filters shall be in accordance with Section 23 4100, "Particulate Air Filtration."

J. Heat Recovery Coil Section:

1. Provide empty section, 24.5 in. in length, compatible with the coil specified in Section 23 8216, "Air Coils."

K. Outdoor Air Section:

1. 100 outside air, furnish rain hood and screen.

L. Controls: Furnish interface to Building Automation System specified in Section 25 5000, "Integrated Automated Facility Controls."

M. Accessories:

1. Disconnect Switch: Factory mounted, non-fused type, interlocked with access door, accessible from outside unit, with power lockout capability.

N. Capacity:

1. See equipment schedule on the drawings

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that roof is ready to receive work and opening dimensions are as shown on design drawings.

B. Verify that proper power supply is available.

3.2 INSTALLATION

A. Roof Curb:

1. Assemble roof curb.

2. Install roof curb level.

3. Install units on roof curb providing watertight enclosure to protect ductwork and utility services.

4. Install gasket material between unit base and roof curb.

B. Install units on vibration isolators. Refer to Section 22 0548, "Vibration and Seismic Controls for Plumbing Piping and Equipment."

C. Connect units to supply and return ductwork with flexible connections. Refer to Section 23 3101, "HVAC Ducts."

D. Install condensate piping with trap and route from drain pan to nearest roof drain. Refer to Section 23 2113, "Hydronic Piping."

E. Install components furnished loose for field mounting.

F. Install electrical devices furnished loose for field mounting.

G. Install control wiring between unit and field installed accessories.

3.3 INSTALLATION - HOT WATER HEATING COIL

A. Make connections to coils with unions or flanges.

B. Connect water supply to leaving airside of coil (counter flow arrangement).

C. Locate water supply at bottom of supply header and return water connection at top.

D. Install water coils to allow draining and install drain connection at low points.

E. Install valves and piping specialties in accordance with details as indicated on Drawings.

F. Install automatic air vents at high points complete with shutoff valve. Refer to Section 23 2113, "Hydronic Piping."

G. Install hot water piping accessories within unit casing.

3.4 MANUFACTURER'S FIELD SERVICES

A. Furnish initial start-up and shutdown during first year of operation, including routine servicing and checkout.

B. Furnish 24-hour emergency service on breakdowns and malfunctions for this maintenance period.

3.5 CLEANING

A. Vacuum clean coils and inside of unit cabinet.

B. Install temporary filters during construction period. Replace with permanent filters at Substantial Completion.

3.6 DEMONSTRATION

A. Demonstrate unit operation and maintenance.

B. Furnish services of manufacturer's technical representative for one 8 hour day to instruct LANL personnel in operation and maintenance of units. Schedule training with LANL, provide at least 7 days notice to the LANL Subcontract Technical Representative (STR) of training date.

3.7 SCHEDULES

A. See the equipment schedule on the drawings.

END OF SECTION

FOR LANL USE ONLY

This project specification is based on LANL Master Specification 23 7413, Rev. 2, dated September 1, 2009.

SECTION 23 8126

SPLIT-SYSTEM AIR-CONDITIONERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Split-system heat pump units consisting of separate evaporator-fan and compressor-condenser components. Units are designed for exposed or concealed mounting, and may be connected to ducts.

1.2 RELATED SECTIONS

A. Section 01 2500, "Substitution Procedures."

B. Section 01 4000, "Quality Requirements."

C. Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

D. Section 22 0548, "Vibration and Seismic Controls for Plumbing, Piping, and Equipment."

1.3 ABBREVIATIONS AND ACRONYMS, DEFINITIONS, AND REFERENCES

A. Refer to Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

1.4 SUBMITTALS

Submit the following in accordance with the requirements of Exhibit I:

A. Product Data: For each unit indicated. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.

B. Operation and maintenance data.

C. Leak Test Report.

D. Operational Report.

1.5 QUALITY ASSURANCE

A. Work identified in this section shall be done under a Quality Assurance Program in accordance with Section 01 4000, "Quality Requirements."

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace split-system air-conditioning units that fail in materials and workmanship within five years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 PRODUCT OPTIONS AND SUBSTITUTIONS

A. Comply with Section 01 2500, "Substitution Procedures."

2.2 MANUFACTURERS

A. Mitsubishi.

B. Carrier.

C. Trane.

2.3 EVAPORATOR-FAN UNIT

A. Wall Mounted Unit Chassis: Galvanized steel with flanged edges, removable panels for servicing, and insulation on back of panel.

B. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with ARI 210/240, and with thermal-expansion valve.

C. Evaporator Fan: Forward-curved, double-width wheel of galvanized steel; directly connected to motor.

D. Fan Motor: Multispeed.

E. Filters: washable

2.4 AIR-COOLED, COMPRESSOR-CONDENSER UNIT

A. Casing steel, finished with baked enamel, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.

B. Compressor: Hermetically sealed reciprocating or scroll type with crankcase heater and mounted on vibration isolation. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor

1. Refrigerant: R-410A. Class I and Class II Ozone-Depleting Substances are not allowed.

C. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with ARI 210/240, and with liquid subcooler.

D. Fan: Aluminum-propeller type, directly connected to motor.

E. Motor: Permanently lubricated, with integral thermal-overload protection.

F. Mounting Base: Polyethylene.

2.5 ACCESSORIES

A. Thermostat: Low voltage remote controller to control compressor and evaporator fan.

B. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends.

C. Condensate pump 208V or 240V, single phase, 60 Hz, as indicated on the drawings.

D. Provide Service ball valves with Schrader valve for refrigerant service

PART 3 EXECUTION

3.1 INSTALLATION

A. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.

B. Install roof-mounted, compressor-condenser components on equipment supports. Anchor units to supports with removable, cadmium-plated fasteners.

C. Install compressor-condenser components per Section 22 0548, "Vibration and Seismic Controls for Plumbing, Piping, and Equipment."

3.2 CONNECTIONS

A. Connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

B. Connect supply and return condenser connections with shutoff-duty valve and union or flange on the supply connection and with throttling-duty valve and union or flange on the return connection.

C. Install piping adjacent to unit to allow service and maintenance.

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections. Report results in writing.

B. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist. Report results in writing.

C. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new components, and retest. Report results in writing.

D. Replace damaged and malfunctioning controls and equipment.

END OF SECTION

SECTION 23 8216

AIR COILS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Air coils that are not an integral part of air-handling units.

1. Heat Recovery Coils.

1.2 RELATED SECTIONS

A. Section 01 4000, "Quality Requirements."

B. Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

C. Section 22 0548, "Vibration and Seismic Controls for Plumbing, Piping and Equipment."

D. Section 23 2113, "Hydronic Piping."

E. Section 25 5000, "Integrated Automated Facility Controls."

F. Section 26 0519, "Low Voltage Electrical Power Conductors and Cables."

1.3 ABBREVIATIONS AND ACRONYMS, DEFINITIONS, AND REFERENCES

A. Refer to Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

1.4 SUBMITTALS

Submit the following in accordance with the requirements of Exhibit I:

A. Certificate of Conformance (CoC) that is signed or otherwise authenticated by responsible managers within the supplying organization and that certifies the conformance of end-items to order requirements. CoC must include:

1. Certification that the coils have been designed, manufactured and constructed in accordance with the manufacturer's QA Plan and Paragraph 2.1.

2. Certification documentation showing that the coils meets the design requirements.

3. Purchased item identified by part number.

4. PO number.

B. Copy of the coil manufacturer's QA plan identifying procurement, fabrication, test & inspection, material traceability and nonconformity controls for approval.

C. Qualification and Test Acceptance reports, and material requirements of Paragraph 2.1. Examples of such documents include: supplier performance test information, inspection reports, justification for design integrity, drawings, etc.

D. Any approved changes, waivers, or deviations from this specification.

E. Warranty documentation guarantee against failure in proper use or operation caused by defective materials and/or workmanship for a period of one year from the date of acceptance.

F. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each air coil. Include rated capacity and pressure drop for each air coil.

G. Operation and Maintenance Data.

1.5 QUALITY ASSURANCE

A. Work identified in this section shall be done under a Quality Assurance Program in accordance with Section 01 4000, "Quality Requirements."

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. ASHRAE Compliance:

1. Comply with ASHRAE 15 for refrigeration system safety.

2. Comply with ASHRAE 33 for methods of testing cooling and heating coils.

3. Comply with applicable requirements in ASHRAE 62.1-2004, Section 5, "Systems and Equipment" and Section 7, "Construction and Startup."

1.6 PACKAGING, SHIPPING, RECEIVING, STORAGE, AND HANDLING

A. Package, ship and store heat recovery coils per the requirements of ASME AG-1, article CA-7000.

PART 2 PRODUCTS

2.1 WATER/GLYCOL HEAT RECOVERY COILS IN EXHAUST DUCT

A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawing or a comparable product.

B. Materials shall be equivalent to or exceed the requirements in ASME AG-1, Table CA-3230.

C. Performance Ratings: Tested and rated according to ARI 410 and ASHRAE 33.

D. Minimum Working-Pressure/Temperature Ratings: 200 psig, 300 deg F.

E. Source Quality Control: Factory tested to 300 psig.

F. Tubes: ASTM B 743 copper, minimum 0.017 inch thick.

G. Fins: Aluminum, minimum 0.006 inch thick.

H. Headers: Seamless Copper with drain and air vent tappings.

I. Frames: Galvanized-steel channel frame, minimum 0.0625 inch thick for flanged mounting.

J. Water/Glycol Coil Capacities and Characteristics: Scheduled on Drawings

K. Cooling Fluid: See Drawings, Class I and Class II Ozone-Depleting Substances are not allowed.

2.2 WATER/GLYCOL HEAT RECOVERY COILS IN HVA-5321

A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawing or a comparable product.

B. Performance Ratings: Tested and rated according to ARI 410 and ASHRAE 33.

C. Pressure/temperature ratings in first paragraph below are common. Some manufacturers may vary ratings.

D. Minimum Working-Pressure/Temperature Ratings: 200 psig, 325 deg F.

E. Source Quality Control: Factory tested to 300 psig .

F. Tubes: ASTM B 743 copper, minimum 0.017 inch thick.

G. Fins: Aluminum, minimum 0.006 inch thick.

H. Headers: Seamless copper tube with brazed joints, with drain and air vent tappings.

I. Frames: Galvanized-steel channel frame, minimum 0.0625 inch thick for fanged mounting.

J. Water/Glycol Coil Capacities and Characteristics: Scheduled on Drawings

K. Cooling Fluid: See Drawings, Class I and Class II Ozone-Depleting Substances are not allowed.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install coils level and plumb.

B. Install coils in metal ducts and casings constructed according to SMACNA's "HVAC Duct Construction Standards, Metal and Flexible."

C. Install coils in housings in accordance with the manufacturer's written instructions.

D. Install coils in accordance with Section 22 0548, "Vibration and Seismic Controls for Plumbing, Piping and Equipment."

E. Straighten bent fins on air coils.

F. Clean coils using materials and methods recommended in writing by manufacturers, and clean inside of casings and enclosures to remove dust and debris.

G. Piping installation requirements are specified in other Division 23 sections. Drawings indicate general arrangement of piping, fittings, and specialties.

H. Install piping adjacent to coils to allow service and maintenance.

I. Connect water piping with unions and shutoff valves to allow coils to be disconnected without draining piping. Control valves are specified in Section 25 5000, "Integrated Automated Facility Controls," and other piping specialties are specified in Section 23 2113, "Hydronic Piping."

J. Connect wiring according to Section 26 0519, "Low Voltage Electrical Power Conductors and Cables."

3.2 FIELD QUALITY CONTROL

A. Replace damaged and malfunctioning controls and equipment.

END OF SECTION

SECTION 23 8239

UNIT HEATERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Wall heaters with propeller fans and electric-resistance heating coils.

1.2 PERFORMANCE REQUIREMENTS

A. Unit Heaters shall perform satisfactorily in the following service conditions:

1. Elevation: 7500 feet above sea level.
2. Maximum ambient temperature: 104 degrees F.
3. Minimum ambient temperature: Minus 20 degrees F.
4. 24-hour average temperature: not exceeding 86 degrees F.

1.3 RELATED SECTIONS

A. Section 01 4000, "Quality Requirements."

B. Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

C. Section 26 0519, "Low-Voltage Electrical Power Conductors and Cables."

D. Section 26 0526, "Grounding and Bonding for Electrical Systems."

E. Section 26 0700, "Induction Motors – 500HP and Smaller."

1.4 ABBREVIATIONS AND ACRONYMS, DEFINITIONS, AND REFERENCES

A. Refer to Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

1.5 SUBMITTALS

Submit the following in accordance with the requirements of Exhibit I:

A. Product Data: For each type and size of unit heater indicated, include rated capacities, operating characteristics, furnished specialties, and accessories for each product indicated. Include documentation indicating that units comply with ASHRAE 62.1, Section 5, "Systems and Equipment."

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Plans, elevations, sections, and details.
2. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly
3. Location and size of each field connection.
4. Wiring Diagrams: Power, signal, and control wiring as applicable.
5. Equipment schedules to include rated capacities, furnished specialties, and accessories.

C. Manufacturer's Installation Instructions.

D. Warranty: Provide documentation of one year warranty.

E. Unit Heater Labeling: Certified and labeled by testing agency acceptable to authorities having jurisdiction.

F. Operation and maintenance data: Include emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Work identified in this section shall be done under a Quality Assurance Program in accordance with Section 01 4000, "Quality Requirements."

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by any nationally recognized testing laboratory (NRTL) recognized under 29 CFR 1910.7.

C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5, "Systems and Equipment;" and Section 7, "Construction and Startup."

D. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6, "Heating, Ventilating, and Air-Conditioning."

1.7 WARRANTY

A. Furnish one year manufacturer warranty for heat exchanger.

PART 2 PRODUCTS

2.1 MANUFACTURERS:

A. Subject to compliance with requirements, provide products indicated on Drawings or a comparable product by one of the following:

1. Chromalox, Inc.; a division of Emerson Electric Company.
2. Indeeco.
3. Markel Products; a division of TPI Corporation.
4. Marley Engineered Products.
5. Modine Manufacturing Company.
6. Reznor/Thomas & Betts Corporation.
7. Ruffneck Heaters; a Division of Lexa Corporation.
8. The Trane Company.

2.2 WALL ELECTRIC UNIT HEATERS

A. Description: An assembly including chassis, electric heating coil, fan, motor, and controls. Comply with UL 2021.

B. Cabinet:

1. Front Panel: Stamped-steel louver, with removable panels fastened with tamperproof fasteners.

2. Finish: Baked enamel over baked-on primer with manufacturer's standard color selected by Architect, applied to factory-assembled and -tested wall and ceiling heaters before shipping.

3. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

C. Surface-Mounting Cabinet Enclosure: Steel with finish to match cabinet.

D. Electric-Resistance Heating Coil: Nickel-chromium heating wire, free from expansion noise and hum, embedded in magnesium oxide refractory and sealed in corrosion-resistant metallic sheath. Terminate elements in stainless-steel, machine-staked terminals secured with stainless-steel hardware, and limit controls for high temperature protection. Provide integral circuit breaker for overcurrent protection.

E. Fan: Aluminum propeller directly connected to motor.

1. Motor: Permanently lubricated. Comply with requirements in Section 26 0700, "Induction Motors – 500HP and Smaller."

F. Controls: Unit-mounted thermostat, tamperproof. Low-voltage relay with transformer kit.

G. Electrical Connection: Factory wire motors and controls for a single field connection with disconnect switch.

H. Capacities and Characteristics: See Drawings.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install unit heaters to comply with NFPA 90A.

B. Install wall-mounting thermostats and switch controls in electrical outlet boxes at heights to match lighting controls. Verify location of thermostats and other exposed control sensors with Drawings and room details before installation.

C. Ground equipment according to Section 26 0526, "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Section 26 0519, "Low-Voltage Electrical Power Conductors and Cables."

E. Adjust initial temperature set points.

F. Adjust unit components for optimum heating performance and efficiency.

3.2 FIELD QUALITY CONTROL

A. Perform the following field tests and prepare test reports:

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

2. For units that have electric resistance heating coils, operate electric heating elements through each stage to verify proper operation and electrical connections.

3. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

B. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION

FOR LANL USE ONLY

This project specification is based on LANL Master Specification 23 8239, Rev. 0, dated February 14, 2011.

SECTION 25 5000

INTEGRATED AUTOMATED FACILITY CONTROLS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. This section includes the specification for development of the Building Automation System (BAS). The BAS system architecture utilizes intelligent distributed control modules, located throughout the building, that communicate over a BACnet™ controller network.

B. It is the intent of this section to provide, install, connect, program, and calibrate the additions and/or modifications to the BAS as necessary to provide fully automatic control for all systems as shown in the control drawings, stated in the sequences of operation.

C. It is the responsibility of the bidder to read and conform to all sections of the specifications, review all subcontract drawings, and coordinate with all equipment suppliers of material specified under other sections of the specifications.

D. The engineering, installation supervision, programming, graphic development, calibration, start up, and checkout necessary for a complete and fully operational BAS, as specified hereafter, shall be provided under this section.

E. Provide training and instruction of the installed BAS.

F. Provide the necessary materials and manpower to participate in the testing, adjusting, and balance and the commissioning process as required by those sections of the specification.

1.2 RELATED SECTIONS

A. Section 01 2500, "Substitution Procedures."

B. Section 01 4000, "Quality Requirements."

C. Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

D. Section 23 0800, "Commissioning of HVAC."

E. Section 26 0533, "Raceway and Boxes for Electrical Systems."

F. Section 26 0553, "Identification for Electrical Systems."

G. Section 28 3100, "Fire Detection and Alarm."

H. Section 40 9600, "Process Control Software."

1.3 ABBREVIATIONS AND ACRONYMS, DEFINITIONS, AND REFERENCES

A. Refer to Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

1.4 SUBMITTALS

Submit the following in accordance with the requirements of Exhibit I:

A. With Bid: BAS system manufacturer and subcontract information for local installing subcontractor and factory representative. Failure to comply with the specified requirements of this section will result in rejection of submittal.

B. Submittals shall consist of shop drawings, catalog data sheets, graphic displays, and software development parameters as defined in the following paragraphs. No materials shall be purchased and no work shall be conducted at the job site until submittals have been reviewed and approved.

1. Shop drawings shall be provided that show detailed communications architectures (including connection to the LANL campus LAN), control devices, electrical ladder diagrams, control system schematics, approved protocol implementation compliance statements (PICS), sequences of operation, and a material list. These same sequences of operation shall also be provided as a separate document from the drawings in either Microsoft Word or PDF format. All systems and the associated control components as well as all connections between components shall be clearly indicated. The submittal shall indicate the required coordination with equipment supplied by sources other than this section. The intention is for the shop drawings to be comprehensive enough for the installation crew to complete all aspects of the installation without the need for supporting documentation, except third party equipment installation manuals. All wiring shown on the drawings shall be labeled on both ends and these labels shall be used in the installation process for ease of comparing the shop drawings to the actual field installation. Each control component shall be given a unique identifier. This identifier shall be used in creating equipment field device labels and in the sequence of operation so that each device can be matched uniquely to the drawings.

   a. Electrical Ladder Diagrams shall be shown on the shop drawings. Electrical ladder diagrams shall show the specific details of all switches, relays, motor starters, etc. The electrical ladder diagrams shall show the correct control wiring and interlock wiring of all equipment provided under the Subcontract. Each diagram shall reference the correct power source by breaker panel and circuit number.

   b. The sequence of operation for each controlled system shall be provided with reference to the control device identifier. The sequence of operation shall break down the control operation by major function (e.g., mixed air control, occupied-unoccupied, smoke purge, etc.) and describe in detail the correct operation and interaction with other system functions. Use of the sequences of operation stated on the subcontract control drawings is acceptable; however, they shall be modified to reflect actual control device identifiers. Point list tables shall be included to describe alarm, monitoring, interlock, and other general functions.

   c. A complete material listing shall be included on the shop drawings that show the device model numbers, control device identifiers, quantities, manufacturers, etc., of all equipment provided under this section. The material list shall be organized in alphabetical order so that it can be easily compared to the associated catalog data sheets.

2. Catalog data sheets shall be provided for each different piece of equipment provided under this section. At a minimum the data sheet shall contain sufficient information so that compliance with the

specification can be verified. Where multiple models or options are indicated on the same catalog data sheet, the equipment proposed shall be circled or otherwise indicated (highlighter is not acceptable because of copy quality). The catalog data sheets shall be organized in alphabetical order to match the material listing on the shop drawings.

3. Point verification and sensor calibration forms shall be submitted for all points and sensors that are installed as part of the BAS. This includes all points connected to unitary controllers (UCs). Once approved, the Subcontractor shall complete the forms during startup to document successful point functionality and sensor calibration. The completed forms shall be included as part of the record documentation. The LANL Subcontract Technical Representative (STR) reserves the right to designate a representative to monitor completion of the point verification.

4. A test plan shall be submitted for review and approval.

5. All graphic slides (or typical graphics for identical equipment) proposed for use on this project shall be submitted for review and approval. The submitted slides shall be printed in color or submitted electronically as a PDF or other commonly viewable format. All real-time display fields, user picks, set point picks, etc. shall be clearly indicated. No graphic software shall be installed on the job site until the graphic slides have been approved.

6. Software development parameters including all trend logs, reports, point alarm parameters, passwords, and scheduling shall be submitted based on the contents of this specification section. The information contained in this portion of the submittal shall be followed during development of the programming code and shall be used for evaluation of the systems performance during the commissioning phase.

   a. Report templates shall indicate what information will be presented on each report, how the information will be presented, report hard disk upload parameters, and report log file names.

   b. Blank schedule forms for each air-handling unit shall be submitted for completion by the LANL STR. Additionally, a blank schedule group form template shall be submitted so the LANL STR can identify schedule groups of HVAC equipment.

7. Provide detailed operation sequences for all variable frequency drives including required ramp up/down speeds, accelerations, resets, and deadbands.

8. Submit calibration reports.

1.5 QUALITY ASSURANCE

A. Work identified in this section shall be in accordance with Section 01 4000, "Quality Requirements."

B. Qualification of the Installing Firm: The installing firm shall:

1. Have satisfactorily installed at least five (5) BAS systems of equivalent nature and scope to the system described in this section.

2. BAS supplier shall have an authorized factory representative and service department of the product manufacturer within 125 miles of LANL.

3. Provide the services of a qualified system technician to design the system and to test the completed system.

4. Be a factory-certified representative of the manufacturer of the system that will be used on this project.

C. Acceptable Building Automation System Installers:

1. The following Factory Authorized Installers have demonstrated their capabilities to provide a BAS meeting LANL standards and the criteria herein (no substitutions).

a. Integrated Control Systems, Inc. (Automated Logic's dealer for the Albuquerque, NM area)

b. Automated Control Systems, Inc. (Alerton Technologies' dealer for the Albuquerque, NM area)

D. Qualifications of the BAS system technician: The BAS system technician shall:

1. Be factory trained in the theory, operation, installation, and troubleshooting of the BAS that will be used for this project.

2. Have satisfactorily designed at least five (5) BAS systems of equivalent nature and scope to the system described in this section.

3. Have satisfactorily field-tested at least five (5) BAS systems of equivalent nature and scope to the system described in this section.

E. Electrical Suitability:

1. All controllers and hardware shall be Underwriters Laboratories, Inc. (UL®) or nationally recognized testing laboratory (NRTL) listed or labeled.

2. Branch-Circuit Conductors. The branch-circuit conductors supplying one or more units of a data processing system shall have an ampacity not less than 125 percent of the total connected load. (NEC Article 645.5)

3. Each enclosure or panel configuration with control hardware installed shall be UL or NRTL listed as an assembly.

1.6 RECORD DRAWINGS

A. Record drawings shall be provided as required by the general Subcontract requirements. Record drawings shall not be completed until after installation is complete. Any changes made during installation shall be recorded as red-lines on the approved coordinated BAS shop drawings as they are made. These red-line drawings shall be available at all times for inspection by the LANL STR. At completion of the project, all hand drawn field changes shall be incorporated into a clean reproducible set of as-built drawings. These as-built drawings shall be provided to LANL electronically (current AutoCAD format) and used during the training sessions.

B. The Subcontractor shall furnish complete spare parts lists, operating instructions, maintenance literature, and completed point verification and sensor calibration forms.

C. Two (2) sets of the following documents shall be delivered to the LANL STR prior to the beginning of training:

1. One operating manual for each component purchased through a third-party vendor including equipment such as computers, printers, video monitors, interface cards, modems, etc.

2. All manuals relating to operating system software. This requirement includes not only the BAS operating software but also the current version of Windows.

3. A systems programmer's manual that includes all information necessary to perform BAS programming and produce system graphics.

D. After final occupancy and all debugging have occurred, the Subcontractor shall prepare two copies of all project-specific control software on nonvolatile computer recording media (CD) and deliver them to the LANL STR.

E. License agreements for all supplied software shall be provided.

F. Licensed copies of all specialty software needed for controlled configuration.

1.7 SYSTEM TESTING

A. At the termination of the point verification and sensor calibration process, the Subcontractor shall submit completed and approved point verification and calibration forms for each point or sensor in the system.

B. Upon successful completion of all point verification and sensor calibration testing, the Subcontractor shall submit hard copies of all trend logs as specified in PART 3 of this section. The trend logs shall trend at least 48 hours of normal uninterrupted operation (non-weekend or holiday) for the purpose of documenting proper implementation of the control sequences of operation. The control sequence of operation shall also be verified by the completion of a Sequence of Operation (SOO) commissioning procedure.

C. The LANL STR reserves the right to participate in or assign a representative to participate in the startup, testing, programming, or any other aspect of the construction of this project at no additional cost to LANL. In general, the FPT shall be observed by the LANL CxA.

D. The Subcontractor shall be responsible for developing and implementing a Pre-Functional Test before Functional Performance Testing (FPT) begins. This test shall verify the point-to-point wiring, calibration, field device operation, and basic functionality of the BAS. The Subcontractor is responsible for back-checking and documenting his own work before a system or portion of a system is observed for FPT.

E. The Subcontractor shall be responsible for developing and implementing a Functional Test. The Subcontractor shall perform and otherwise support the FPT. See Section 23 0800, "Commissioning of HVAC," for details and example FPT.

1.8 TRAINING

A. Provide a total of 80 hours of training time.

B. During the initial startup phase of the project, the BAS supplier shall permit the LANL operating personnel to be involved with the troubleshooting, initial startup,

point verification testing, performance trending and sequence of operations verification.

C. Prior to the final system trending, provide three days (20 hours) of training for up to six (6) LANL STR-designated operating personnel, at least one of which shall be from LANL ES-DE I&C, or their designee. The training shall cover all general aspects of the BAS system installation, wiring, calibration techniques, programming, troubleshooting, etc. The training shall not cover the details of this specific project. The training shall provide the same structure and depth as that provided to a factory authorized representative's installation and programming personnel.

D. Upon completion and acceptance of the work, provide three days (20 hours) of training for up to six (6) LANL STR-designated operating personnel who have responsibility for the mechanical/control system. This training shall be conducted on site and shall focus on the specifics of this project. A complete training booklet shall be provided and used during the training period. The booklet shall include the as-built drawings and the sequence of operations.

E. The BAS supplier shall provide 40 additional hours of onsite training during the warranty period. The Subcontractor shall provide this training at the request of the LANL STR. The LANL STR will give at least one-week notice of the need for additional training. Warranty and service time shall not constitute training hours.

1.9 SERVICE AND WARRANTY

A. The system supplier shall have a maintenance support facility complete with system technicians, diagnostic and test equipment, and new spare components. Emergency service shall be available in the local office on a 24-hour, 7-day-a-week basis. The service agent shall provide a continuously monitored local service telephone number for emergency service.

B. Service and maintenance shall be provided for one (1) year from time of substantial completion or from successful completion of the SOO functional testing, whichever is later. If the manufacture has a standard warranty that exceeds the specified requirement then the longer manufacturer's warranty shall be provided to the LANL STR. Service during this period shall be available within 12 hours from the time the trouble call is placed. Warranty shall be for all materials and labor provided as the scope of work of this section.

PART 2 PRODUCTS

2.1 PRODUCT OPTIONS AND SUBSTITUTIONS

A. Comply with Section 01 2500, "Substitution Procedures."

2.2 SYSTEM FUNCTIONALITY

A. AHU's

1. All AHUs must be equipped with (as a minimum):
   a. OA, RA (if 100% OA, no RA sensor required), and SA Temperature sensors.
   b. OA flow measurement.
   c. Indication of valve position.
2. All Constant air volume (CAV) boxes must be equipped with (as a minimum):

a. Supply air temperature to zone, zone temperature, and zone CFM.
b. Indication of damper and valve position.

3. Space temperature sensors shall have setpoint adjustment that is limited to ± 2ºF.

2.3 NETWORKING / COMMUNICATIONS

A. Local Area Network (LAN).

1. The BAS for this facility will stand alone. It will have no connection to the primary ETHERNET® LAN communication network.

2. All BAS devices shall communicate in BACnet™ encoded to be compatible with the ETHERNET®. BAS devices that communicate using proprietary protocols or LonTalk protocols are unacceptable.

B. Controller Local Area Network (LAN).

1. All BAS Primary Controllers, Application Specific Controllers, and Unitary Controller Interfaces within a specific building shall reside on the second tier LAN referred to as the Controller LAN. The Controller LAN shall begin at the building BAS Gateway and extend to one or more BAS Controller LAN controllers located throughout the building.

2. Development of the Controller LAN is work provided entirely under this section of the specification.

3. All BAS Devices that reside on the Controller LAN shall communicate in BACnet™. Proprietary or LonTalk protocols shall not be permitted except for VFDs that may be connected using a LonTalk or Modbus™ network.

C. Sub-Controller Local Area Network.

1. All lower-level controllers associated with each Unitary Interface Controller shall reside on the third-tier LAN referred to as the Sub-Controller LAN.

2. Unitary Controllers (UCs) shall be installed on a Sub-Controller LAN. These LAN's shall operate off the associated Unitary Controller Interface but in no case shall the Sub-Controller LAN be necessary for standalone operation of any attached UC.

3. All BAS Devices that reside on the Sub-Controller LAN shall communicate in BACnet™. Proprietary or LonTalk protocols shall not be permitted except for VFDs that may be connected using a LonTalk or Modbus™ network.

4. The Sub-Controller LAN shall operate using RS-485 at a selectable speed of from 9.6K to 115.2K baud. Development of the Sub-Controller LAN is work provided entirely under this section of the specification.

2.4 BACNET™ COMPLIANCE

A. The BAS system shall utilize BACnet™ communications between all controllers on the controller LAN as defined by ANSI/ASHRAE Standard 135-2001. This means that the system shall use BACnet™ as the communication protocol between distributed controllers communicating on the Controller LAN and that proprietary or LonWorks protocols are not acceptable except for communication

with VFDs. The BACnet™ communication protocol shall, at a minimum, support the following Objects and Application Services (Conformance Class 3):

Objects >	Services >
Binary Input	Read property
Binary Output	Write property
Binary Value	I-Am
Analog Input	I-Have
Analog Output	Read Multiple Property
Analog Value	Write Multiple Property
Calendar	Who-Has
Schedules	Who-Is

B. The communication network between controllers (Controller LAN) shall be EIA-485, at least 78.4kbps, using either MS/TP or 156K baud using ARCNET® at the Data Link Layer or shall be ETHERNET®. Systems that use proprietary protocol for the main controller field bus are not acceptable.

2.5 CENTRAL BAS WORKSTATION SERVER

A. The BAS server will reside in CAB-100 in the Operations Center. A client workstation (VersaView touchscreen or equivalent) shall be mounted in the BAS-2 cabinet in the Utility Building. The client workstation will be used for configuration, maintenance and local monitoring. Primary control of the BAS system will reside in the FCS workstation in the Operations Center. See Drawing C55864, Sheet E-6140 for a depiction of the control system block diagram.

B. The BAS shall communicate with the FCS Workstation server. This project shall be installed in coordination with LANL ES-DE I&C Team. The operating system on these servers shall be Windows 2008 Server (or better), and are maintained by a LANL IT support group (currently IST-12). The operating system on web appliances, if different from Windows 2008 Server, shall be maintained by the controls vendor in cooperation with ES-DE I&C Team. The BAS control software on the FCS servers is maintained by LANL ES-DE. All necessary software or server/appliance upgrades and database consolidation required for this new project to integrate with other existing projects from this same controls vendor shall be provided by the Controls Subcontractor. The intent here is to utilize the existing central servers/appliances and integrating the new building databases on the server/appliance whenever possible.

C. Graphical User Interface Software (GUI)

1. BAS signals will be displayed on the FCS GUI. The FCS software is specified in Section 40 9600, "Process Control Software."

D. Password protection:

1. Password access shall be provided by the FCS workstation.

E. System Interaction

1. The operator interface shall allow the operator to perform commands within any BAS controller on the BAS local area network including, but not limited to, the following:

a. Start-up or shutdown of all equipment converted to the BAS

b. Adjust, override, and release setpoints
c. Enable/Disable process execution
d. Lock/Unlock alarm reporting for each point
e. Enable/Disable Totalization for each point
f. Enable/Disable Trending for each point
g. Enter temporary override schedules
h. Change time/date
i. View limits

2. All control strategies and energy management routines shall be definable by the operator. System definition and modification procedures shall not interfere with normal system operation and control.

3. The system shall be provided complete with all equipment and documentation necessary to allow an operator to independently perform the following functions:

a. Add/Delete/Modify Standalone BAS Panels

b. Add/Delete/Modify Application Specific Controllers

c. Add/Delete/Modify points of any type, and all associated point parameters, and tuning constants

d. Add/Delete/Modify alarm reporting definition for each point

e. Add/Delete/Modify control loops

f. Add/Delete/Modify energy management applications

g. Add/Delete/Modify time- and calendar-based programming

h. Add/Delete/Modify Totalization for every point

i. Add/Delete/Modify Historical Data Trending for every point

j. Add/Delete/Modify custom control processes

k. Add/Delete/Modify any and all graphic displays, symbols, and cross-references to point data

l. Add/Delete/Modify all operator passwords

m. Add/Delete/Modify Alarm Messages

4. Definition of operator device characteristics, BAS panels, individual points, applications, and control sequences shall be performed through fill-in-the-blank templates.

F. Reports

1. Reports shall be generated automatically or manually, and directable via operator input to GUI monitors, printers, or disk files. As a minimum, the system shall allow the user to easily obtain the following types of reports:

a. A general listing of all points in the network
b. List all points currently in alarm
c. List of all off-line points
d. List all points currently in override status
e. List of all disabled points
f. List all points currently locked out
g. List of all items defined in a "Follow-Up" file

h. List all Weekly Schedules
i. List all Holiday Programming
j. List of Limits and Deadbands

2. Summaries shall be provided for specific points, for a logical point group, for a user-selected group of groups, or for the entire facility without restriction due to the hardware configuration of the BAS.

G. Third Party Software Interface

1. System data, including transactions, alarms, totalization files, etc., shall be stored on the server hard drive in a format compatible with Microsoft database and spreadsheet programs.

H. Dynamic Color Graphic Displays

1. Software for development of BAS color graphic site plans, buildings, building floor plan displays, and system schematics for each piece of mechanical equipment, including air handling units, chilled water systems, hot water boiler systems, and all other controlled or monitored systems shall be provided as specified in PART 3 of this specification.

2. Dynamic point (actual or calculated) indication shall be shown in their respective locations, and shall automatically update to represent current conditions without operator intervention.

I. System Maintenance

1. The following maintenance activities shall be performed on the BAS server:

a. Add/Modify/Delete programming,
b. Limit setpoint adjustment range of zone sensors,
c. Define Holiday Schedules,
d. Enter/Modify analog alarm limits, and
e. Enter/Modify analog warning limits.

J. Database Save/Restore/Back-Up

1. Back-up copies of all standalone BAS panel databases shall be stored on the appropriate BAS server. The subcontractor shall backup all affected databases each day after modifications are made.

2. Continuous supervision of the integrity of all BAS panel databases shall be provided. In the event that any BAS panel on the network experiences a loss of its data base for any reason, the system shall automatically download a the latest updated copy of the respective database to restore proper operation. Database back-up/download shall occur without operator intervention. Operators shall also have the ability to manually execute uploads and downloads of any or all portions of a BAS panel database to or from the appropriate LANL BAS server.

2.6 GATEWAY CONTROLLERS (GWC)

A. The Gateway Controller (GWC) shall be a microprocessor-based communications device that functions as a communications gateway/router between a Controller LAN and the Primary LAN. It shall be capable of acting as a bridge and router between designated BACnet™ data links and the ARCNET

data link. It shall offer PTP to ARCNET and BACnet/IP to ARCNET routing capability.

B. The Primary LAN that connects GWCs in other buildings exists and development of that LAN is not work of this section. The Primary LAN is configured as an Ethernet 10/100Base-T (10 or 100Mbps) or Gigabit Ethernet (future) network operating over fiber-optic cable. In the case of Ethernet connections, the LAN Gateway may be configured as Ethernet 10/100Base-T(10/100Mbps), and shall be CAT5 or current industry standard cable that exceeds CAT5 specifications

C. Each GWC shall support a building Controller LAN on which shall reside Primary Controllers, Application Specific Controllers, or Unitary Controller Interfaces.

D. The Controller LAN shall use the BACnet™ communication protocol. The communication between controllers shall be at least 156 Kbps using ARCNET implemented over EIA-485 at the Data Link Layer.

E. The GWC shall provide two EIA 232 ports that can be connected to future portable computers or modems.

F. The GWC shall provide full arbitration between multiple users, whether they are communicating through the same or different GWCs.

G. The GWC shall be responsible for routing global information from the various building Controller LAN's that may be installed throughout a building or multiple buildings.

H. The GWC shall utilize FLASH memory that allows firmware updates to be performed remotely.

2.7 PRIMARY BAS CONTROLLERS (PFC)

A. Primary BAS Controllers (PFCs) shall be provided where larger non-application specific I/O is installed. Such applications could include central chiller plants, boiler plants, larger built up air handling units with special point and software requirements. PFCs shall reside on the Controller LAN and their point information shall be fully accessible by the FCS.

B. PFCs shall use the BACnet™ communication protocol for communication with all other Controller LAN controllers and shall, at a minimum, support the following Objects and Application Services (Conformance Class 3):

Objects >	**Services >**
Binary Input	Read property
Binary Output	Write property
Binary Value	I-Am
Analog Input	I-Have
Analog Output	Read Multiple Property
Analog Value	Write Multiple Property
Calendar	Who-Has
Schedules	Who-Is

C. Each PFC shall be capable of standalone direct digital operation utilizing its own 32-bit processor, nonvolatile flash memory, input/output, 12-bit A-to-D conversion, hardware clock/calendar, and voltage transient and lightning protection devices. All nonvolatile flash memory shall have a battery backup of

at least five years. Firmware revisions to the module shall be able to be made from the LANL BAS server, portable operator terminals (future), or from remote locations over modems or LANs.

D. Each PFC shall be expandable to the specified I/O point requirements and shall accommodate multiple I/O Expander Modules via a designated expansion I/O bus port. These expander modules shall expand the total point capacity of each controller up to 192 points where specified. The controller, in conjunction with the expansion modules, shall act as one standalone controller. The Subcontractor shall provide 30% spare hardware I/O capacity.

E. All point data, algorithms, and application software within a PFC shall be custom programmable from the Web based GUI with appropriate password level.

F. Each Primary BAS Controller shall execute application programs, calculations, and commands via a 32-bit microcomputer resident in the controller. All operating parameters for application programs residing in each PFC shall be stored in read/writable nonvolatile flash memory within the PFC and shall be able to upload/download to/from the BAS server via the Web based GUI with appropriate password level.

G. Each PFC shall include self-test diagnostics that allow the PFC to automatically relay to the FCS any malfunctions or alarm conditions that exceed desired parameters as determined by programming input.

H. PFCs shall contain both software and firmware to perform full DDC PID control loops.

I. Each PFC shall contain a serial or USB port for the interface of maintenance personnel's portable computer (future). All network interrogation shall be possible through this port.

J. Input/Output Processing:

1. Digital outputs shall be relays, 24 VAC or VDC maximum, 3 amp maximum current. Each configured as normally open or normally closed using jumpers and either dry contact or bussed. Triac outputs are unacceptable. Each output shall have a manual Hand-Off-Auto switch, to allow for override and an LED to indicate the operating mode of the output.

2. Universal inputs shall be Thermistor (BAPI Curve II) 10K Ohm at 77EF (25EC), 0-5 VDC, 10K Ohm maximum source impedance, 0-20mA – 24 VDC loop power 250 Ohm input impedance, dry contact - 0.5mA maximum current.

3. Analog output shall be electronic, voltage mode 0-10 VDC or current mode 4-20mA.

4. Analog pneumatic outputs shall be 0-20 psi. Each pneumatic output shall have a feedback transducer to be used in the system for any software programming needs. The transducer shall measure the actual psi output value and not a calculated value. Each output shall have a manual override switch that shall allow each output to be configured in one of three ways: open, closed, or automatic operation. An LED shall indicate the state of each output.

2.8 APPLICATION SPECIFIC CONTROLLERS

A. Application Specific Controller (ASCs) shall be provided where small application-specific I/O is installed. Such applications include packaged rooftop equipment, packaged chiller controllers, and exhaust fan control. Multiple Application Specific Controllers (ASCs) shall not be employed to substitute for a single PFC. ASCs shall reside on the Controller LAN and their point information shall be fully accessible by the GWC.

B. The ASC shall use the BACnet™ communication protocol to communicate with all other Controller LAN controllers and shall, at a minimum, support the following Objects and Application Services (Conformance Class 3):

Objects >	**Services >**
Binary Input	Read property
Binary Output	Write property
Binary Value	I-Am
Analog Input	I-Have
Analog Output	Read Multiple Property
Analog Value	Write Multiple Property
Calendar	Who-Has
Schedules	Who-Is

C. Each ASC shall be capable of stand-alone BAS operation utilizing its own 32-bit processor, nonvolatile flash memory, input/output, 10-bit A-to-D conversion, hardware clock/calendar, and voltage transient and lightning protection devices. All nonvolatile Flash memory shall have a battery backup of at least five years. Firmware revisions to the module shall be made from the LANL BAS server, Web based GUI.

D. All point data, algorithms, and application software within the ASCs shall be custom programmable from the Web based GUI.

E. Each ASC shall execute application programs, calculations, and commands via a 32-bit microcomputer resident in the controller. All operating parameters for the application program residing in each ASC shall be stored in read/writable nonvolatile flash memory within the ASC and shall be able to upload/download to/from the LANL BAS server via the Web based GUI with appropriate password level.

F. Each ASC shall include self-test diagnostics that allow the ASC to automatically relay to the GWC any malfunctions or alarm conditions that exceed desired parameters as determined by programming input.

G. Each ASC shall contain both software and firmware to perform full DDC PID control loops.

H. A serial or USB port shall be provided for the interface of maintenance personnel's portable computer. All network interrogation shall be possible through this port.

I. ASCs shall be capable of being operated in an ambient temperature environment of -20 °F to +150 °F (-28.9 °C to 65.6 °C).

J. Input/Output Processing:

1. Digital outputs shall be relays, 24 VAC or VDC maximum, 3 amp maximum current. Triac outputs are unacceptable. Each output shall have a manual Hand-Off-Auto switch to allow for override and an LED to indicate the operating mode of the output.

2. Universal inputs shall be Thermistor (BAPI Curve II) 10K Ohm at 77EF (25EC), 0-5 VDC - 10K Ohm maximum source impedance, 0-20mA – 24 VDC loop power 250 Ohm input impedance, Dry Contact - 0.5mA maximum current.

3. Analog electronic outputs shall be voltage mode 0-10 VDC or current mode 4-20mA.

4. Enhanced Zone Sensor Input shall provide one thermistor input, one local setpoint adjustment, one timed local override switch, and an occupancy LED indicator.

2.9 UNITARY CONTROLLER INTERFACE

A. Unitary Controller Interfaces (UCIs) shall be provided where small unitary type controllers are required but these small controllers are not capable of direct connection to the Controller LAN. UCIs shall reside on the Controller LAN.

B. The UCI shall use the BACnet™ communication protocol to communicate with all other Controller LAN controllers and shall, at a minimum, support the following Objects and Application Services (Conformance Class 3):

Objects >	**Services >**
Binary Input	Read property
Binary Output	Write property
Binary Value	I-Am
Analog Input	I-Have
Analog Output	Read Multiple Property
Analog Value	Write Multiple Property
Calendar	Who-Has
Schedules	Who-Is

C. The UCI shall use the BACnet™ protocol for communication to the attached UCs over the Sub-Controller LAN. The communication speed between Sub-Controller LAN shall be adjustable from between 9600 baud to 115.2 kbps.

D. A serial or USB port shall be provided on the UCI for the interface of the operators' portable computer (future). All network interrogation shall be possible through this port.

E. Each UCI shall execute application programs, calculations, and commands via a 32-bit microcomputer resident in the UCI. All operating parameters for application programs residing in each UCI shall be stored in read/writable nonvolatile flash memory within the controller and shall be able to upload/download to/from the LANL BAS server via the Web based GUI with appropriate password level. All nonvolatile memory shall have a battery backup of at least five years. Firmware revisions to the controller should be able to be made from the LANL BAS server via the Web based GUI.

F. The UCI shall contain both software and hardware to perform full DDC PID control loops.

G. UCI Circuits shall be optically isolated.

2.10 UNITARY CONTROLLERS

A. Each Unitary Controller (UC) shall use the BACnet™ communications protocol for communication with the UCI and the other UCs on the Sub-Controller LAN and shall, as a minimum, support the following Objects and Application Services (Conformance Class 2):

Objects >	**Services >**
Binary Input	Read property
Analog Value	Write Property

B. Each UC shall be able to support various types of zone temperature sensors, such as temperature sensor only, temperature sensor with built-in local override switch, with set point adjustment switch.

C. Each UC for CAV application shall have a built-in airflow transducer for accurate (+/- 5.0% F.S.) airflow measurement in order to provide the pressure independent CAV operation.

D. Each UC for CAV applications shall have an integral direct-coupled electronic actuator. The actuator shall provide on-off/floating point control with a minimum of 35 in-lb of torque. The assembly shall mount directly to the damper operating shaft with a universal V-Bolt clamp assembly. The actuator shall not require any limit switches, and shall be electronically protected against overload. When reaching the damper or actuator end position, the actuator shall automatically stop. The gears shall be manually disengaged with a button on the assembly cover. The position of the actuator shall be indicated by a visual pointer. The assembly shall have an anti-rotational strap supplied with the assembly that shall prevent lateral movement.

E. Each UC and UCI shall have LED indication for visual status of communication, power, and all outputs.

F. In the event of a loss of communication with the UCI, each UC shall control from a standalone algorithm that maintains the assigned space temperature until communication with the UCI is restored.

G. Input/Output Processing:

1. Digital outputs shall be relays, 24 VAC or VDC maximum, having a 3 Amp maximum current. Each relay shall be configured as normally open or normally closed, and either dry contact or bussed. Triac outputs are not acceptable.

2. Universal inputs shall be Thermistor Precon Type II, dry contacts or 0-5 VDC with 0-10K Ohm input impedance.

3. One input shall be provided for an enhanced space sensor. This sensor input capability shall include one thermistor input, one local setpoint adjustment, one timed local override switch, and an occupancy LED indicator.

4. Analog output, voltage mode 0-10 VDC or current mode 4-20 mA.

2.11 ELECTRONIC TEMPERATURE ELEMENT AND TRANSMITTER

A. Zone Space Sensors

1. Each UC or ASC controlling a single zone application shall be provided with a space temperature sensor. The space sensor shall include a thermistor packaged in the standard UC/sensor design, timed override button, set point adjustment, and a maintenance communication port.

B. All Other Temperature Sensors

1. All Temperature sensors connected to a PFC or an ASC shall be a Type II Thermistor compatible with the attached BAS controller without the need for any signal conversion hardware. The accuracy of the thermistor shall be +/- 0.5 °F over the range of the sensor. Manufacturer/Model: Precon ST series.

2. Sensors used for mixed air applications shall be 25' averaging type. The sensor span shall have a field set range of 32.0 °F to 160.0 °F.

3. Duct temperature sensors for supply air temperatures and return temperature shall be a minimum of 18" in length. The sensor span shall have a range of -30.0 °F to +160.0 °F.

4. Sensors used for outdoor air temperature shall be provided complete with a sunshield. The sensor span shall have a range of -30.0 °F to +140.0 °F.

5. All chilled water sensors and sensors placed in locations susceptible to condensation (outside or in chilled and condenser water liquid lines with the potential to drop below the ambient dew point) shall be furnished complete with a NEMA 3R enclosure for the electronics.

6. All immersion water sensors shall have an immersion length of one half the pipe diameter plus the length of the pipe tap. The sensors shall have a range of +10.0 °F to +230.0 °F. Units shall be furnished complete with a brass thermowell.

2.12 CURRENT TRANSDUCERS

A. Current sensing transducers shall measure the AC current of loads and shall output a 4-20 mA DC signal over the measured range of 0 to 20 amps AC. If the load is in excess of 20 amps AC, a step down current transformer shall be selected for the actual range of the load and used in conjunction with the current transducer. Manufacturer/Model: Neilsen-Kuljian 4CMA Series.

2.13 CURRENT SENSING SWITCH

A. Current sensing relays shall indicate the presence of AC current. The transistor switches shall be rated for switching controller DC current up to 150 mA continuously at 30 VDC or 500 mA momentarily at 30 VDC. The setpoint of the contact operation shall be field adjustable from 1 to 150 amps AC. The switch shall be self-powering with an applied power indication LED and a second switched load LED for local indication. Manufacturer/Model: Neilsen-Kuljian PD75 Series.

2.14 AIR DIFFERENTIAL PRESSURE SWITCHES

A. Air differential pressure switches shall have an adjustable setpoint of from 0.05" W.C. to 12.0" W.C. Manual reset shall be provided where indicated on the drawings. One snap acting SPDT Type C switch shall be enclosed under a NEMA 1 enclosure with a 1/2" conduit opening. Contacts shall be rated for 10 amps at 120 VAC. Manufacturer/Model: Cleveland AFS series.

2.15 ELECTRIC LINE VOLTAGE THERMOSTAT

A. The thermostat shall be of the bimetallic design with a SPDT set of contacts rated for 120 VAC at 25 amps. Thermostat shall have an adjustable set point of from 50 to 86 °F with a fixed differential of 2.0 °F. The cover shall be metal. Manufacturer/Model: Barber-Coleman Model No. TC-195.

2.16 ELECTRIC FLOW SWITCH

A. The switch shall utilize a multi-segment paddle for use in pipes ranging in size from 1" to 8" with a maximum operating pressure of 150 PSIG and utilize a sealed bronze bellows (packless construction). A snap-acting SPDT switch rated for 16.0 amps at 120 VAC shall be installed in a NEMA 1 enclosure with 1/2" conduit knockout is used for indoor applications. A NEMA 4 enclosure with threaded 1/2" rigid conduit connection is used in all outdoor or high humidity applications, on liquid lines handling fluids below ambient dewpoint or as indicated on the drawings. Manufacturer/Model: Johnson F61 series.

2.17 LIQUID DIFFERENTIAL PRESSURE SWITCH

A. Switch shall have an adjustable set point of from 3 to 30 PSIG and a minimum differential of 2 PSIG. One snap acting SPDT switch enclosed under a NEMA 1 enclosure with 1/2" conduit opening and rated for 12 amps at 120 VAC shall be provided. Manufacturer/Model: Johnson P74 series.

2.18 CONTROL RELAYS

A. Control relay contacts shall be rated for 150% of the loading application, with self-wiping, snap-acting silver cadmium Form C contacts, enclosed in dust proof enclosure. Relays shall be equipped with the necessary mounting base, DIN rail, labels, termination clips, etc. and a coil transient suppression devices. All relays for control by the BAS shall have 24 VAC coils. All other required relays shall have coil voltages appropriate for the installation. Manufacturer/Model: IDEC RH Series.

2.19 CONTROL TRANSFORMERS

A. Control transformers required for all other control purposes including control of pilot duty relays, power supplies, damper and valve actuators, etc. shall be provided. Control transformers 100 VA and less may have internal secondary overload if desired but anything over 100 VA shall be external fused. In no case shall a transformer have a capacity less than 65% of the attached load.

2.20 AUTOMATIC DAMPERS

A. All automatic dampers shall be furnished under this section of the specifications unless provided as part of the equipment.

1. Control Dampers not required for measurement of outside air velocity pressure shall be constructed of galvanized steel with synthetic or Teflon

bearings and trunnions of noncorrosive materials. Each blade shall have a positive closing butyl-rubber or neoprene edge seal, and spring loaded side seals unless otherwise noted. Dampers shall be designed so that the blades are interconnected to give parallel movement. Jack shafting shall be provided for all dampers greater than 24" x 48" and damper shaft extensions shall be provided for connection of damper actuators outside the duct.

a. Parallel Blade Dampers: Provide parallel blade type automatic dampers for return air, two position, the face section of face and bypass dampers, and where indicated on the drawings.

b. Opposed Blade Dampers: Provide opposed blade type dampers for volume control, exhaust and outside air dampers of a mixing section, throttling application and, where indicated on drawings.

c. Manufacturer/Model: Ruskin CD-36

2.21 DAMPER ACTUATORS

A. Modulating and Two-Position Damper Actuators

1. The actuator shall be of the direct-coupled design. The fastening clamp assembly shall be of a "V" bolt design with associated "V" shaped toothed cradle attaching to the shaft for maximum strength and eliminating slippage. Spring return actuators shall have a "V" clamp assembly of sufficient size to be directly mounted to an integral jackshaft of up to 1.05 inches when the damper is constructed in this manner. Actuators shall be designed for a minimum of 60,000 full stroke cycles at the actuator's rated torque and shall have a two (2) year manufacturer's warranty, starting from the date of installation.

2. The actuator shall have electronic overload or digital rotation sensing circuitry to prevent damage to the actuator throughout the entire rotation of the actuator. Mechanical end switches or magnetic clutch to deactivate the actuator at the end of rotation are not acceptable. For power-failure/safety applications, an internal mechanical spring return mechanism shall be built into the actuator housing. Non-mechanical forms of fail-safe operation are not acceptable.

3. Spring return actuators shall be provided for all outside and exhaust/relief air dampers in addition to all locations indicated on the drawings. Spring return actuators shall be capable of both clockwise or counterclockwise spring return operation by simply changing the mounting orientation

4. Proportional actuators shall accept Pulse Width Modulation (PWM) control signaling and power from a 24 VAC source, 4-20 mA, or Tri-State control. Two position actuators shall be 24 VAC with spring return.

5. All actuators shall not require more than 10 VA regardless of the operating voltage.

6. Actuators shall be provided with a conduit fitting and a minimum three-foot electrical cable and shall be pre-wired to eliminate the necessity of opening the actuator housing to make electrical connections.

7. Manufacturer: Belimo.

2.22 CONTROL VALVES

A. Ball Control Valves

1. Valves to be two-way industrial quality with bronze bodies and female NPT threads or flange connections. Valve bodies may also be stainless steel, or nickel with operating pressure up to 250 psi.

2. All valves shall have blowout-proof stem, glass-reinforced Teflon thrust seal washer and stuffing box ring with minimum 250 psi rating. Stem packing gland screw shall be adjustable for wear.

3. Standard chromium plated stainless steel ball and stem, shall be rated at a minimum of 250 psi WOG (water-oil-gas), cold, non-shock. All valves shall be provided with Reinforced Teflon seats.

4. Valve actuators shall be factory mounted and provided as described in "Valve Actuators."

5. Manufacturer: Delta

B. Two- and Three-Way Globe Control Valves Two Inches and Less

1. Valves 1/2 inch through 2 inches shall be bronze, screw type, and shall be rated at 250-psi maximum working pressure for water and steam.

2. Valve stems shall be stainless steel, highly polished, corrosion-resistant, alloy to decrease friction and increase response. Valve plugs shall be brass and guided to insure perfect seating.

3. Stem packing shall be spring loaded EP V-Rings for water applications and Teflon V-Rings for steam applications to eliminate leakage around the stem and insure a minimum amount of stem friction. Stem lift shall be 1/2 inch to 3/4 inch.

4. Flow type shall be equal percentage for water. The maximum operating differential shall be 10 psi for water.

5. Manufacturer/Model: Johnson Controls VA-8000 series.

C. Two- and Three-Way Globe Control Valves Greater than Two Inches

1. Valves 2-1/2 inches through 6 inches shall be cast iron flanged, and rated at 125-psi maximum working pressure. The maximum working temperature shall be 300°F/149°C.

2. Valve plug stems shall be stainless steel, highly polished, corrosion-resistant, alloy to decrease friction and increase response. Valve plugs shall be brass and guided to insure perfect seating. Stem packing shall be Teflon, spring loaded EP V-rings to eliminate water leakage around the stem and insure a minimum amount of stem friction. Lift shall be 3/4 inch to 1-1/2 inch.

3. Flow type shall be equal percentage. The maximum recommended differential shall be 10 psi. Composition discs shall be replaceable and provide tight shutoff.

D. Control Two- and Three-Way Butterfly Valves

1. All butterfly valves shall be supplied in accordance with the requirements of this and other applicable sections.

2. Three way butterfly control valves shall be supplied complete with flanged pipe tees and all linkage necessary to cross-link the two valves.

2.23 CONTROL VALVE ACTUATORS

A. Electronic Valve Actuators

1. All ball and globe valves actuator shall be fully modulating using a 4-20 mA input signal. There shall be a visual valve position indicator. Control power shall be 24 VAC and shall not exceed 8 watts at 24 VAC. The actuator shall provide minimum torque required for proper valve close-off, with an approximate running time of 2 minutes for full rotation. The actuator shall be designed with current limiting motor protection. (End of travel switches and magnetic clutches are not acceptable.) A release button on the actuator shall be provided to allow for manual override, except when utilizing spring return actuators.

2. The actuators and valves shall be factory mounted and tested and supplied.

3. Manufacturers:

a. Ball valves: Delta
b. Globe two-way and three-way control valves: Belimo

B. Butterfly Valve Actuators

1. Electronic actuators and linkages shall be factory mounted with each butterfly valve as shown on the control drawings.

2. Modulating valves shall be shall be complete with positioners to modulate the valve with a 4-20 mA input signal. All automatic valves shall have provision shall be made for hand activation of the valve in the event of an actuator failure. Valve actuator shall be powered from 120 VAC. Actuators shall be selected so as to provide positive shut off based on the system operating parameters.

3. Actuators and positioning relays shall be NEMA 4 rated for installation in wet locations. Sun shields shall also be provided for all actuators and positioners installed in locations exposed to direct sunlight.

4. Actuators shall be factory mounted, tested, and supplied.

5. Manufacturer/Model: Keystone Model 777

a. Two-Position Butterfly Valve Actuators

1) Outside the scope of this section.

2.24 INPUT/OUTPUT AND INTERLOCK WIRING

A. Class I circuits

1. All materials required for installation of Class I circuits or circuits operating at greater than 48 VAC or VDC shall meet the requirements stated in National Electric Code, and all applicable building codes as they apply to Class I circuits.

B. Class II circuits

1. All materials required for installation of Class II circuits shall meet all requirements of the National Electric Code and all applicable building codes as they apply to Class II circuits.

2. Cable run exposed in plenums where permitted shall contain twisted conductors or pairs of twisted conductors no smaller than 18 gauge. The number of conductors shall be as required by the application and an overall foil shield with stranded drain wire shall be provided in all cases. The cable shall be factory stamped with a clear indication of the cable classification. The cable jacket shall be Teflon or other approved materials that comply with the smoke generation limitations outlined in Article 725 of the NEC, UL, and all requirements of the NFPA.

3. Cable run in a metallic raceway shall contain twisted conductors or pairs of twisted conductors no smaller than 18 gauge. The number of conductors shall be as required by the application and an overall foil shield with stranded drain wire shall be provided in all cases. The cable shall be factory stamped with a clear indication of the cable classification and number of pairs. The cable jacket shall be PVC. Metallic raceway shall be as specified in Section 26 0533, "Raceway and Boxes for Electrical Systems."

2.25 DUCT STATIC PRESSURE STATION

A. Provide at each duct static pressure measuring location a traverse probe capable of continuous monitoring of static pressure. The probe shall contain multiple static pressure pick-up points along the exterior surface of the cylindrical probe, internally connected to their respective averaging manifold. Each probe shall be extruded aluminum construction with threaded end support rod and nut, and mounting plate with gasket. Each probe shall be sized to span the entire duct and not extend past either side. The probe shall not produce a measurable pressure drop and shall produce a non-pulsating signal with an accuracy of 0.5 percent of total span. Manufacturer/Model: Air Monitor Model STAT-Probe/1.

2.26 DUCT VELOCITY STATION

A. Install per manufacturer's instructions to insure proper duct diameters upstream and downstream of flow measuring station. Provide at each location indicated, traverse probes capable of continuous monitoring of total and static pressure pick-up points, along the exterior surface of the cylindrical probe, each internally connected to their respective averaging manifold. Multiple probes, required for specified accuracy, shall be externally connected in a parallel configuration. Each probe shall be extruded aluminum construction with installation hardware specifically designed for duct mounting. The probes shall produce a non-pulsating signal with an accuracy of 99% of total system flow. Manufacturer/Model: Air Monitor Model VOLU-Probe/1.

2.27 OUTSIDE AIR STATIC PRESSURE PROBE

A. Outside air static pressure probe shall be constructed of 10-gauge anodized aluminum with a 2" diameter FPT connection. The probe shall be capable of sensing the outside atmospheric air pressure to within 2% of the actual value when subject to radial wind velocities up to 80 miles per hour with approach

angles up to 30 degrees to the horizontal. Manufacturer/Model: Air Monitor S.O.A.P.

2.28 ELECTRONIC DIFFERENTIAL PRESSURE TRANSMITTER

A. Electronic differential pressure transmitter shall be designed to measure the differential air pressure as indicated on the drawings or as required. The output shall be a two-wire 4-20 mA loop-powered device with an input range as indicated in the drawings but not more than twice the actual measure variable. The accuracy, including linearity, hysteresis, and repeatability, shall be less than ±2%. Provide gauge root valves at all transmitters.

B. Duct static pressure, Pre-filter, and bag filter Differential Pressure Transmitters

1. Wetted Material: Stainless Steel.
2. Power Requirements: Loop powered.
3. Accuracy: ± 0.2 percent.
4. Range: -40 to 40 inches water gauge.
5. Span: 4 inches water gauge
6. Output: HART 4 to 20 mA.
7. Process ports: 1/4" FNPT.
8. Manufacturer: Yokogawa: Model EJA110A Series.

C. HEPA Filter train HEPA filter Differential Pressure Transmitters

1. Wetted Material: Stainless Steel.
2. Power Requirements: Loop powered.
3. Accuracy: ± 0.2 percent.
4. Range: -40 to 40 inches water gauge.
5. Span: 10 inches water gauge
6. Output: HART 4 to 20 mA.
7. Process ports: 1/4" FNPT.
8. Manufacturer: Yokogawa: Model EJA110A Series.

D. Space Differential Pressure Transmitters

1. Power Requirements: Loop powered.
2. Accuracy: ± 1.0 percent.
3. Range: -0.50 to 0.50 inches water gauge.
4. Span: 1 inch water gauge
5. Output: 4 to 20 mA.
6. Display: LCD
7. Process ports: 1/8" barbed.
8. Surface Mounting Bracket: Dwyer A-299
9. Manufacturer: Dwyer DM-2013-LCD.

2.29 ELECTRONIC AIR FLOW ELEMENT AND TRANSMITTER

A. Probes shall be supplied complete with curved duct mounting plate and gasket and the probe shall be constructed of stainless steel. The associated transmitter shall process the flow signal, automatically amplify, and linearize the thermal sensor signal. The indicating transmitter units shall be remote panel mounted and shall have a 3.5 digit, 0.5 " high LCD display and that is calibrated to display flow rate in SCFM. The unit power is 24 VAC, 3-watt power input and the output is 4-20 mA signal linear to the measured airflow rate. The unit selected has a maximum flow rate. Manufacturer/Model: Air Monitor Electra/1 Model C/D.

2.30 ELECTRONIC LIQUID FLOWMETER

A. Flow Element: Electronic flowmeter with process ready 4-20 ma output signal. Sensor/Transmitter shall have an accuracy of ±0.5% of the full range. Provide 316 stainless steel electrode and polyurethane meter tube liner. Factory set for reverse flow enabled. Rosemount Model 8705PSRAxxxC1W3N0G1D1. Sizes shown on drawings.

B. Transmitter shall be remote mounted and powered by 120V, single phase, 60 Hz. Rosemount Model 8712DR12N0D1M4.

2.31 ELECTRIC LOW LIMIT (FREEZESTAT)

A. Freezestat shall have a 20° temperature sensitive element designed to respond to the lowest temperature to which any 1 foot length of the element is exposed. The unit shall have an adjustable set point of from 35 °F to 450 °F. The electrical rating of the two SPDT contacts shall be 10.2 full load amps at 120. Unit shall be complete with an external manual reset lever. Manufacturer/Model: Johnson A70 series.

2.32 SMOKE AND FIRE DETECTORS

A. Smoke detectors installation is outside the scope of this section.

2.33 CONTROL PANELS

A. All indoor control cabinets shall be fully enclosed NEMA 1 Type construction with hinged door, key-lock latch, and removable subpanels. A single key shall be common to all field panels and sub-panels.

B. Provide on/off power switch with over-current protection for control power sources and include a service outlet for main panels where a lap-top is required for controller configuration.

C. The design and workmanship shall comply with the requirements of Underwriters Laboratories (UL) Bulletin 508 by affixing a UL 508 compliance label to the interior of each panel.

D. Conform to applicable UBC for flame/fuel/smoke rating and ventilation requirements for application of finishes.

E. All individual panel components shall be UL listed.

F. Panels shall have no exposed terminals that may be inadvertently touched (i.e., terminal screws shall be in wells). A plastic protective guard shall be provided for all exposed terminals greater than 50 VAC or 50 VDC.

2.34 ELECTRICAL POWER AND SIGNAL WIRING

A. Control and signal wiring external to the control panels and all power wiring shall conform to the equipment manufactures recommendations for the equipment it is connected to.

B. Power to the BAS shall be provided from dedicated circuits. Providing power to any BAS components from lighting circuits, receptacle circuits or any other circuit that serves other building general loads is unacceptable. Providing power from primary BAS control panels to controllers and sub-controllers is acceptable.

C. Control and signal wiring in control panels shall be restrained by plastic ties or ducts. Hinge wiring shall be secured at each end so that any bending or twisting

will be around the longitudinal axis of the wire and the bend area shall be protected with a sleeve.

D. Arrange wiring neatly, cut to proper length, and remove surplus wire. Provide abrasion protection for any wire bundles which pass through holes or across edges of sheet metal.

E. Use manufacturer's recommended tool with the proper sized anvil, for all crimp terminations. No more than one wire may be terminated in a single crimp lug and no more than two lugs may be installed on a single screw terminal.

F. Wiring shall not be spliced or tapped except at device terminals or terminal blocks.

G. Provide wire markers per Section 26 0553, "Identification for Electrical Systems," on each conductor in the panel, at load connections, and at intermediate terminal blocks. Identify circuit with control wire number, as per Drawings.

H. The Subcontractor will be responsible for providing, installing, labeling, terminating, controling and control power wiring as well as the BAS communications system (Ethernet) wiring.

I. Connection of field wiring shall be made on the terminal blocks in the PLC control panels.

PART 3 EXECUTION

3.1 GENERAL

A. All field hardware, control devices, conduit, wiring, etc. shall be provided as specified in PART 2.

1. The installation of all aspects of the system shall comply with all applicable codes, regulations, and all related Subcontract Documents.

2. The installation of all materials shall be in accordance with the published manufacturer's recommendations without exception. If for some reason a particular component cannot be installed in compliance with these recommendations, the Subcontractor shall advise the LANL STR of the situation.

3. Where miscellaneous materials are required to complete an installation, e.g. isolation valves for pressure switches, wall switches for an exhaust fan control circuit, etc., the materials shall be supplied as defined in the relevant section of these specifications and installed under this section of the specification, unless otherwise noted.

4. Coordinate with other trades where installation of a particular component requires other trades to be involved. Installation coordination includes the correct placement of thermowells, flow switches, dampers, control valves, control power circuits, etc. Care shall be exercised to identify locations that meet the requirements of the manufacture including upstream and downstream distances, pressures, temperatures, etc.

5. All signal wiring requiring shielding shall have the shield terminated at the controller end only. The shield wire shall be trimmed and insulated at the device end.

6. Label all wiring with permanent labels indicating the point device identifier. Install a phenolic label mounted at the device indicating the device type and point identifier name.

7. All field devices shall be labeled with 1" x 3" phenolic labels. Labels shall include the point name and device name. Labels for BAS controllers shall indicate the breaker and panel number of the power source. Labels shall be glued, attached with screws, or stainless wire in the case of valves and actuators.

3.2 NETWORKING/COMMUNICATION

A. General

1. All LAN's shall be installed in a manner recommended by the manufacturer, based on the environment, communications speed requirements, and distance. All LAN media shall be installed in a manner that provides protection from physical damage and interference from RF or other electrical sources.

B. Controller Local Area Network (LAN)

1. The Controller LAN shall be installed with materials and procedures that comply with the requirements of the BAS equipment manufacturer. In general, the conductors are to be a 22 gauge, low capacitance, twisted-pair.

C. Sub-Controller Local Area Network (LAN)

1. The Sub-Controller LAN shall be installed with materials and procedures that comply with the requirements of the BAS equipment manufacturer. In general, the conductors are to be a 22 gauge, low capacitance, twisted-pair.

3.3 BACNET™ COMPATIBILITY

A. All BAS software shall be developed to meet the BACnet™ conformance class of the relevant LAN. Refer to PART 2 of this section.

3.4 BAS SERVERS

A. User Access

1. Complete installation of STR supplied operator names derived from the approved submittal request form. During the training session, complete the input of login and passwords associated with those personnel.

B. Reports and Trends

1. All associated I/O data as well as computational data shall be linked to the appropriate formatted report for automatic archiving on the LANL BAS server.

2. Provide report capability for monitoring of each system. Custom reports and trends shall be easily configured by the operator for either printing or archiving. The operator shall be able to easily adjust the scale of the trend graphs and trend at least 3 separate points of the same type (analog with analog, binary with binary) on the same graph as he/she chooses. The trend graphics shall have a dynamic cursor option for identifying values of individual points on the trend graph.

C. Dynamic Color Graphic Displays

1. The slides shall include a color graphic representation of the geographic area or system being observed, all realtime point value data, user interactive setpoints, schedules, etc., and realtime alarm information. Graphics shall provide flexible "pick" options, such as expandable trees, to easily move across the system without the need to go back to the trees start. The focus on the graphic generation shall be ease of understanding and user interaction for all day-to-day functions. At a minimum, the following graphic slides shall be developed:

   a. A graphic shall be provided for each floor and/or quadrant (depending on the size of the building) of each building. All major walls, temperature zones and actual space numbering shall be indicated. These drawings may be scanned from building floor plans or imported from ACAD drawing files and modified as necessary. All zone temperature shall either be displayed within the appropriate zone in text format or the area of each zone shall be color coded to represent the relationship to set point. Each graphic shall indicate the current occupied/unoccupied status of the "building" floor or quadrant group" or "floor subgroup" schedules, the minimum and maximum zone temperature on the floor, the run status of all air handling equipment serving the floor, all un-acknowledged alarms, etc. "Pick" windows shall be provide on these graphics to permit the operator to view a specific building air handling unit graphic or a graphic of the fan coil unit or outside air handling unit supplying a particular area. "Picks" shall be provided to move back to the building or the campus.

   b. A graphic shall be provided for each temperature zone of each floor. This graphic shall be a graphic representation of the mechanical equipment serving the zone. All real time system information relative to any particular temperature zone and all color-coding of the temperature zone shall be the same as was provided for the floor plan graphics. This graphic shall indicate the current occupancy status and which schedule group has control of the zone. "Pick" windows shall be provide on these graphics to permit the operator to view the specific supporting mechanical system relative to the respective floor plan or to move back to the building floor plan.

   c. Separate graphics shall be provided for all mechanical equipment serving the respective building or zone. This includes all air-handling units, central chilled water plant, heating plant, etc. Mechanical system graphics shall be displayed complete with all real time data relevant to the equipment being displayed including temperatures, flow rates, positions, etc. Every controlled or monitored device (all dampers, valves, filter banks with differential pressure, etc) related to the major unit being described on the graphic, shall be shown and labeled on the same graphic. The intent is to show the entire "chilled water system" or "building heating water system," for instance, as a coherent unit with all the necessary information on a single page.

d. All valves or dampers, whether normally open or normally closed, shall be described as 0% when fully closed and 100% when fully opened as seen on the Web based GUI. Three-way control valves shall have a descriptive label on the GUI that clearly indicates the direction of flow when fully opened or closed.

e. A realtime graphic of the BAS system architecture shall be provided. The graphic shall indicate the actual wiring configuration of all Controllers on the network. Realtime information regarding the communication status of all BAS controllers shall be displayed on this graphic. Additionally, any controller that has an alarm condition shall be clearly identified on this graphic. If the size of the network prevents display of the entire network on one page, multiple graphic slides with connectors and "picks" may be employed.

D. Database Save/Restore/Back-Up

1. All new or existing LANL BAS servers shall have an ongoing backup scheme configured and activated with cooperation from IT support (e.g., IST-12) so that all BAS related software and databases are backed up on a schedule. After all BAS Controller software and Graphic slides have been developed, two complete backup sets of this software shall be stored on CD and delivered to the STR for archiving. All future warranty work, software patches, upgrades or punchlist resolution relating to BAS software or graphics shall be done on the appropriate LANL BAS server in coordination with the BAS administrator. In the event of server failure, a verified method of restoring the BAS onto the server from backup shall be included in the BAS administrator training with the controls subtier subcontractor.

E. Alarm Paging

1. Major alarms shall initiate paging and email notification to designated LANL pagers and email utilizing the LANL email/paging system.

3.5 PRIMARY BAS CONTROLLERS

A. General

1. New PFCs shall be installed where required or indicated on the drawings; however, in no case shall more than 90% of the maximum attached potential node limitations be designed nor shall more than 75% of the PFC RAM be utilized by the programming code specified herein, including trending and global programming. If these limits are met, additional PFCs or RAM shall be added.

2. All PFCs shall be installed in accordance with manufacturer's instructions, and 120 VAC power shall be provided to each. If a PFC requires power at a different voltage or at a location other than as shown on the drawings, it shall be the work of this section to provide and install all necessary conduit, wiring, transformers, etc. and make the final connections. All power shall be verified as work of this section prior to powering the controllers.

3. All PFCs shall be installed in a factory enclosure that provides protection from the environment and is adequately ventilated to protect against excessive temperature exposure.

B. Communications

1. It shall be work of this section to develop Controller LAN. This work includes installation and troubleshooting of new media. All PFCs shall be connected to the Controller LAN network in a manner recommended by the manufacturer based on the environment, communications speed requirements, and distance.

C. Input/Output

1. The installation of all BAS field control components and the associated I/O wiring back to the respective BAS Controller shall be installed under this section of the specification. Each point shall be checked by the subcontractor for voltage, short circuit, etc. prior to termination to the PFC to prevent potential damage to the controller.

D. Software Requirements

1. All sequences of operation as stated in the Subcontract Documents are to be implemented. In addition to these specific sequences, the following general requirements shall be implemented to for a complete operating software package.

   a. SOO Features: The following features shall be provided as a minimum:

      1) Unoccupied operations,

      2) Optimal start,

      3) Supply air reset based on zone load,

      4) Boiler operation based on zone demand,

      5) Chiller operation based on zone demand, and

      6) Heating and chilled water temperature reset based on zone demand.

   b. Run Time Totalization: All digital input, digital output points, and digital software points (triggers or flags) shall be setup to accumulate totalized run time information. The frequency of accumulation and reset shall be based on report and trending requirements.

c. Alarms:

1) The following analog input points shall have upper and lower limits established and alarms shall be generated in the event these limits are exceeded. These limits are generally defined as follows:

Alarm Parameter Table			
Point Type	**Low Condition**	**High Condition**	**Reset Condition**
Space Temperatures	5.0 °F < active SP	5.0 °F > active SP	2.0 °F change
Supply Air Temperatures	5.0 °F < SP	5.0 °F > SP	2.0 °F change
Outside Air Volume	<95% of SP	> 110% SP	5% change
CWS Temperature	2.0 °F < SP	3.0 °F > SP	1.0 °F change
HW Temperature	2.0 °F < SP	3.0 °F > SP	1.0 °F change
Duct Static	<90% of SP	> 110% SP	5% change
Velocity Pressure (Flow)	<90% of SP	> 110% SP	5% change
Static Pressure Space	<90% of SP	> 110% SP	5% change
Humidity	<90% of SP	> 110% SP	5% change

2) Digital inputs shall be compared to the associated digital outputs (e.g., fan start/stop vs. fan status) and alarms shall be issued if the commanded position is inconsistent with the actual condition, after a start delay timer of 30 seconds.

3) All digital points that represent actual alarm monitoring points (e.g., VFD alarm) shall display an alarm immediately upon indication of an alarm condition.

4) All alarms shall be viewable via the Web based GUI, and archived on the hard drive as routed by the user. The identity of the operator acknowledging the alarm shall be archived with the alarm message text.

d. Minimum Runtimes: All digital output points shall have a minimum runtime of 5 minutes to prevent accidental short cycling.

e. Staggered Starts: All digital outputs to motors or equipment with input voltages of 480 VAC or more within a particular building shall have staggered start times of 15 seconds to minimize demand spikes, especially after a power failure restart.

f. Trend Analysis: The system shall be configured to trend all system points and display them both numerically and graphically. Date and time stamps shall accompany all trend data. The initial interval for all trend logs shall be configured for 15 minutes or change of value (COV) as reason dictates. Trend groups shall be identified as follows:

Outside Air Unit Trend Log Groups (Typical of All Units)	
Sub-System Function	**Group I/O & Software Points to Trend**
Fan Operations (Digital)	Occupied/Unoccupied Mode, Optimal Start Mode, Override Mode, Temp. Override Mode, VFD Alarm, VFD Start/Stop
Supply Air (Typical)	Supply Air SP, Supply Air Temp, Chilled Water Valve Position

3.6 APPLICATION SPECIFIC CONTROLLERS (ASC)

A. The same execution requirements specified for the Primary BAS Controllers shall apply to the Application Specific Controllers.

3.7 UNITARY CONTROLLER INTERFACE (UCI)

A. General

1. New UCIs shall be installed where required or indicated on the drawings; however, in no case shall more than 90% of the maximum attached UC node limitations be designed.

2. All UCIs shall be installed in accordance with manufacturer's instructions. 120 VAC power shall be provided to each UCI. If a UCI requires power at a different voltage or at a location other than as shown on the drawings, it shall be the work of this section to provide and install all necessary conduit, wiring, transformers, etc. and make the final connections. All power shall be verified as work of this section prior to powering the controllers.

3. All UCIs shall be installed in a factory enclosure that provides protection from the environment and is adequately ventilated to protect against excessive temperature exposure.

B. Communications

1. It shall be work of this section to develop Controller LAN for connection of each UCI. This work includes installation and troubleshooting of new media. All UCIs shall be connected to the Controller LAN in a manner recommended by the manufacturer based on the environment, communications speed requirements, and distance.

C. Alarms

1. The same analog input points described in the Primary BAS Controllers section above shall be used for all UCs connected to the Sub-Controller LAN, with upper and lower limits established and alarms generated in the event these limits are exceeded. The Subcontractor shall submit specific limit details for every point; however, these limits are generally defined as described in the ALARM PARAMETER TABLE for the Primary BAS Controllers section above.

   a. Digital inputs associated with all attached UCs shall be compared to the associated digital outputs (e.g., fan start/stop vs. fan status) and alarms shall be issued if the commanded position is inconsistent with the actual condition, after a start delay timer of 30 seconds.

   b. All alarms shall be directed viewable via the Web based GUI, and archived on the hard drive as routed by the users. The identity of the operator acknowledging the alarm shall be archived with the alarm message text.

D. Trend Analysis

1. The FCS shall be configured to trend all UC points and display them both numerically and graphically. Date and time stamps shall accompany all trend data. The initial interval for all trend logs shall be configured for 15 minutes or change of value as reason dictates. Trend groups shall be identified as follows.

2. The following table is provided as an example of the trend log. Provide trend logs for monitoring each system.

CAV Terminal Unit Trend Log (Typical of All Units)	
Sub-System Function	**Group I/O & Software Points to Trend**
Space Temperature Loop	Space Temp. SP, Space Temperature, Hot Water Valve Position, Primary air flowrate.

3.8 UNITARY CONTROLLER (UC)

A. General

1. A new UC shall be installed for each fan coil unit, CAV unit, unit ventilator, etc. The UC shall mount directly on the equipment unit or nearby. UCs shall be installed such that reasonable access to the unit can be achieved. The installation shall not interfere with access to other components.

2. All UCs shall be installed in accordance with manufacturer's instructions. 120 VAC Power shall be provided at various locations as indicated on the drawings. If a controller requires power at a different voltage or a location other than as shown on the drawings, it shall be the work of this section to provide and install all necessary conduit, wiring, transformers, etc. and make the final connections. All power shall be verified as work of this section prior to powering the controllers.

3. All UCs shall be installed in a factory enclosure that provides protection from the environment and is adequately ventilated to protect against excessive temperature exposure.

B. Communications

1. It shall be work of this section to install the Sub-Controller LAN from each UCI. This work includes installation and troubleshooting of any new or existing media. All UCs shall be connected to the BAS Sub-Controller LAN in a manner recommended by the manufacturer based on the environment, communications speed requirements, and distance.

C. Input/Output

1. The installation of all BAS field control components and the associated I/O wiring back to the respective UC shall be installed under this section. Each point shall be checked by the Subcontractor for voltage, short circuit, etc. prior to termination to the BAS Controller to prevent potential damage to the controller

3.9 ELECTRONIC TEMPERATURE ELEMENT AND TRANSMITTER

A. All temperature sensors shall be installed and wired under this section of the specification.

1. Immersion temperature sensors shall be installed in the thermowells provided with the sensor. A thermo-conductive paste shall be applied between the sensing element and the thermowell.

2. Outdoor air temperature elements shall be installed in a location that is continuously shaded and not effected by heat generating equipment or equipment intakes or discharges. The element shall be installed under a sun shield.

3. Duct point temperature elements shall be installed directly on ductwork and the connection between the duct and the flange shall be gasketed and secured with sheet metal screws to prevent any air leakage. Care shall be taken to avoid direct contact between the temperature element and any heat transfer surface such as a coil.

4. Duct averaging elements shall be installed with the same requirements as for the temperature point element; however, the averaging element shall be extended across the entire duct area in a zig-zag pattern. Special clips shall be used to secure the element at turns to prevent chafing of the element. Where the element passes through the duct, plastic tubing or similar protection shall be installed on the element to prevent damage to the element from vibration.

5. Space temperature transmitters shall be installed 60" above finished floor. If a setpoint adjustment is provided on the sensor then the unit shall be installed 48" above finished floor (A.F.F.) unless otherwise specified on the plans. Location of space temperature sensors shall be coordinated with furniture layout drawings to avoid dead air space behind bookshelves or discharge heat from equipment (such as printers, copiers, coffee pots, etc.).

6. Space temperature sensors shall be mounted in server and telecommunications rooms for monitoring and alarm in case of CRAC (computer room air conditioner) failure. Temperature sensors shall also be provided in the mechanical equipment rooms for monitoring and alarm. These alarms shall be sent to duty pagers via the BAS.

3.10 CURRENT TRANSDUCERS

A. Current transducers shall be installed on one hot leg of either single or three phase and after the local disconnect. The transducer shall be securely mounted in the associated motor starter housing or motor control.

3.11 CURRENT SENSING SWITCH

A. Current switches shall be installed in one leg of three phase circuits and the hot leg of single phase circuits and in all cases, after the local disconnect. The switch shall be securely mounted in the associated motor starter housing or motor control. The switches shall be adjusted to close at approximately 10% of the attached load's full load amps.

3.12 AIR DIFFERENTIAL PRESSURE SWITCHES

A. Differential pressure switches shall be connected to pitot tube pickup probes pointing into the air stream on both sides of the process variable. Connection between the switch and the pitot tubes shall be 1/4" hard copper. The switches shall be adjusted to close at approximately 25% of the fans maximum speed.

3.13 ELECTRIC LINE VOLTAGE THERMOSTAT

A. Where thermostats are to be mounted remotely from the controlled device, all Class I and/or Class II conductors shall be installed in a metallic raceway and the thermostat shall be mounted on a junction box. Mount the thermostat 48" A.F.F unless otherwise specified on the plans.

3.14 ELECTRIC FLOW SWITCH

A. Flow switches in liquid lines shall be installed in a Thread-O-Let with isolation valve or valves to allow removal without draining the system. The paddle of the flow switch shall be selected and the spring adjustment shall be carefully set to provide good switching between flow and no flow conditions. Ensure that the flow direction of the device matches the actual flow direction.

3.15 LIQUID DIFFERENTIAL PRESSURE SWITCH

A. Differential pressure switches shall be connected to pressure taps installed on the piping under other sections of the specification. The connections shall be 1/4" hard copper complete with isolation valves on both lines. The switch shall be supported either by mounting on a wall or on a frame constructed from Unistrut. The switch setpoint and differential shall be set as necessary to provide good switching between pressure and no pressure conditions.

3.16 CONTROL RELAYS

A. Control relays shall be mounted in the respective termination panel and are intended primarily to isolate the BAS controller digital outputs from the source load. If a relay must be field mounted, it shall be installed in a NEMA I housing.

B. Control relays shall be installed in bases and the based mounted on a DIN rail. All accessories including end clips, jumpers, etc. shall be provided. All wiring shall be labeled. Multiple conductors shall be bundled and run by Class in plastic wireways. Relays shall be labeled as indicated in the shop drawings for ease in troubleshooting.

C. Relays coils shall be wired complete with 24 VAC power such that a jumper (simulating a BAS contact closure) will energize the control relay.

3.17 CONTROL TRANSFORMERS

A. Control transformers shall be field mounted using a plate to mount on an electrical junction box. Locations shall be as identified on the shop drawings or as determined by field requirements.

B. A phenolic label on each transformer shall identify the power source by breaker panel and circuit. Fusing of the primary and secondary sides and sizing shall be as required by the NEC.

3.18 AUTOMATIC DAMPERS

A. All automatic control dampers shall be installed under this section.

3.19 DAMPER ACTUATORS

A. Electronic Damper Actuators

1. Damper actuators shall be mounted on the damper jackshaft or shaft extender using a "V" clamp. The actuator shall then be anchored to the ductwork housing the damper.

3.20 CONTROL VALVES

A. The valves will be installed by the mechanical Subtier-subcontractor and are outside the scope of this section.

3.21 CONTROL VALVE ACTUATORS

A. Electronic Valve Actuators

1. Valve actuators shall be mounted in either the vertical (above the pipe) or 90 degrees from vertical position. Steam valve actuators shall be mounted at 90 degrees from vertical to avoid heat damage to actuator. Actuators shall be installed to ensure they do not interfere with the operation or access to other equipment such as balancing valves. Actuators shall be configured in a consistent manner with attention to actuator rotation direction so that a 0% "close" or 100% "open" command has consistent results to close or open the valve. All valves serving coils exposed to outside air and possible freezing conditions shall be tested and documented to proper rotational direction.

3.22 INPUT/OUTPUT AND INTERLOCK WIRING

A. General

1. All wiring located in mechanical spaces, chiller or boiler plants, outdoors, in exposed areas, or in areas of potential damage, regardless of class, shall be run a metallic raceway of the appropriate design for the

application. Refer to Section 26 0533, "Raceway and Boxes for Electrical Systems."

2. All Class I and Class II conductors shall be selected and installed in complete compliance with the NEC, regardless of the definition of conductor types stated for each device type. The conductor types stated for each device type installation are provided to indicate the design intent only.

B. Class I Wiring

1. All wiring shall be installed in accordance with the NEC. Class I and Class II wiring shall be separated as defined in Art. 725 of the NEC. All Class I circuits and all control or power circuits greater than 48 VAC or VDC shall be run in a metallic raceway. Conduit shall be run parallel with building lines in a neat professional manner and supported as defined in Section 26 0533, "Raceway and Boxes for Electrical Systems."

C. Class II Wiring

1. All wiring shall be installed in accordance with the NEC. Class II wiring run in hollow walls and in accessible concealed areas may be run without conduit, as local codes permit. Cables run loose shall be tied to building structures no less than every 6 feet and bundled where possible. Care shall be taken to avoid chafing at points of connection to the building. Cables run in conduit shall be installed in the same manner required for Class I conduit runs.

3.23 EQUIPMENT CONNECTIONS

A. BAS Class II field wiring for all non-control device applications shall be installed under this section of the specification. This includes equipment such as VFDs, chillers, boilers, etc. that may have point types include status or alarm monitored from an equipment supplier Class "C" contact or analog control signals to equipment, etc.

3.24 DUCT STATIC PRESSURE STATION

A. Ensure that the direction of flow is observed when installing the probe to prevent measurement of total pressure. The connection between the duct and the flange shall be gasketed and secured with sheet metal screws to prevent any air leakage. Connections from the "HI" pressure port to the differential pressure transducer shall be 1/4" plastic tubing that shall not extend for more than 10 feet.

3.25 DUCT VELOCITY STATION

A. Ensure that the direction of flow is observed when installing the probe and maintain the manufacturer's recommended upstream and downstream distance requirements. The connection between the duct and the flange shall be gasketed and secured with sheet metal screws to prevent any air leakage. Connections from the "HI" and "LO" pressure ports to the differential pressure transducer shall be 1/4" plastic tubing that shall not extend for more than 10 feet.

3.26 OUTSIDE AIR STATIC PRESSURE PROBE

A. Outside air static pressure probe shall be installed and piped according to manufacturer's instructions to ensure accuracy of the static pressure reading and eliminate the effects of condensation in the sensing lines, respect to prevailing

wind direction and building geometry. Please seek advice from LANL ES-DE with any questions regarding installation. Coordinate installation of probe with the necessary trades for proper sealing of all roof penetrations.

3.27 ELECTRONIC DIFFERENTIAL PRESSURE TRANSMITTER

A. All differential pressure transmitters shall be installed within 10 feet of the pressure sensing point. The transmitters shall be installed in a NEMA I housing for interior conditioned spaces and in NEMA 3R housings for outside or unconditioned spaces. The transmitters and housings shall be rigidly supported to prevent vibration and shall never be mounted to ductwork or piping. Access to the transmitter shall be provided.

3.28 ELECTRONIC AIR FLOW ELEMENT AND TRANSMITTER

A. Ensure that the direction of flow is observed when installing the probe and maintain the manufacturer's recommended upstream and downstream distance requirements. The connection between the duct and the flange shall be gasketed and secured with sheet metal screws to prevent any air leakage.

3.29 ELECTRONIC LIQUID FLOWMETER

A. The flow meter/ transmitter shall be installed according to the manufacturer's recommendations with isolation valve or valves to allow removal without draining the system and tied into the DDC system.

3.30 ELECTRIC LOW LIMIT (FREEZESTAT)

A. Low limit thermostats shall be installed with the averaging element extended across the entire duct area in a pattern. Special clips shall be used to secure the element at turns to prevent chafing of the element. Where the element pass through the duct, plastic tubing or similar protection shall be installed on the element to prevent damage to the element from vibration. The thermostat setpoint shall be set as indicated and the circuit shall be tested to ensure actions as required.

3.31 SMOKE AND FIRE DETECTORS

A. Installation of smoke detectors and the associated wiring are outside the scope of this section (see Section 28 3100, "Fire Detection and Alarm"); however, under this section, provide an interlock for HVAC shutdown from the fire detection system.

3.32 COMMISSIONING

A. Refer to Section 23 0800, "Commissioning of HVAC."

END OF SECTION

FOR LANL ONLY

This project specification is based on LANL Master Specification 25 5000, Rev. 1, June 11, 2008.

SECTION 26 0519

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Building wire (600 V).

B. Wire and Cable Connectors.

C. Insulating Tape and Tubing.

D. Wire Pulling Lubricant.

1.2 LANL PERFORMED WORK

A. None.

1.3 RELATED SECTIONS

A. Section 01 2500, "Substitution Procedures."

B. Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

C. Section 01 7839, "Project Record Documents."

D. Section 26 0553, "Identification for Electrical Systems."

E. Section 26 2213, "Low-Voltage Distribution Transformers."

1.4 ABBREVIATIONS AND ACRONYMS, DEFINITIONS, AND REFERENCES

A. Refer to Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

1.5 QUALITY ASSURANCE

A. Comply with the *National Electrical Code* (NEC) (NFPA 70) for components and installation.

B. Provide products that are listed and labeled by a Nationally Recognized Testing Laboratory (NRTL) for the application and environment in which installed.

1.6 CRITICAL SYSTEM

A. The following are critical systems:

1. Fire pump systems covered in NEC (NFPA 70, Article 695).

1.7 SUBMITTALS

A. Submit the following in accordance with the requirements of Exhibit I:

1. Catalog Data: Compression connectors; indicate installation tools and dies that will be used.

1.8 PROJECT RECORD DOCUMENTS

A. Submit the following in accordance with the provisions of Section 01 7839, "Project Record Documents":

1. Field Test Records:

a. Cable pulling records required in Building Wire Installation.
b. Inspections and tests required in Field Quality Control.

1.9 RECEIVING, STORING, PROTECTING, AND HANDLING

A. Receive, store, protect, and handle products according to NECA 1, *Standard Practices for Good Workmanship in Electrical Construction*.

PART 2 PRODUCTS

2.1 PRODUCT OPTIONS AND SUBSTITUTIONS

A. Refer to Section 01 2500, "Substitution Procedures."

2.2 BUILDING WIRE

A. Provide NRTL-listed building wire as shown on the drawings with the following characteristics:

1. Description: Single-conductor, 600-volt, insulated wire.

2. Conductor:

a. 98% conductivity, annealed, uncoated copper, ASTM B 3, *Standard Specification for Soft or Annealed Copper Wire*, solid or stranded as specified in PART 3 of this section.

b. Where indicated on the drawings for conductors 1/0 AWG and larger: AA 8000-series aluminum alloy registered in ASTM B 800, *Standard Specification for 8000-Series Aluminum Alloy Wire for Electrical Purposes—Annealed and Intermediate Tempers*, compact stranded in accordance with ASTM B 801, *Standard Specification for Concentric-Lay-Stranded Conductors of 8000 Series Aluminum Alloy for Subsequent Covering or Insulation*.

3. Insulation: The following types, rated 600 volts:

a. Unless Otherwise Indicated on the Drawings: 1 AWG and smaller, Type THHN/THWN-2 per UL 83, *Thermoplastic-Insulated Wires and Cables*.

b. 1/0 AWG and larger, Type XHHW-2 per UL 44, rated 105 °C for wet and dry locations, *Thermoset-Insulated Wires and Cables*.

B. Color code conductors as follows:

1. Use colored insulation for color coding conductors 6 AWG and smaller

2. Use water and oil resistant colored plastic adhesive tape, 3/4 in. minimum width, for color coding conductor 4 AWG and larger. Manufacturer: 3M "Scotch 35."

3. Provide black conductor insulation where colored tape is used for color coding.

4. Use the following color codes for alternating current power system conductors:

System Voltage: Conductor	480Y/277V	208Y/120V	120/240V
Phase A	Brown	Black	Black
Phase B	Orange	Red	Red
Phase C	Yellow	Blue	--
Grounded (Neutral)	Gray	White	White White/Blue*
Equipment Grounding	Green	Green	Green
Isolated Ground	--	--	--
Switched	Purple	Pink	Blue
*Provide grounded conductor insulation with colored stripe when installed in any raceway, box, or enclosure with wiring of another system voltage.			

5. Use the following color codes for direct current power system conductors:

   a. Positive: Red
   b. Negative: Black

6. Provide color code for control conductors as indicated on equipment or control system manufacturer's drawings.

2.3 WIRING CONNECTORS

A. For splices and taps on copper wire, sizes 20 to 12 AWG solid and 16 to 14 AWG stranded, use push-on, insulated, spring type connectors, rated 600 V and 105 ºC that are NRTL-listed to UL 486C, *Splicing Wire Connectors*, and provide a means of visual inspection of the connection. Manufacturer: IDEAL "In-Sure."

B. For splices and taps on copper wire, sizes 8 AWG and smaller, use insulated, spring type connectors, rated 600 volts and 105 ºC that are NRTL-listed to UL 486C, *Splicing Wire Connectors*. Manufacturer: 3M "Scotchlok."

C. For splices and taps on copper wire, sizes 6 AWG through 1 AWG, use the following materials:

1. Tin-plated copper split-bolt connectors that meet the requirements in UL 486A and UL 486B, *Wire Connectors*; provide with matching 600-volt snap-on insulating cover. Manufacturer: FCI Burndy "Type KSA" with "Type SC" insulating cover.

2. Multi-tap connectors that meet the requirements of UL 486A and UL 466B that have two or more range-taking mechanical lugs and matching 600-volt insulated cover. Manufacturers: Burndy "POLYTAP" or "UNITAP," Ilsco "Type PCT," Blackburn "AMT."

D. For copper wire, sizes 1/0 AWG and larger, use UL 486A- and UL 486B-listed circumferential or hexagonal crimp compression terminals, splices, or adapters.

1. Provide compression terminals and splices made from electro-tin plated seamless copper tubing and marked with wire size, die index / color code, and number / locations of crimps. Manufacturers: FCI Burndy Types "YA," "YA-L," "YA-L-NT," "YS," and "YC-C." Thomas & Betts "Color-Keyed."

2. Provide straight and offset compression adapters made from electro-tin plated aluminum, NRTL-listed for use on copper conductors, and marked with wire size, die index / color code, and number / locations of crimps. Each adapter shall include a 600 V, 90 °C rated insulating cover. Manufacturer: FCI Burndy Types "AYP" and "AYPO."

3. Range-taking, die-less, or indenter-applied terminals are not acceptable.

E. For aluminum wire, sizes 1/0 AWG and larger, use UL 486A-486B listed circumferential or hexagonal crimp compression terminals, splices, or adapters.

1. Provide compression terminals and splices made from electro-tin plated wrought aluminum, filled with oxide inhibiting compound, and marked with wire size, die index / color code, and number / locations of crimps. Manufacturer: FCI Burndy Types "YA-A," "YS-A," and "YRB." Thomas & Betts "Color-Keyed."

2. Provide straight and offset compression adapters made from electro-tin plated aluminum, NRTL listed for use on aluminum conductors, and marked wire size, die index / color code, and number / locations of crimps. Each adapter shall include a 600 V, 90 degree C rated insulating cover. Manufacturer: FCI Burndy Types "AYP" and "AYPO." Thomas & Betts "Color-Keyed."

3. Range-taking, die-less, or indenter-applied terminals are not acceptable.

F. For control wiring use nylon insulated crimp-on terminals with insulation grip that meet the requirements of UL 486A and UL 486B. Manufacturer: 3M "Scotchlok MNG," Thomas & Betts "Sta-Kon."

1. Use ring tongue terminals for nutted studs.
2. Use flanged fork terminals for barrier terminal blocks.
3. Use pin terminals or ferrules for DIN type terminal blocks.

G. Insulation-piercing type connectors are not acceptable for power or control wiring.

2.4 INSULATING TAPE AND TUBING

A. For making re-enterable tape-insulated splices and connections, provide varnished cambric electrical insulating tape made of cotton cambric fabric that is oil primed and coated with electrical insulating varnish. Manufacturer: 3M "Scotch 2510" (no adhesive) and "Scotch 2520" (pressure-sensitive adhesive).

B. Insulate taped splices and connections using ethylene propylene rubber (EPR) tape that meets the requirements of UL 510, *Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape*, and is rated for 90 ºC continuous operation and 130 ºC short-term overload service. Manufacturer: 3M "Scotch 130C."

C. For the outer covering of tape-insulated splices and connections use vinyl plastic tape that meets the requirements of UL 510. *Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape*, and has the following characteristics:

1. 8.5 mil minimum thickness,

2. ASTM D 3005, *Standard Specification for Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape – Type 1.*

3. Rated 600 volts and 105 ºC, suitable for indoor and outdoor applications.

4. Retains flexibility, adhesion, and applicable at temperature ranges from 0 through 100 °F without loss of physical or electrical properties.

5. Resistant to abrasion, moisture, alkalis, acid, corrosion, and sunlight.

6. Manufacturer: 3M "Scotch Super 88."

D. Provide heat shrinkable tubing that meets the requirements of UL 486D, *Sealed Wire Connector Systems*, and has the following characteristics:

1. Rated 600 volts,
2. Factory applied adhesive/sealant,
3. Split resistant, and
4. Manufacturer: 3M "ITCSN."

E. Use motor lead splicing kits to insulate and seal connections to leads for motors rated 480V and less. Manufacturer: 3M "5300 Series."

2.5 WIRE PULLING LUBRICANT

A. Provide NRTL-listed wire pulling lubricant that is compatible with the conductor insulation or jacket, has a maximum coefficient of dynamic friction of 0.25, and leaves no flammable residue. For cold weather installations, provide wire pulling lubricant suitable for conduit temperature.

B. Compatibility with conductor insulation shall be determined in accordance with IEEE Std 1210, Standard Tests for Determining Compatibility of Cable-Pulling Lubricants with Wire and Cable.

C. Manufacturer:

1. For conduit temperature above freezing: Polywater "Lubricant J."
2. For conduit temperature below freezing: Polywater "Lubricant WJ."

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify interior of building has been protected from weather.

B. Verify that work of other trades likely to damage wire and cable is completed.

C. Verify raceway installation is complete and supported.

D. Verify that field measurements are as shown on drawings.

E. Wire and cable routing shown on drawings is approximate unless dimensioned.

1. Route wire and cable as required meeting project conditions.

2. Where cable routing is not shown, and destination only is indicated, determine exact routing and lengths required to meet Project conditions.

3.2 PREPARATION

A. Examine raceways and building finishes that are to receive wires and cables for compliance with installation tolerances and other conditions. Do not proceed with installation until unsatisfactory conditions have been corrected.

B. Completely and thoroughly swab raceway before installing wire.

C. Do not handle or pull cables that are colder than +14 °F. Store cold cables for at least 24 hours in a heated building prior to installation.

3.3 BUILDING WIRE INSTALLATION

A. Install building wire according to, the NEC (NFPA 70), the requirements in this section, and the following NECA installation standards as applicable:

1. NECA 1.

2. NECA/AA 104 Recommended Practice for Installing Aluminum Building Wire and Cable (ANSI).

B. Do not damage conductor, insulation, or jacket by excessive installation pulling tension or sidewall bearing pressure.

1. Calculate expected cable pulling tension and sidewall bearing pressures for each set of conductors being pulled into a conduit run where any of the following combinations of bends and raceway length is exceeded between accessible pull points:

a. Four equivalent 90-degree bends and 10 ft of raceway.
b. Three equivalent 90-degree bends and 40 ft of raceway.
c. Two equivalent 90-degree bends and 80 ft of raceway.
d. One equivalent 90-degree bend and 150 ft of raceway.
e. Straight pull with more than 250 ft of raceway.

2. For cable pulling tension and sidewall bearing pressure calculations use formulas and factors described in IEEE Std 422, *IEEE Guide for the Design and Installation of Cable Systems in Power Generating Stations*.

3. Obtain recommended maximum conductor or cable pulling tension and sidewall bearing pressure values from the manufacturer, or use the following maximum allowable values:

a. Maximum sidewall bearing pressure: 500 lb/ft.

b. Maximum tension, pulling directly on conductor: 0.008 lb/cmil

c. Maximum tension, pulling on basket grip over insulation jacket: 2000 lb, not to exceed 0.008 lb/cmil of conductor.

4. Use a tension measuring device to monitor pulling force on runs where cable pulling calculations indicate installation stresses may exceed 80 percent of allowable pulling tension or sidewall bearing pressure.

a. Record the maximum measured pulling tension for each monitored cable pull.

b. Submit the recorded cable pulling tension for each monitored cable pull and the corresponding calculated allowable pulling tension.

5. Use a tension measuring device to monitor pulling force on each pull of conductors for critical systems where a pulling winch is used. Record and submit the maximum measured pulling tension for each cable pull.

C. Use solid copper conductors for power circuits 10 AWG and smaller except use stranded conductors in flexible conduits.

D. Use stranded conductors for power circuits 8 AWG and larger.

E. Use copper conductors not smaller than 12 AWG for power and lighting branch circuits.

F. Use stranded copper conductors not smaller than 14 AWG for 120V control circuits.

G. Use minimum 10 AWG copper conductors from panelboard to first outlet for 20-ampere, 120-volt branch circuits longer than 75 ft; use larger conductors as indicated on the drawings.

H. Use minimum 10 AWG copper conductors from panelboard to first outlet for 20-ampere, 277-volt branch circuits longer than 150 ft; use larger conductors as indicated on the drawings.

I. Use AA8000 aluminum conductors 1/0 AWG and larger only at locations indicated on the drawings.

J. Do not "through-pull" conductors at boxes, fittings, or cabinets where a change of raceway alignment occurs.

K. Install wiring at outlets with at least 6 in. of slack conductor at each outlet.

3.4 CONNECTOR INSTALLATION

A. Install conductors in terminals, splices, adapters, and connectors in accordance with the manufacturer's instructions. Have the manufacturer's installation instructions available at the construction site.

B. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise above the conductor temperature.

C. Do not nick conductors when removing insulation.

D. Do not cut conductor strands to fit into connectors, splices, adapters, or terminals.

E. Make connections using clean connection surfaces. Wire brush conductors immediately before installing lugs, terminals, splices, or adapters.

F. Connect conductors 1/0 AWG and larger using compression terminals at the locations described below where there is adequate wire bending space to accommodate compression terminals. Select compression terminals suitable for the conductor sizes, materials, and termination point configurations. Install compression terminals using the manufacturer's recommended dies and minimum 12-ton force compression tools.

1. Circuit breakers with frame size greater than 100 amperes that are NRTL-listed for with compression terminals. Use compression adapters where the circuit breaker is not listed for compression terminals.

2. Safety switches and fused switches rated more than 100 amperes.

3. Transformers; refer to Section 26 2213, "Low-Voltage Distribution Transformers."

4. Switchgear, switchboards, panelboards, busway, motor control centers, and similar service and distribution equipment.

5. Utilization equipment connections that are NRTL-listed for with compression terminals.

G. Install copper conductors, 1/0 AWG and larger, connected using mechanical lugs, in the locations or conditions described below.

1. Connection points not NRTL-listed for either compression terminals or compression adapters.
2. Where there is insufficient wire bending space to accommodate either compression terminals or compression adapters.
3. 100 ampere frame circuit breakers.
4. 30, 60, and 100 ampere safety switches.

H. Terminate power conductors smaller than 1/0 AWG using mechanical lugs.

I. Terminate control conductors using crimp-on terminals or ferrules. Do not place stranded conductors directly under terminal screws. Install terminals or ferrules on conductors using ratchet-type compression tools.

J. Connect outlets and components to wiring and to ground as indicated and instructed by manufacturer. Tighten connectors and terminals, including screws and bolts, according to equipment manufacturer's published torque-tightening values for equipment connectors. Where manufacturer's torque requirements are not indicated, tighten connectors and terminals according to tightening torques specified in UL 486A and UL 486B.

3.5 INSULATING TAPE AND TUBING INSTALLATION

A. Install insulating tape and tubing in accordance with the manufacturer's instructions. Have the manufacturer's installation instructions available at the construction site.

B. Insulate splices and taps of irregular shapes with manufactured insulating covers or insulating tape built up to not less than 150 percent of insulation rating of conductor.

1. Apply varnished cambric tape over connections where re-entry is likely, such as motor lead connections.
2. Use rubber insulating tape in half-lapped layers to develop the basic insulation over splices and taps.
3. Use vinyl plastic tape in half-lapped layers to provide the outer protective covering over splices and taps.

C. Insulate cylinder shaped splices and taps, connector barrels and adapter barrels using heat shrinkable insulating tubing, insulating covers manufactured for the connector, or tape insulation as described above.

3.6 IDENTIFICATION

A. Identify wire and cable under provisions of Section 26 0553, "Identification for Electrical Systems."

B. Identify each conductor with its circuit number or other designation indicated on drawings.

C. Apply color coding tape on conductors at each termination, splice, junction, and pull box.

D. Post conductor color code on each panelboard, switchboard, switchgear assembly, motor control center, dry-type transformer, safety switch, and separate motor controller. Use type-written, adhesive-backed labels

3.7 FIELD QUALITY CONTROL

A. Observe conductors and cables during the installation process.

1. Reject and replace entire reels, rolls, or boxes containing conductors or cables with material or manufacturing defects.

2. Reject and replace cable or conductor segments that have been kinked, dented, or otherwise damaged during handling or installation.

B. After installation of wires and cables and before electrical circuit is energized, show product capability and compliance with requirements and verify by documented inspections and tests.

C. Perform the following inspections:

1. Inspect conductors and cables for:

a. Freedom from material defect or physical damage,
b. Correct conductor size, material, and insulation type,
c. Correct color coding and identification.

2. Inspect connections for:

a. Correct connector size and type according to the specifications,

b. The use of the correct compression dies and the correct number of crimps on compression connectors in accordance with the connector manufacturer's instructions.

D. Perform the following tests:

1. Before connecting conductors to equipment, use a megohm meter in a 1-minute test to verify the insulation integrity of each service conductor, feeder conductor, critical system branch circuit conductor, and critical system control conductor with respect to ground and other conductors in the same raceway.

a. Use 1000-volts dc to test conductors rated 600 volts.

b. Conductors with insulation resistances over 50 megohms are acceptable.

c. Conductors with insulation resistances less than 2 megohms are defective.

d. If the conductor insulation resistance is between 50 megohms and 2 megohms notify the LANL Subcontract Technical Representative and investigate the conductor installation.

2. After connecting conductors to equipment, test continuity and correct connection of each power circuit conductor and each control circuit conductor.

3. Measure and record the tightness of not less than 10% of each size and type of mechanical or bolted connection using a calibrated torque wrench or torque screwdriver.

   a. Compare measured torque with torque recommended by the connector manufacturer or UL 486A and UL 486B.

   b. If any connection is found to be less than 90% of the recommended torque, notify the LANL STR and re-torque all bolted connections on the Project.

E. Remove and replace defective, incorrect, or improperly installed conductors and connectors. Re-inspect and re-test replacement conductors and connectors.

F. Submit test and inspection records to the LANL STR.

END OF SECTION

FOR LANL USE ONLY

This project specification is based on LANL Master Specification 26 0519, Rev. 4, dated May 6, 2009.

SECTION 26 0526

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Main Grounding Electrode System (Lightning Protection System grounding is specified in Section 26 4100, "Facility Lightning Protection").

B. Circuit and System Grounding.

C. Enclosure and Equipment Grounding System.

1.2 RELATED SECTIONS

A. Section 01 2500, "Substitution Procedures."

B. Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

C. Section 01 7839, "Project Record Documents."

D. Section 26 0529," Hangers and Supports for Electrical Systems."

E. Section 26 0536, "Cable Trays for Electrical Systems."

F. Section 26 0553, "Identification for Electrical Systems."

G. Section 26 0813, "Electrical Acceptance Testing."

H. Section 26 4100, "Facility Lightning Protection."

I. Section 27 1000, "Structured Cabling."

J. Section 33 7119, "Electrical Underground Ducts and Manholes."

1.3 ABBREVIATIONS AND ACRONYMS, DEFINITIONS, AND REFERENCES

A. Refer to Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

1.4 LANL PERFORMED WORK

A. None.

1.5 SUBMITTALS

A. Submit the following in accordance with the requirements of Exhibit I:

1. Catalog Data: Submit catalog data for grounding conductors, grounding clamps, grounding bushings, grounding plates, grounding bars, chemical ground rods, exothermic weld materials, compression grounding connector materials, static grounding materials, and signal reference grid materials.

2. Project Record Documents: Submit project record documents to include specified certifications and field test reports of installed grounding systems (refer to Section 01 7839, "Project Record Documents").

1.6 REGULATORY REQUIREMENTS

A. Comply with the *National Electrical Code* (NEC) (NFPA 70) for components and installation.

B. Provide products that are listed and labeled by a nationally recognized testing laboratory (NRTL) for the application and environment in which installed.

1.7 RECEIVING, STORING, PROTECTING, AND HANDLING

A. Receive, store, protect, and handle products according to NECA 1, *Standard Practices for Good Workmanship in Electrical Construction*.

PART 2 PRODUCTS

2.1 PRODUCT OPTIONS AND SUBSTITUTIONS

A. Alternate products may be accepted; follow Section 01 2500, "Substitution Procedures."

2.2 GROUND ELECTRODE CABLE

A. Provide bare stranded, soft temper copper cable that conforms to ASTM B 8, *Standard Specification for Concentric-Lay Stranded Copper Conductors*.

2.3 GROUND ELECTRODE BACKFILL MATERIAL

A. Provide ground enhancement backfill material for ground rods and cable type electrodes.

B. Field-mixed backfill material shall consist of approximately 75 percent gypsum (calcium sulfate), 20 percent bentonite clay, and 5 percent sodium sulfate.

C. Commercial backfill material, when at 300% moisture content ((weight of water/weight of material)x 100), shall have a resistivity of approximately 250 ohm-cm at 30% solids density and a pH of 8 to 10.

D. Manufacturers: Lyncole "Lynconite," LEC Inc. "GAF," Superior Grounding Systems "Electro-Fill."

2.4 EQUIPMENT GROUNDING CONDUCTORS

A. Provide NRTL-listed THHN/THWN insulated copper wire.

B. Use solid grounding conductors 10 AWG and smaller where not subject to vibration or repeated flexing.

C. Use stranded grounding conductors for 8 AWG and larger.

D. Use stranded grounding conductors where subject to vibration or repeated flexing. Use stranded grounding conductors in flexible conduit at motor connections.

E. Color code grounding conductors as follows:

1. Equipment ground:

a. Conductors 6 AWG and smaller: Green colored insulation.

b. Conductors 4 AWG and larger: Green colored insulation or black colored insulation with 3/4 inch wide band of water and oil-resistant green plastic adhesive tape.

2.5 GROUND BAR

A. Provide ground bar, 12 in. long or greater length as indicated on the drawings, fabricated from 1/4-in.-thick, 4-in.-wide copper stock with (1-in. plus 3/4-in.) by 2-in. bolt hole pattern to accept NEMA standard lugs. Mount ground bar on 2700-volt standoff insulators.

B. Provide 25-ft 4/0 AWG copper pigtail exothermically welded to the ground bar.

C. Manufacturer: Harger "GBIT."

2.6 PIPE GROUNDING CONNECTORS

A. Provide NRTL-listed copper-alloy connectors for making cable to pipe connections.

B. Manufacturer: O-Z/Gedney "ABG" or "CG."

2.7 CONDUIT GROUNDING BUSHINGS

A. Provide NRTL-listed, galvanized malleable iron, 150 C rated insulated throat grounding bushings with lay-in type ground cable lugs.

B. Manufacturers: O-Z/Gedney Type "BLG."

2.8 EXOTHERMIC WELD GROUNDING CONNECTIONS

A. Provide molds and welding material for making exothermic weld connections.

B. In interior locations and in vaults, use low smoke emission type welding material.

C. Match mold and weld material to material types, shapes and sizes to be joined.

D. Manufacturer: ERICO Cadweld.

2.9 COMPRESSION GROUNDING CONNECTIONS

A. Provide wrought copper connectors, terminals, taps, and splices for making irreversible compression grounding connections.

B. Furnish NRTL-listed grounding connectors that are suitable for direct burial and have been tested successfully according to the requirements of IEEE Std 837.

C. Provide connector manufacturer's hydraulic compression tools and dies that match the connectors.

D. Match connector and die size to material shapes and conductor sizes to be joined.

E. Use two-hole heavy-duty compression lugs for bolted connections to ground bars, ground plates, and equipment ground pads.

F. Manufacturer: Burndy "Hyground."

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that work of other trades likely to damage grounding and bonding material has been completed.

B. Verify that field measurements are as shown on drawings.

C. Electrode locations and grounding cable routing shown on drawings are approximate unless dimensioned.

1. Install electrodes and route cable as required meeting project conditions.

2. Where electrode location or cable routing is not shown, and destination only is indicated, determine exact locations, routing, and lengths required to meet project conditions.

3.2 PREPARATION

A. Examine equipment and building finishes that are to receive grounding and bonding material for compliance with installation tolerances and other conditions. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.3 GENERAL

A. Comply with the requirements of the NEC (NFPA 70), this section and the drawings.

B. Install grounding and bonding material according to manufacturer's instructions. Have the manufacturer's installation instructions available at the construction site.

C. Do not use the grounding systems specified in this section for lightning protection grounding. A separate lightning protection grounding system is specified in Section 26 4100, "Facility Lightning Protection." Bond the lightning protection ground to the main electrode system at the service entrance ground bar.

D. Use the following connection methods unless otherwise specified or indicated on the drawings:

1. Use exothermic weld grounding connections for underground or concealed connections of dissimilar materials.

2. Use exothermic weld or compression grounding connections for underground or concealed connections of like materials.

3. Use exothermic weld, compression, or bolted grounding connections for accessible connections.

4. Make bolted connections using bolts, nuts, flat washers, and toothed lock washers suitable for the connector and the installation environment; acceptable materials include high strength silicon bronze and 18-8 alloy stainless steel.

5. Make irreversible bolted connections using 18-8 alloy stainless steel tamper-resistant bolts and tamper-resistant nuts along with flat washers, and toothed lock washers. Tamper-resistant nuts and bolts must resist loosening with common tools; acceptable tamper-resistant fasteners include penta-head, break-away, and oval designs.

E. Tighten grounding and bonding connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values for connectors and bolts. Where manufacturer's torquing requirements are not indicated, tighten connections to comply with torque tightening values specified in UL 486A and UL 486B. Use a calibrated torque wrench.

F. Use hydraulic compression tools to provide the correct circumferential pressure for compression connectors. Follow connector manufacturer's installation instructions and use tools and dies recommended by the manufacturer of the connectors. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed.

G. Install exothermic welds in accordance with manufacturer's instructions and recommendations. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.

H. Make connections in such a manner as to minimize possibility of galvanic action or electrolysis. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.

1. Use electroplated or hot-tin-coated materials to assure high conductivity and make contact points closer in order of galvanic series.

2. Make connections with clean bare metal at points of contact.

3. Make aluminum to steel connections with stainless steel separators and mechanical clamps.

4. Make aluminum to galvanized steel connections with tin-plated copper jumpers and mechanical clamps.

5. Coat and seal connections involving dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

I. Comply with requirements in Section 26 0529," Hangers and Supports for Electrical Systems."

3.4 MAIN GROUNDING ELECTRODE SYSTEM

A. Concrete Encased Electrode: Where available, use the building concrete grade beam or strip footing to make a concrete encased main grounding electrode; use either copper ground cable or reinforcing steel as follows:

1. Install a continuous ground cable in the bottom one-third of the grade beam around the entire perimeter of the building. Use ground cable as indicated on the drawings, not smaller than the grounding electrode cable required by the NEC (NFPA 70), and not smaller than 4 AWG. Space cable from the bottom and sides of the grade beam so it has at least 2 in. of concrete coverage.

2. Make one or more reinforcing bars located in the bottom one-third of the footing, electrically continuous around the entire perimeter of the building. Use galvanized or uncoated reinforcing bars not smaller than the following sizes based on the total length of the interconnected and paralleled reinforcing bars:

Total Length of Reinforcing Bars	Minimum Reinforcing Bar Size	
112 ft	1-3/8 in.	(#11 bar)
150 ft	1 in.	(#8 bar)
192 ft	3/4 in.	(#6 bar)
223 ft	5/8 in.	(#5 bar)
268 ft	1/2 in.	(#4 bar)

Bond the reinforcing bars together using bare copper ground cable jumpers that are either exothermically welded to the reinforcing bars or

connected using hydraulically compressed tap connectors. Use jumpers compatible with the tap fitting that are not smaller than the grounding electrode cable required by the NEC (NFPA 70) and not smaller than 4 AWG.

B. Main Ground Electrode Ground Bar:

1. Install a main electrode ground bar in an accessible location in the main electrical room adjacent to the service entrance equipment.

2. Make an irreversible connection between the main electrode ground bar and the main grounding electrode conductor; use exothermic weld connection or compression grounding lug with tamper-resistant fasteners.

3. Main ground electrode ground bar extensions may be established at additional locations by installing ground bars or ground plates connected to the main electrode ground bar using 4/0 AWG insulated ground conductor with an irreversible connection to each ground bar.

4. Connections to the main ground electrode ground bar or extensions will be considered as connections directly to the main ground electrode.

C. Bond exterior underground metal fire protection and potable water service pipes to the main ground electrode bar; use pipe grounding fittings and ground cable as indicated on the drawings, or not smaller than the grounding electrode cable required by the NEC (NFPA 70) and not smaller than 4 AWG. Make bond to each water pipe at an accessible location within 5 ft of where it enters the structure. Comply with NEC (NFPA 70) requirements for bonding around water meters and insulating joints.

D. Bond the nearest building perimeter structural steel column or effectively grounded metal structure to the main ground electrode ground bar; use ground cable as indicated on the drawings, or not smaller than the grounding electrode cable required by the NEC (NFPA 70) and not smaller than 4 AWG.

E. Bond each interior metal piping system to the main ground electrode bar; use pipe grounding fittings and ground cable as indicated on the drawings, or not smaller than the grounding electrode cable required by the NEC (NFPA 70) and not smaller than 4 AWG. Make bond to each pipe at an accessible location.

F. Label each conductor connected to the main ground electrode ground bar or main ground electrode ground bar extensions. Refer to Section 26 0553, "Identification for Electrical Systems."

3.5 CIRCUIT AND SYSTEM GROUNDING

A. Connect the service entrance equipment ground bus to the main electrode ground bar; use ground cable as indicated on the drawings, or not smaller than the grounding electrode conductor required by the NEC (NFPA 70) and not smaller than 4 AWG.

B. In the service entrance equipment, connect the neutral bus to the ground bus using a bonding jumper not smaller than the grounding electrode conductor required by the NEC (NFPA 70); do not use a bonding screw for this purpose. Make no other neutral-to-ground connections on the load side of the service entrance disconnect.

C. Separately Derived Systems:

1. Connect ground bus of first disconnecting means for separately derived systems (e.g. dry type transformers) in the vicinity of the main electrical equipment room to the main electrode ground bar; use grounding conductor sized as shown on the drawings or as required by the NEC (NFPA 70).

2. Connect ground bus of first disconnecting means for separately derived systems that are remote from the main electrical room to the nearest effectively grounded building structural steel column and the nearest effectively grounded metal water pipe; use grounding conductor sized as shown on the drawings or as required by the NEC (NFPA 70). Make connections at accessible locations.

3. Connect ground bus of first disconnecting means for separately derived systems that are remote from the main electrical room to an extension of the main electrode ground bar if there is neither a nearby effectively grounded building structural steel column nor an effectively grounded metal water pipe; use grounding conductor sized as shown on the drawings or as required by the NEC (NFPA 70).

4. At the first system overcurrent device or disconnecting means, connect the neutral bus to the ground bus using a bonding jumper sized as required by the NEC (NFPA 70); do not use a bonding screw for this purpose. Make no other neutral-to-ground connections on the load side of the separately derived system disconnect.

3.6 ENCLOSURE AND EQUIPMENT GROUNDING

A. Provide permanent and effective equipment, enclosure, and raceway grounding in accordance with NEC (NFPA 70) requirements and as further specified or shown on the drawings.

B. Provide an equipment ground bar, separate from any neutral bar, in all switchgear, switchboards, panelboards, transformers, motor control centers, starters, disconnect switches, cabinets, etc., for grounding the enclosure and for connecting other equipment and raceway ground conductors. Make connections to the ground bar using mechanical lugs or compression lugs.

C. Make connections and couplings on metallic conduit systems wrench tight.

D. Bonding Bushings:

1. Install bonding bushings on metallic conduit containing circuits rated 100 amperes and higher.

2. Install bonding bushings on metallic conduits entering enclosures through concentric, eccentric or oversize knockouts.

3. Install bonding bushings on metallic conduits that terminate to a metallic enclosure without effective electrical connection such as locknuts or threaded bushings.

4. Bond conduit bonding bushing lug to the equipment ground bar or ground lug in switchgear, panelboards, transformers, motor control centers, starters, disconnect switches, cabinets, etc. Size bonding jumpers in accordance with the NEC (NFPA 70).

E. Provide an insulated equipment grounding conductor for each feeder and branch circuit.

1. Install the grounding conductor within the common conduit or raceway with the related phase and neutral conductors and connect to the grounding terminal or grounding bus in each box or cabinet.

2. Size equipment ground conductor in accordance with the NEC (NFPA 70) or as shown on the drawings.

F. In each 15 or 20 ampere branch circuit outlet box and junction box, install a green colored washer head grounding screw with a 12 AWG equipment grounding conductor pigtail.

G. Connect receptacle grounding terminals to the equipment ground system using minimum 12 AWG equipment grounding conductor. Do not use a "self-grounding" receptacle strap as the only equipment grounding path.

H. Bond raceways served from cable tray using conduit clamps or grounding bushings that are NRTL approved for the purpose. Refer to Section 26 0536, "Cable Trays for Electrical Systems."

I. Install an equipment grounding conductor in each cable tray; size conductor per the NEC (NFPA 70), but not smaller than 6 AWG. Bond grounding conductor to each cable tray section using UL-listed cable tray ground clamps. Connect grounding conductor to ground bus of each enclosure or equipment item served by the cable tray. Refer to Section 26 0536, "Cable Trays for Electrical Systems."

3.7 COMMUNICATION SYSTEM GROUNDING

A. Refer to Section 27 1000, "Structured Cabling."

3.8 UNDERGROUND DUCTBANK SYSTEM GROUNDING

A. Refer to Section 33 7119, "Electrical Underground Ducts and Manholes."

3.9 FIELD QUALITY CONTROL

A. General: Perform on-site verification, certification, and acceptance testing of the grounding installation during construction. Verification and testing will be witnessed by designated LANL representatives.

B. Notify the LANL Subcontract Technical Representative (STR) ten (10) working days in advance of the expected completion of a grounding system installation. Verification and testing can be scheduled in parts or by area depending on the system and construction schedule.

C. Before work is concealed verify and certify that the following grounding installations have been made correctly:

1. The building grounding electrode system. This includes the bonding of the foundation reinforcing bars, bonding of the structural steel columns, and bonding of other metallic systems and other grounding electrode systems.

2. Ground plates and grounding bars.

3. All other underground grounding installations.

D. Acceptance Testing: Perform acceptance testing and submit written reports to the LANL STR in accordance with the requirements of Section 26 0813, "Electrical Acceptance Testing." Tests will be witnessed by designated LANL representatives.

1. Perform ground-impedance measurements using the "fall-of-potential" method in accordance with IEEE Std 81, *Guide for Measuring Earth Resistivity, Ground Impedance and Earth Surface Potentials of a Grounding System*. Use instrumentation specifically designed for ground impedance testing. Provide sufficient spacing of test electrodes so that the plotted curves flatten in the 62% area of the distance between the item under test and the current electrode. When sufficient spacing of electrodes is impractical for the "fall-of-potential" method, perform ground-impedance measurements using either the "intersecting curves method" or the "slope method," referenced in IEEE Std 81. Investigate and correct ground resistances that exceed the following values:

   a. Service rated 50 kVA or less: as required by the NEC (NFPA 70).

   b. Service rated more than 50 kVA but less than 2500 kVA: 5 ohms.

2. Test equipment ground resistances for the following items. Measure resistance between the equipment item and the Main Ground Electrode Ground Bar. Use the "two-point method" of IEEE Std 81. Investigate and correct equipment ground resistances that exceed 0.5 ohm.

   a. Transformers,
   b. Switchgear and Switchboards,
   c. Panelboards,
   d. Motor Control Centers, and
   e. Motors larger than 1 hp.

E. Prepare test reports, certified by the testing organization, of the ground resistance at each test location. Include observations of weather and other phenomena that may affect test results. Describe any measures taken to improve test results.

END OF SECTION

FOR LANL USE ONLY

This project specification is based on LANL Master Specification 26 0526, Rev. 1, dated July 23, 2008.

SECTION 26 0529

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Furnish and install, hangers, supports, anchors, concrete bases, and other positive fastenings for electrical components such that gravity loads are safely transferred to the structure.

1.2 RELATED SECTIONS

A. Section 01 2500, "Substitution Procedures."

B. Section 03 3001, "Reinforced Concrete."

C. Section 03 1534, "Post-Installed Concrete Anchors Purchase – Normal Confidence."

D. Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

E. Section 09 9100, "Painting."

F. Section 26 0548, "Vibration and Seismic Controls for Electrical Systems."

G. Section 26 0533, "Raceways and Boxes for Electrical Systems."

1.3 ABBREVIATIONS AND ACRONYMS, DEFINITIONS, AND REFERENCES

A. Refer to Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

1.4 VIBRATION AND SEISMIC CONTROLS

A. Refer to Section 26 0548, "Vibration and Seismic Controls for Electrical Systems," for hangers, supports, vibration isolation, concrete bases, and seismic control for electrical components identified on the drawings as having vibration isolators or seismic designed anchors or braces.

1.5 QUALITY ASSURANCE

A. Furnish and install hangers and supports that conform to the requirements of the following codes and standards:

1. *2009 International Building Code* (IBC).
2. ASCE 7-05, *Minimum Design Loads for Buildings and Other Structures.*
3. MFMA-4, *Metal Framing Standards Publication.*
4. MFMA-102, *Guidelines for the Use of Metal Framing.*
5. NECA 1, *Standard Practices for Good Workmanship in Electrical Contracting.*
6. NFPA 70, *National Electric Code* (NEC).

B. Where a nationally recognized testing laboratory (NRTL) has requirements for such products, provide products that are NRTL-listed and labeled for the application, installation condition, and the environment in which installed.

1.6 SUBMITTALS

A. Submit the following in accordance with the requirements of Exhibit I:

1. Catalog Data: Submit catalog data for each type of product specified. Include information substantiating equivalent corrosion resistance to zinc-coated steel of alternative treatment, finish, or inherent material characteristic.

2. Test Reports: Submit International Code Council Evaluation Service, Inc (ICC-ES) evaluation report for each post-installed concrete or masonry anchor product showing that it complies with the current edition of the IBC and the intended conditions of use.

1.7 RECEIVING, STORING, PROTECTING, AND HANDLING

A. Receive, store, protect, and handle products according to NECA 1.

PART 2 PRODUCTS

2.1 SUBSTITUTIONS

A. Alternate products may be accepted; follow Section 01 2500, "Substitution Procedures."

2.2 COATINGS AND MATERIALS

A. Furnish products for use indoors protected with zinc coating or with treatment of equivalent corrosion-resistance using approved alternative treatment, finish, or inherent material characteristic.

B. Furnish products for use outdoors, or in damp or corrosive indoor locations, with hot-dip galvanized coating or with treatment of equivalent corrosion-resistance using approved alternative treatment, finish, or material, such as stainless steel with inherent corrosion-resistant characteristics.

2.3 RACEWAY SUPPORTING DEVICES

A. Furnish supports as described below for the installation of raceway systems.

B. Use pressed steel, single bolt hangers to support individual rigid-galvanized steel (RGS), intermediate metal conduit (IMC), or electrical metallic tubing (EMT) conduits from threaded rods or beam clamps. Manufacturer: Steel City "6H_ B Series."

C. For individual runs of EMT up to 1-in. trade size above accessible ceilings, use spring-steel conduit clips with positive snap closure. Manufacturer: ERICO CADDY "M Series."

D. Use malleable iron conduit clamps to secure individual RGS, IMC, or EMT conduit runs across, parallel, or perpendicular to beams, channels, and angle supports. Manufacturer: Steel City "RC, EC, and PC Series."

E. Use two-piece, carbon-steel, riser clamps for individual vertical conduits passing through floors. Manufacturer: Kindorf "C-210 Series."

F. Use snap-on-type, one-hole, steel straps to secure individual conduits up to 2-in. trade size to flat, dry, interior surfaces. Manufacturer: T&B "1210 Series" for RGS and IMC and "4100 Series" for EMT.

G. Use one-hole, malleable, iron straps to secure individual conduits up to 4-in. trade size to flat, dry, interior surfaces. Manufacturer: T&B "1275 Series."

H. Use one-hole, malleable, iron straps and conduit spacers to secure individual conduits to flat exterior or damp flat interior surfaces. Manufacturer: T&B "1275 Series" straps with "1350 Series" spacers.

I. Support multiple parallel horizontal conduits with trapeze hangers fabricated from framing channel materials specified below.

2.4 OUTLET BOX SUPPORTING DEVICES

A. Furnish prefabricated sheet steel brackets to support outlet boxes from metal studs in dry-wall construction.

B. Single Outlet Boxes: Provide brackets that are inset to allow for dry-wall ring and have a far-side support leg. Manufacturer: ERICO CADDY "H Series" or "MEB1" attached with "SMS8" low-profile, self-tapping screws.

C. Multiple Outlet Boxes: Provide brackets that are inset to allow for dry-wall rings and span from stud-to-stud. Manufacturer: ERICO CADDY "RBS Series" attached with "SMS8" low-profile, self-tapping screws.

2.5 HANGER RODS

A. Furnish mild steel rods that conform to ASTM A 307, *Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength*.

B. Furnish rods that are threaded on both ends, threaded on one end, or continuous threaded with UNC (coarse) thread pitch.

C. Provide swivel hangers to eliminate inelastic bending of hanger rods that are not seismically braced.

2.6 FASTENERS

A. Pre-set Concrete Inserts:

1. Furnish pre-set concrete inserts as shown on the drawings.

2. Manufacturers:

a. Continuous Inserts. Design load 2,000 lb/ft of insert length with safety factor of 3 in 3,000 psi concrete. Manufacturer: B-Line "B221."

b. Spot Inserts. NRTL-listed with design load of 1,000 lb. Manufacturer: B-Line "B2506."

c. Metal Deck Bolts. Adjustable with bolt sizes from 3/8 in. to 3/4 in. Manufacturer: B-Line "B3019."

B. Post-Installed Concrete Anchors:

1. Furnish post-installed concrete anchors as shown on the drawings.

2. Each post-installed anchor shall have an ICC-ES evaluation report stating that the product is compliant with the current edition of the IBC and the intended conditions of use.

3. For applications in outdoor, damp, or corrosive locations furnish stainless-steel, post-installed anchors.

4. Furnish post-installed expansion, adhesive, and undercut anchors specified in Section 03 1534, "Post-Installed Concrete Anchors Purchase – Normal Confidence."

5. Power-Actuated Threaded Studs. Use zinc-plated carbon steel or stainless steel suitable for the intended service:

   a. 1/4-20 threaded stud. Manufacturer: Hilti X-W6 and
   b. 3/8-16 threaded stud. Manufacturer: Hilti W10.

6. Concrete and Masonry Screw Anchors. Heat-treated carbon steel. Manufacturer: Simpson Strong-Tie "Titen HD."

C. Beam Clamps:

1. Furnish beam clamps that are NRTL-listed and compliant with WW-H-171E (*Federal Specification – Hangers and Supports, Pipe*) Type 23 or Manufacturers' Standardization Society (MSS) SP-58 (*Pipe Hangers and Supports – Materials, Design and Manufacture*) and MSS SP-69 (*Pipe Hangers and Supports – Selection and Application*) Type 23.

2. Provide beam clamps with a locknut on the setscrew.

3. Provide NRTL-listed restraining strap for each beam clamp. Strap shall be not less than 16 gauge thickness, not less than 1 in. wide, and of sufficient length to wrap around the beam flange not less than 1 in.

D. Hollow Wall Anchors: Furnish zinc-plated steel hollow wall anchors that meet FF-B-588C (*Federal Specification – Lockwire Drilling*), Type III.

E. Toggle-Bolt Anchors: Furnish zinc-plated steel toggle-bolt anchors that meet Federal Specification FF-B-588C, Type I, Class A, Style 1.

F. Masonry Screw Anchors: Case hardened steel. Manufacturer: Hilti "HUS-H."

2.7 FRAMING CHANNEL SYSTEMS

A. Furnish U-channel framing systems that conform to MFMA-4 and are fabricated using minimum 12-gauge steel, with 9/16-in.-diameter holes, from 1-1/2 to 1-7/8 in. on center, in the surface opposite the "U" opening.

B. Furnish fittings and accessories that mate and match with U-channel and are of the same manufacturer. Use two-piece, single bolt-type conduit straps on U-channel supports.

C. Manufacturers: Unistrut, B-Line, Superstrut.

2.8 FABRICATED SUPPORTING DEVICES

A. Furnish shop- or field-fabricated supports or manufactured supports assembled from U-channel components.

B. Furnish steel brackets fabricated from angles, channels, and other standard structural shapes. Connect with welds and machine bolts to form rigid supports.

PART 3 EXECUTION

3.1 GENERAL

A. Install hangers and supports according to the NEC (NFPA 70), IBC, NECA 1, ASCE 7-05, the requirements in this section, and specific-supporting requirements in other sections of this specification.

B. Conform to manufacturer's instructions and recommendations for selection and installation of hangers and supports.

C. Do not use wire or perforated strap for permanent supports.

D. Refer to Section 26 0533, "Raceways and Boxes for Electrical Systems," for required flexible sections where raceways cross building expansion joints and where raceways connect to equipment.

E. Do not support conduits, boxes, raceways, etc. from ceiling suspension wires.

3.2 EXAMINATION

A. Examine surfaces to receive hangers and supports for compliance with installation tolerances and other conditions affecting performance of the system. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.3 FASTENERS

A. Pre-set Inserts: Install pre-set inserts for anchoring to reinforced concrete slabs, sides of reinforced concrete beams, and reinforced concrete walls.

B. Post-Installed Concrete Expansion Anchors: Install in accordance with Section 03 1554, "Post-Installed Concrete Anchors Purchase – Normal Confidence" and the product's ICC-ES report conditions of use.

C. Masonry Screw Anchors: Use in accordance with NECA 1 and the product's ICC-ES report conditions of use.

D. Power-Actuated Threaded Studs:

1. Use only to fasten clips or straps for individual rigid metal (RMC) or intermediate metal (IMC) conduits 1-1/2-in. trade size and smaller or EMT 2-1/2-in. trade size and smaller;

2. Install in accordance with the product's ICC-ES report conditions of use and the manufacturer's instructions using recommended tools and loads;

3. Use only in uncracked concrete; and

4. Install to provide embedment as indicated on the drawings.

E. Hollow Wall Anchors: Use hollow wall anchors for fastening to wallboard, plaster, or paneling.

F. Toggle Bolt Anchors: Use toggle bolt anchors for fastening to block, wallboard, or plaster.

G. Use wood screws for fastening to wood construction.

H. Use beam clamps for fastening to structural metal beams, joists, and purlins.

1. Install a restraining strap at each beam clamp. Wrap the restraining strap around the beam flange not less than 1 in. Where purlins or beams do not provide a secure lip for the restraining strap, secure the strap with a self-tapping screw or by through-bolting.

2. Use a locknut on each beam clamp set screw.

I. Use self-tapping screws or machine bolts, nuts, and washers for fastening to metal studs or metal surfaces.

J. The use of lead-cinch, drop-in anchors is not allowed.

K. Torque threaded fasteners as recommended by the manufacturer's instructions.

3.4 RACEWAY SUPPORTS

A. Install individual and multiple (trapeze) raceway hangers and riser clamps as necessary to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assembly and for securing hanger rods and conduits.

B. Support three or more parallel runs of horizontal raceways together on trapeze hangers.

C. Support individual horizontal raceways by separate conduit hangers.

D. Do not support conduits from ceiling suspension wires.

3.5 BOXES AND CABINETS

A. Support sheet metal boxes directly from the building structure, or by approved brackets or bar hangers, as shown on the drawings or as required. Where bar hangers are used, attach the bar to structure on opposite sides of the box.

B. In open overhead spaces, cast boxes threaded to raceways need not be supported separately except where used for fixture support.

C. Install surface-mounted cabinets and panelboards as shown on the drawings or as required.

3.6 FRAMING CHANNEL SYSTEMS

A. Select and install framing channel systems in accordance with MFMA-102.

B. Use framing channel to support electrical equipment that is mounted free of walls.

C. Use framing channel to support equipment mounted on walls that do not have sufficient strength to resist pull-out or wallowing out of equipment mounting bolts.

3.7 CONCRETE BASES

A. Install a reinforced concrete base for each piece of floor-mounted electrical equipment. Refer to Section 03 3001, "Reinforced Concrete," for materials and installation requirements.

1. Form concrete equipment bases using framing lumber with form-release compounds.

2. Construct concrete bases as shown on the drawings and not less than 4 in. high and not less than 4 in. larger in both directions than the supported equipment or as shown on drawings.

3. Place pre-set anchors, conduits, and sleeves using the equipment manufacturer's installation template or instructions. Install post-installed anchors in accordance with Paragraph 3.3 of this section.

4. Place concrete and provide a steel-trowel finish on top; chamfer top edges and corners.

B. Cure concrete not less than seven days before installing equipment.

3.8 HANGER RODS

A. Use minimum 3/8-in.-diameter threaded rod; use larger diameter rod as indicated on the drawings, in other sections, or in the supported equipment manufacturer's installation instructions.

B. Install a locknut at every hanger rod connection.

C. Install swivel hangers at the top of hanger rods that are not seismically braced.

3.9 PAINTING

A. Paint hangers and supports to match finish of adjacent surfaces.

B. Refer to Section 09 9100, "Painting," for materials and installation requirements.

END OF SECTION

FOR LANL USE ONLY

This project specification is based on LANL Master Specification 26 0529, Rev. 3, dated February 14, 2011.

SECTION 26 0533

RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Conduits and Fittings.

B. Outlet Boxes.

C. Pull and Junction Boxes.

D. Floor Boxes.

E. Surface Metal Raceways.

F. Wireway.

1.2 RELATED SECTIONS

A. Section 01 2500, "Substitution Procedures."

B. Section 01 4000, "Quality Requirements."

C. Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

D. Section 01 8116, "Facility Environmental Requirements."

E. Section 03 3001, "Reinforced Concrete."

F. Section 07 8400, "Firestopping."

G. Section 26 0526, "Grounding and Bonding for Electrical Systems."

H. Section 26 0529, "Hangers and Supports for Electrical Systems."

I. Section 26 0553, "Identification for Electrical Systems."

J. Section 26 2726, "Wiring Devices."

K. Section 33 7119, "Electrical Underground Ducts and Manholes."

1.3 ABBREVIATIONS AND ACRONYMS, DEFINITIONS, AND REFERENCES

A. Refer to Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

1.4 SUBMITTALS

A. Submit the following in accordance with the requirements of Exhibit I:

1. Catalog Data:

a. Submit catalog data describing floor boxes (include data substantiating that materials comply with specified requirements).

b. Submit catalog data describing surface metal raceway (include data substantiating that materials comply with specified requirements).

c. Submit catalog data describing wireway (include data substantiating that materials comply with specified requirements).

1.5 QUALITY ASSURANCE

A. Work identified in this section shall be done under a Quality Assurance Program in accordance with Section 01 4000, "Quality Requirements."

B. Comply with the *National Electrical Code* (NEC) (NFPA 70) for components and installation.

C. Provide products that are listed and labeled by a nationally recognized testing laboratory (NRTL) for the application, installation condition, and the environment in which installed.

1.6 ENVIRONMENTAL REQUIREMENTS

A. See Section 01 8116, "Facility Environmental Requirements."

B. Provide supports and seismic anchorage in accordance with manufacturer's installation instructions and requirements of Section 26 0529, "Hangers and Supports for Electrical Systems."

1.7 RECEIVING, STORING, PROTECTING, AND HANDLING

A. Receive, store, protect, and handle products according to NECA 1, *Standard Practices for Good Workmanship in Electrical Construction*.

PART 2 PRODUCTS

2.1 PRODUCT OPTIONS AND SUBSTITUTIONS

A. Alternate products may be accepted; follow Section 01 2500, "Substitution Procedures."

2.2 COATINGS

A. Provide products with zinc coating or with treatment of equivalent corrosion-resistance using approved alternative treatment, finish, or inherent material characteristic that is suitable for the environment in which the product will be installed and used.

2.3 INTERMEDIATE METAL CONDUIT AND FITTINGS (IMC)

A. Furnish intermediate metal conduit (IMC) that conforms to UL 1242, Intermediate Metal Conduit and ANSI/NEMA C80.6, *American National Standard for Intermediate Metal Conduit (EIMC).*

B. Furnish zinc-plated, threaded, malleable iron fittings and conduit bodies that meet the requirements of UL 514B, *Fittings for Conduit and Outlet Boxes* and ANSI/NEMA FB 1, *Fittings, Cast Metal Boxes and Conduit Bodies for Conduit, Electrical Tubing (EMT) and Cable.*

2.4 RIGID METAL CONDUIT AND FITTINGS (RMC)

A. Furnish rigid metal conduit (RMC) that meets the requirements of UL 6, *Rigid Metal Electrical Conduit* and ANSI/NEMA C80.1, *American National Standard for Electrical Rigid Steel Conduit (ERSC).*

B. Furnish zinc-plated, threaded, malleable iron fittings and conduit bodies that meet the requirements of UL 514B and ANSI/NEMA FB 1.

2.5 PLASTIC-COATED STEEL CONDUIT AND FITTINGS

A. Furnish polyvinyl chloride (PVC) exterior-coated, urethane interior-coated, RMC or IMC that meets the requirements of NEMA RN 1, *PVC Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.*

B. Use factory-fabricated elbows.

C. Furnish 40-mils PVC exterior-coated, urethane interior-coated, zinc-plated, threaded, malleable iron fittings and conduit bodies meeting the requirements of UL 514B and NEMA RN 1.

2.6 RIGID NON-METALLIC CONDUIT AND FITTINGS (RNC)

A. Furnish rigid non-metallic conduit (RNC) that conforms to UL 651, *Schedule 40 and 80 Rigid PVC Conduit.*

B. Furnish non-metallic, solvent-welded socket fittings that meet the requirements of UL 514C, *Non-Metallic Fittings for Conduit and Outlet Boxes* and NEMA TC 3, *PVC Fittings for Use with Rigid PVC Conduit and Tubing.*

2.7 ELECTRICAL METALLIC TUBING AND FITTINGS (EMT)

A. Furnish galvanized electrical metallic tubing (EMT) that conforms to UL 797, *Electrical Metallic Tubing* and NEMA C80.3, *Steel Electrical Metallic Tubing (EMT).*

B. Furnish compression or set-screw type fittings that meet the requirements of UL 514B, *Fittings for Conduit and Outlet Boxes* and ANSI/NEMA FB1, *Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.* Furnish insulated throat connectors.

2.8 FLEXIBLE METAL CONDUIT AND FITTINGS

A. Furnish galvanized steel flexible metal conduit that meets the requirements of UL 1, *Flexible Metal Electrical Conduit.*

B. Furnish zinc-plated, malleable iron fittings that meet the requirements of UL 514B, *Fittings for Conduit and Outlet Boxes* and ANSI/NEMA FB1, *Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.* Furnish insulated throat connectors.

2.9 LIQUID-TIGHT FLEXIBLE METAL CONDUIT AND FITTINGS

A. Furnish liquid-tight flexible metal conduit that meets the requirements of UL 360, *Liquid-Tight Flexible Steel Conduit, Electrical.*

B. Furnish zinc-plated, malleable iron or zinc-plated steel liquid-tight fittings that meet the requirements of UL 514B, *Fittings for Conduit and Outlet Boxes* and ANSI/NEMA FB1, *Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.* Furnish insulated throat connectors.

2.10 INSULATING BUSHINGS

A. Provide NRTL-listed insulating bushings with 105 °C rated insulation.

B. Manufacturer: O-Z/Gedney, Type IB.

2.11 GROUNDING BUSHINGS

A. Provide NRTL-listed, galvanized-malleable iron, 150 ºC rated insulated throat grounding bushings with lay-in type ground cable lugs.

B. Manufacturer: O-Z/Gedney, Type BLG.

2.12 EXPANSION FITTINGS

A. Furnish NRTL-listed expansion fittings with hot-dipped, galvanized-malleable iron body, factory installed packing, and a bonding jumper.

B. Manufacturer: O-Z/Gedney, Type AX, TX, or EXE with Type BJ bonding jumper.

2.13 SEALING FITTINGS

A. Furnish zinc-plated, malleable iron sealing fittings that meet the requirements of UL 886, *Outlet Boxes and Fittings for Use in Hazardous Locations.*

B. Select each sealing fitting so the cross-sectional area of conductors passing through the seal is not more than 25 percent of the cross-sectional area of an RMC of the same trade size unless the fitting is specifically identified for a higher percentage of fill.

C. Provide sealing compound specifically listed for use with the sealing fitting.

D. Manufacturer: Crouse-Hinds Type EYS, EYSX, and EYD.

2.14 CORROSION PROTECTION TAPE

A. Furnish pressure-sensitive, 10-mil-thick, PVC-based tape for corrosion protection of metal conduit and fittings.

B. Manufacturer: 3M, Type 50.

2.15 RACEWAY MEASURING TAPE

A. Furnish raceway measuring tape with permanently printed measurements in 1-ft increments and minimum 1,200-lb average breaking strength.

B. Manufacturer: Greenlee "39243."

2.16 SURFACE METAL RACEWAY

A. Furnish surface metal raceway that meets the requirements of UL 5, *Surface Metal Electrical Raceways and Fittings.*

B. Furnish surface metal raceway fabricated from cold-rolled, galvanized steel with a thickness of not less than 0.040 in. and coated with a baked-enamel finish.

C. Furnish fittings required for a complete installation.

D. Manufacturer: Wiremold "500" or "700" series.

2.17 POWER AND COMMUNICATIONS SURFACE METAL RACEWAY

A. Furnish power and communications surface metal raceway that meets the requirements of UL 5.

B. Furnish power and communications surface metal raceway fabricated from cold-rolled, galvanized steel with a thickness of not less than 0.04 in. and coated with a gray baked-enamel finish.

C. Raceway shall consist of a metal base and a snap on metal cover.

D. Nominal dimensions of the assembled raceway shall be 4-3/4 in. wide by 1-3/4 in. high.

E. Furnish fittings required for a complete installation to include a full-length partition separating the power wiring from the communications cables. Provide suitable internal fittings to accommodate bending radii for fiber-optic cables.

F. Manufacturer: Wiremold "4000."

2.18 WIREWAY

A. Provide NRTL-listed, oil-tight and dust-tight-type wireway with covers, elbows, tees, hangers, and fittings required for a complete system.

B. Supply wireway with manufacturer's standard knockouts.

C. Provide 45-degree angle and tee fittings to accommodate bending radii for fiber-optic cables.

D. Manufacturer: Square D "Square-Duct."

2.19 OUTLET BOXES

A. Provide outlet boxes selected for specific installations using the guidance in ANSI/NEMA OS 3, *Selection and Installation Guidelines for Electrical Outlet Boxes*, and the requirements of this section.

B. For dry locations provide galvanized-steel outlet boxes that comply with UL 514A, *Metallic Outlet Boxes* and ANSI/NEMA OS1, *Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports*.

1. For luminaire outlets use 4-in. by 1-1/2-in.-deep octagonal boxes with fixture stud attachment as required to support luminaires.

2. For flush outlets in stud walls or above-grade cast-in-place concrete walls use 4-in.^{2}- by 1-1/2-in.-deep boxes; provide deeper boxes or multiple gang boxes as required to fit devices. Provide raised device covers that match the thickness of the wallboard and the number of devices. Provide supplemental box supports to prevent movement of the box.

3. For flush outlets in above-grade masonry walls use masonry boxes with conduit knockouts. Provide boxes with depth suitable for the masonry unit size. Provide multiple gang boxes as required by the number of devices.

4. For surface outlet boxes in EMT raceway systems, use 4-in.- by 2-1/8-in.-deep square boxes. Provide deeper boxes or multiple gang boxes as required to fit devices. Provide square surface covers that match the installed device and have not less than two holes for securing the device to the cover.

C. For damp or wet locations and for surface-mounted RMC or IMC raceway systems, provide outlet boxes that comply with UL 498, *Attachment Plugs and Receptacles*; UL 514; and ANSI/NEMA FB 1.

1. For lighting fixture outlets use 4-in.- by 2-1/16-in.-deep, round cast, malleable iron boxes with threaded hubs.

2. For flush or surface wall-mounted outlets, use 4-11/16 in^2, 2-11/16-in. deep cast gray or malleable iron boxes with threaded hubs. Provide

multiple gang boxes as required to fit devices. Provide gasketed cast gray or malleable iron or cast copper-free aluminum covers that match the installed device and have not less than two holes for securing the device to the cover.

2.20 PULL AND JUNCTION BOXES

A. For dry locations in clean, non-contaminated environments use galvanized-sheet steel pull and junction boxes that comply with UL 50 (*Standard for Enclosures for Electrical Equipment*), Type 1, and the NEC (NFPA 70) as to size and construction. Use boxes not less than 4 in.^{2} by 1-1/2 in. deep with screw-secured covers. Provide larger boxes as required by the number and size of conduits and conductors.

B. For damp or wet, non-corrosive locations, in conduit runs up to 3/4-in. trade size, provide 4-11/16-in.^{2}-, 2-11/16-in.-deep cast-malleable iron pull and junction boxes with threaded hubs and gasketed-cast malleable iron or cast copper-free, aluminum covers.

C. For damp or wet, non-corrosive locations, in conduit runs 1-in. trade size and larger, provide galvanized-sheet steel pull and junction boxes and covers that comply with UL 50, Type 3R.

D. For damp or wet, non-corrosive locations that are subject to hose-directed water, provide pull and junction boxes and covers that comply with UL 50, Type 4.

E. For damp or wet, corrosive locations provide pull and junction boxes and covers that comply with UL 50, Type 4X.

F. For locations subject to occasional submersion provide pull and junction boxes and covers that comply with UL 50, Type 6.

G. For in-ground, non-metallic, open-bottom handholes provide products that are NRTL-listed to ANSI/SCTE 77, *Specification for Underground Enclosure Integrity*.

1. Material: Polymer concrete.
2. Minimum ANSI/SCTE 77 load rating:
   a. Located in sidewalks – Tier 8 and
   b. Located in driveways, parking lots, and off-roadway locations – Tier 15.
3. Size: Up to 30 in. by 48 in.
4. Cover: Non-skid cover with stainless-steel cover bolts.
5. Identification: Permanent mark or logo on cover prominently identifying the function of the enclosure in accordance with NEC (NFPA 70) requirements.
6. Manufacturer: Quazite "Style PC, PG, or PT."

H. Provide connection points for equipment grounding conductors in each box.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine surfaces to receive raceways and boxes for compliance with installation tolerances and other conditions affecting performance of the raceway system. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 GENERAL

A. Install complete systems of raceways and boxes for wiring systems.

B. Install raceways and boxes according to NECA 1, *Standard Practices for Good Workmanship in Electrical Construction*; NECA 101, *Standard for Installing Steel Conduits (Rigid, IMC, EMT)*; NECA 111, *Standard for Installing Nonmetallic Raceways (RNC, ENT, LFNC)*; the NEC (NFPA 70); the manufacturer's instructions; and requirements in this section.

C. Raceway termination points and box locations shown on the drawings are in approximate locations unless dimensioned. Verify locations before rough-in.

D. Raceway routing is shown on the drawings in approximate locations unless dimensioned. Coordinate routing with structure and with work of other trades. Route as required for a complete wiring system.

E. Ground and bond raceways and boxes as required in Section 26 0526, "Grounding and Bonding for Electrical Systems."

F. Support raceways and boxes in accordance with the requirements the NEC (NFPA 70) and Section 26 0529, "Hangers and Supports for Electrical Systems."

G. Identify raceways and boxes as required in Section 26 0553, "Identification for Electrical Systems."

H. Arrange raceway and boxes to maintain headroom and present neat appearance.

I. Install knockout closures in unused openings in boxes or raceways.

3.3 CONDUIT INSTALLATION

A. For low-voltage wiring systems (less than 1000 volts) use conduit materials according to the NEC (NFPA 70) and the following:

1. Outdoors – Underground:

a. Direct Buried. Use RNC, plastic-coated RMC, tape-wrapped RMC, or tape-wrapped IMC. Do not use RNC where subject to physical damage. Install with 24-in. minimum cover from top of conduit to finished grade or top of paving.

b. Concrete Encased. Use RNC, plastic-coated RMC, RMC, or IMC for concrete encased underground work. Install with 24-in. minimum cover from top of encasement to finished grade or paving.

2. Outdoors – Exposed: Use RMC or IMC.

3. Outdoors – Corrosive Locations (including cooling towers): Use plastic-coated RMC and fittings.

4. Outdoors – Concealed: Use RMC or IMC for concealed outdoor work. Do not use bare RMC or IMC in direct contact with earth. EMT may be used for concealed outdoor work where not in contact with earth, not encased in concrete, and where not exposed to deteriorating agents.

5. Indoors – Exposed Outside of Designated Electrical Rooms or Telecommunications Rooms:

   a. Exposed to Severe Physical Damage during or after Installation. Use RMC or IMC.

   b. Exposed to Moisture. Use RMC or IMC.

   c. Exposed to Corrosives. Use plastic-coated RMC and fittings.

   d. Not Exposed to Deteriorating Agents, and Not Subject to Severe Physical Damage during or after Installation. Use RMC, IMC, or EMT.

6. Indoors – Concealed:

   a. Within Drywall Partitions and Above False Ceilings. Use RMC, IMC, or EMT.

   b. Within Masonry or Cast-In-Place Concrete Walls or Floors. Use RMC or IMC.

   c. Direct Buried under Building Floor Slabs On-Grade. Use RNC, plastic-coated RMC, tape-wrapped RMC, or tape-wrapped IMC. Locate top of conduits not less than 12 in. below the bottom of the concrete slab. Install warning tape approximately 6 in. above the conduits; install multiple warning tapes above parallel conduit runs wider than 18 in.

   d. Concrete Encased under Building Floor Slabs On-Grade. Use RNC, plastic-coated RMC, RMC, or IMC. Locate top of concrete encasement not less than 12 in. below the bottom of the concrete slab. Install warning tape approximately 6 in. above the concrete encasement; install multiple warning tapes above concrete encasements wider than 24 in.

7. Connection to vibrating equipment (including transformers and hydraulic, pneumatic, or electric solenoid or motor-driven equipment). Use a minimum of 24 in.; maximum length as determined by the NEC (NFPA 70):

   a. Outdoors. Use liquid-tight flexible metal conduit.

   b. Mechanical Rooms. Use liquid-tight flexible metal conduit.

   c. Wet, Damp, or Corrosive Indoor Locations. Use liquid-tight flexible metal conduit.

   d. Dry Indoor Locations: Use flexible metal conduit.

8. Connections to Luminaires: Use 3/8-in. flexible metal conduit or metal-clad cable in 6 ft maximum lengths for tap conductors to luminaires above suspended ceilings.

B. For medium-voltage wiring systems (1 kV or greater, but less than 100 kV) use conduit materials according to the NEC (NFPA 70) and the following:

1. Underground (both outside and inside the perimeter of the building, red concrete encased). Use RNC, plastic-coated RMC, RMC, or IMC for concrete encased underground work. Install with 24-in. minimum cover from top of encasement to finished grade, paving, or building slab.
2. Indoors or Outdoors (concealed or exposed). Use RMC or IMC.

C. Use 3/4-in. or larger conduit to enclose multiple conductors larger than 12 American wire gauge (AWG).

D. Conceal conduits, unless otherwise indicated on the drawings, with finished walls, floors, and ceilings. Unless otherwise indicated on the drawings, install concealed conduits with a minimum of bends in the shortest practical distance considering the type of building construction and obstructions.

E. Position parallel underground conduits with not less than 7-1/2-in. center-to-center separation.

F. Install expansion fittings where embedded conduits cross building expansion joints.

G. Use conduit hubs to fasten conduit to boxes in damp and wet locations.

H. Use sealing locknuts, hubs, or similar water-resistant fittings on conduits entering the top of switchgear, switchboards, motor control centers, panelboards, cabinets, pull boxes, and similar enclosures that are exposed in structures with automatic fire sprinkler systems.

I. Install insulating bushings or connectors with an insulated throat to protect conductors or cables at conduit terminations.

J. Install conduits with the following limits of bends and distance between pull points:

1. Less than 50 ft, follow the NEC (NFPA 70);
2. 50 to 100 ft, a maximum of three equivalent 90-degree bends;
3. 100 to 150 ft, a maximum of two equivalent 90-degree bends;
4. 150 to 200 ft, a maximum of with one equivalent 90-degree bend; and
5. Over 200 ft, a straight run with no bend.

K. Stub-Up Connections:

1. Extend conduits through concrete floor for connection to freestanding equipment with an adjustable top or coupling threaded inside for plugs, and set flush with the finished floor or equipment pad.
2. Extend conductors to equipment with rigid steel conduit; flexible metal conduit may be used 6 in. above the floor.
3. Where equipment connections are not made under this Subcontract, install threaded insert plugs set flush with the floor.

L. Install conduit sealing fittings according to the manufacturer's written instructions. Locate fittings at suitable, approved, accessible locations and fill them with NRTL-listed conduit sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points and elsewhere as indicated:

1. Where conduits enter or leave NEC Class I hazardous locations;

2. Where conduits pass from warm locations to cold locations, such as the boundaries of refrigerated spaces and air-conditioned spaces;

3. Where conduits enter or leave radiological "controlled areas;"

4. Where conduits go between areas where air pressure differential must be maintained;

5. Where conduits enter an enclosure protected by a clean agent total flooding fire suppression system; and

6. Where otherwise required by the NEC (NFPA 70).

M. Join nonmetallic conduit using cement as recommended by the manufacturer. Wipe nonmetallic conduits dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for 20 minutes, minimum.

N. Install plastic-coated RMC and fittings according to the NEC (NFPA 70) and manufacturer's instructions. Use only fittings approved for use with that material. Patch all nicks and scrapes in PVC coating after installing conduits.

O. Do not use RNC 90-degree elbows larger than 2-in. trade size; use plastic-coated RMC, tape-wrapped RMC, or tape-wrapped IMC for 2-1/2-in. trade size and larger 90-degree elbows.

P. Maintain the following minimum clearances between conduit and surfaces with temperatures exceeding 104 °F (40 °C):

1. 6 in. at perpendicular crossings and
2. 12 in. between parallel runs.

Q. Avoid moisture traps in conduit system; provide junction boxes with drain fitting at low points in conduit system.

R. Install corrosion protection tape on metal conduits and fittings in contact with soil using half-lapped wrappings.

S. Install grounding bushings at the following locations:

1. At every entry to enclosures on metallic conduits containing circuits rated 100 amperes and higher.

2. On metallic conduits entering enclosures through concentric, eccentric, or oversize knockouts.

3. On metallic conduits that terminate to a metallic enclosure without effective electrical connection, such as locknuts or threaded bushings.

T. Install conduit measuring tape in empty raceways. Leave not less than 12 in. of slack at each end of the tape. Secure each end of tape.

3.4 CONCRETE ENCASEMENT

A. Concrete-encase underground low-voltage (less than 1000 volts) electrical service and feeder conduits outside the perimeter of the building foundation.

B. Concrete-encase underground medium-voltage (1 kV or greater, but less than 100 kV) electrical service and feeder conduits outside and inside the perimeter of the building foundation. Use red-colored concrete.

C. Concrete-encase underground electrical branch circuit, communications, and alarm conduits as indicated on the drawings.

D. Provide not less than 3 in. of concrete coverage on all sides of conduits.

E. Refer to Section 03 3001, "Reinforced Concrete," for basic material and installation requirements. Neither concrete reinforcing nor concrete testing is required for this application.

1. Use a pre-approved concrete mix design that is suitable for exterior use exposed to freezing and thawing.

2. Use uncolored concrete to encase conduits for low-voltage wiring systems.

3. Use red-colored concrete to encase conduits for medium-voltage cables.

a. Use 2.0-lb of pigment per 94-lb sack of cement.
b. Manufacturer: Rockwood Industries/Davis Colors, No. 1117.

F. Refer to Section 33 7119, "Electrical Underground Ducts and Manholes," for requirements pertaining to underground ducts for medium-voltage power, telecommunications, and secure communications.

3.5 FIRESTOPPING

A. Install an NRTL-approved firestop system at each electrical penetration in a fire-rated wall, floor, or partition.

B. Refer to Section 07 8400, "Firestopping," for materials and installation requirements.

C. At least 2 days prior to firestopping installation, notify LANL Subcontractor Technical Representative (STR) so that arrangements can be made for inspection during installation. Do not proceed with the firestopping installation unless a LANL inspector is present.

3.6 OUTLET BOX INSTALLATION

A. Install outlet boxes with centers at the following heights unless noted otherwise on the drawings:

1. Receptacle, Telephone, and Data Outlets:

a. Common Areas (such as conference and break rooms) – 18 in. above finished floor.

b. Offices and Workstations – 7 in. above finished floor.

2. Receptacle, Telephone, and Data Outlets at Lab Benches and Counters: center 44 in. maximum above finished floor; coordinate locations to be above, or completely within, bench and counter backsplashes.

3. Light Switches: Center 48 in. above finished floor and within 6 in. of door frame.

4. Thermostats: Center 48 in. above finished floor.

5. Wall-Mounted Emergency Lights: 80 in. above finished floor or 12 in. below the ceiling; whichever is lower.

6. Fire Alarm Audible/Visible Alarm Devices: Center of strobe light 80 in. above finished floor or 6 in. below the ceiling, whichever is lower.

7. Fire Alarm Pull Stations: Center 48 in. above finished floor.

8. Television Outlets: Center 8 ft above finished floor unless otherwise noted on the drawings. Install a duplex receptacle outlet immediately adjacent to each television outlet.

B. Coordinate outlet box locations with modular furniture and associated hangers.

C. Where the drawings show outlets as adjacent, align outlet boxes with each other and group them symmetrically.

D. Orient boxes to accommodate wiring devices oriented as specified in Section 26 2726, "Wiring Devices."

E. Install a multi-gang box where more than one device is mounted together. Do not use sectional-type boxes.

F. Install box with plaster ring for single or multiple device outlets.

G. Use flush-mounted outlet boxes in finished areas.

1. Install flush-outlet boxes and fittings in walls and ceilings so that front edge is flush with the finished surface. Repair broken wall or ceiling surfaces so no gaps or open spaces exceed 1/8 in. at the edge of boxes or fittings.

2. Locate flush-mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.

3. Do not install flush mounting boxes back-to-back in walls; install with minimum 6-in. separation. Install with minimum 24-in. separation in acoustic-rated walls.

4. Secure flush-mounting boxes to interior wall and partition studs. Accurately position to allow for surface finish thickness.

5. Install stamped steel bridges to fasten multiple flush-mounting outlet boxes between studs.

6. Install flush-mounting box without damaging wall insulation or reducing its effectiveness.

H. Install adjustable steel channel fasteners for hung ceiling outlet box.

I. Do not fasten boxes to ceiling support wires or other piping systems.

J. Support boxes independently of conduit.

K. Install partitions in boxes as follows:

1. Between 277-volt devices,
2. Between 277-volt light switch devices and 120-volt devices, and
3. Between either 120-volt or 277-volt devices and low-voltage control switches.

L. Install a blank cover plate on each outlet box in which no device is installed.

3.7 FLOOR BOX INSTALLATION

A. Install floor boxes at locations indicated on the drawings:

B. Set height of boxes before concrete is placed so cover will be flush with the finished floor surface.

1. Determine the type and thickness of flooring materials and set height of boxes accordingly.

2. In setting box heights, take into account structural deflection that will occur when concrete is placed.

C. Install devices, covers, and carpet flanges after flooring materials are installed; adjust boxes so covers are level and flush with flooring material.

3.8 PULL AND JUNCTION BOX INSTALLATION

A. Install pull and junction boxes as shown on the drawings and as required for splices, taps, wire pulling, and compliance with regulatory requirements.

B. Install pull boxes as required to comply with limits on conduit bends and distance between pull points in Paragraph 3.3 of this section.

C. Install indoor pull and junction boxes in accessible locations above accessible ceilings and in unfinished spaces. Position boxes so covers can be removed. Place boxes to maintain headroom.

D. Furnish NEMA-rated boxes for flush- or surface-mount based on the following enclosure requirements unless otherwise noted in the drawings:

1. NEMA 1: General indoor use

a. Control rooms, corridors, stair wells, and conference/work rooms.

2. NEMA 12: Dust-tight and drip proof

a. Airlocks and telecommunication rooms.

3. NEMA 3R: Rain-tight

a. Locker rooms and general outdoor use.

4. NEMA 4X: Corrosion-resistant fiberglass enclosure, water-tight, dust-tight, and resistant to oil and coolant seepage.

E. Install a concrete collar around handholes not placed in sidewalks or pavement.

3.9 WIREWAY INSTALLATION

A. Install wireways at locations indicated on the drawings.

B. Mount plumb and level.

3.10 SURFACE METAL RACEWAY INSTALLATION

A. Install surface metal raceway at locations indicated on the drawings.

B. Use flat-head screws, clips, and straps to fasten raceway channel to surfaces.

C. Mount plumb and level.

3.11 ADJUSTING

A. Adjust flush-mounted outlets to make front flush with finished floor, wall, or ceiling material.

B. Install knockout closures in unused openings in boxes.

3.12 CLEANING

A. Clean interior of boxes to remove dust, debris, and other material.

B. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.

C. Repair damage to paint finishes with matching touch-up coating recommended by the manufacturer.

3.13 FIELD QUALITY CONTROL

A. Provide final protection and maintain conditions to ensure that coatings and finishes are without damage or deterioration at final inspection.

B. Inspection Points: Provide not less than 2 working days advance notice to the LANL STR for the following LANS inspection points. In the notice identify the particular areas of the Project for which LANS inspection is requested. Correct deficiencies identified during inspections. If the requested LANS inspection does not occur within 1 working day of the LANS inspection point, work may proceed.

1. Underground conduits: After conduits have been installed but before concrete-encasement or trench backfilling commences. LANS inspection may include, but is not limited to:

   a. Correct conduit material and size,
   b. Proper conduit spacing and supports,
   c. Correct conduit stub-up locations, and
   d. Conduit connection and coupling integrity.

2. Raceway systems in concrete walls, floors, slabs, and equipment pads: After raceways and boxes have been installed but before concrete placement commences. LANS inspection may include, but is not limited to:

   a. Correct raceway system materials and sizes,
   b. Proper conduit spacing and supports,
   c. Raceway system connection integrity,
   d. Correct conduit stub-up locations,
   e. Correct floor box locations and proper height setting, and
   f. Correct outlet box locations.

3. Raceway systems in drywall partitions: After raceways and boxes have been installed but before drywall installation that would cover the raceway system commences. LANS inspection may include, but is not limited to:

   a. Correct raceway system materials and sizes,
   b. Proper supports for raceways and boxes,
   c. Raceway system connection integrity, and
   d. Correct outlet box locations and proper depth setting.

4. Raceway systems above ceilings: After raceways and boxes have been installed but before ceiling system installation commences. LANS inspection may include, but is not limited to:

   a. Correct raceway system materials and sizes,
   b. Proper supports for raceways and boxes,
   c. Raceway system connection integrity, and
   d. Correct outlet box locations and proper depth setting.

5. Fire-stop installation: After fire-stop system has been installed but before covering the installation (with gypsum board etc) commences. LANS inspection may include, but is not limited to:

   a. Proper selection and installation of fire-stop system.

END OF SECTION

FOR LANL USE ONLY

This project specification is based on LANL Specification 26 0533, Rev. 4, dated January 5, 2012.

SECTION 26 0536

CABLE TRAYS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Metal cable tray and fittings.

1.2 RELATED SECTIONS

A. Section 01 2500, "Substitution Procedures."

B. Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

C. Section 26 0526, "Grounding and Bonding for Electrical Systems."

D. Section 26 0548, "Vibration and Seismic Controls for Electrical Systems."

1.3 ABBREVIATIONS AND ACRONYMS, DEFINITIONS, AND REFERENCES

A. Refer to Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

1.4 LANL PERFORMED WORK

A. None.

1.5 SUBMITTALS

A. Submit the following in accordance with the requirements of Exhibit I:

1. Catalog Data:

a. Submit manufacturer's data on cable tray including, but not limited to, types, materials, finishes, rung spacing, inside depths, and fitting radii.

2. Test Reports: Provide results of tests performed or witnessed by an independent testing laboratory of the "worst-case" loading conditions outlined in this specification and performed in accordance with the latest revision of NEMA VE 1, *Metal Cable Tray Systems* (including test reports verifying rung load capacity in accordance with NEMA VE 1, Section 5.4).

3. Installation Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements.

a. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

1.6 REGULATORY REQUIREMENTS

A. Conform to requirements of the *National Electrical Code* (NEC) (NFPA 70) for components and installation.

B. Conform to applicable requirements of NEMA VE 1, *Metal Cable Tray Systems* and NEMA VE 2, *Metal Cable Tray Installation Guidelines*.

C. Furnish products listed and labeled by a nationally recognized testing laboratory (NRTL) as suitable for purposes specified and shown.

1.7 COORDINATION

A. Coordinate cable tray, hangers, and accessories with other construction that penetrates ceilings or floors, or is supported by them, including light fixtures, heating, ventilation, and air conditioning (HVAC) equipment and ductwork, fire-suppression system, and partition assemblies.

1.8 RECEIVING, STORING, PROTECTING, AND HANDLING

A. Receive, store, protect, and handle products in accordance to NECA 1, *Standard Practices for Good Workmanship in Electrical Construction* and NECA/NEMA 105, *Standard for Installing Metal Cable Tray Systems.*

PART 2 PRODUCTS

2.1 PRODUCT OPTIONS AND SUBSTITUTIONS

A. Refer to Section 01 2500, "Substitution Procedures."

2.2 METAL CABLE TRAY

A. Provide metal cable tray and accessories conforming to NEMA VE 1, the NEC (NFPA 70), and this section.

B. Cable tray shall be of types, classes, and sizes indicated on the drawings or specified, complete with splice plates, bolts, nuts, and washers for connecting units.

C. Cable tray shall be capable of carrying not less than the following uniformly distributed and concentrated loads at the rated support span with a safety factor of 1.5 when supported as a simple span and tested per NEMA VE 1 (Section 5.2). Load and safety factors are applicable to both side rails and rung capacities.

1. 6 and 12 in. widths: 50 lb/linear ft plus a 200-lb load at mid-span.
2. 18 and 24 in. widths: 75 lb/linear ft plus a 200-lb load at mid-span.
3. 30 and 36 in. widths: 100 lb/linear ft plus a 200-lb load at mid-span.

D. Materials and Finish:

1. Aluminum. Straight section and fitting side rails and rungs extruded from aluminum alloy.

E. Type of Tray System:

1. Ladder-type trays shall consist of two longitudinal members (side rails) with transverse members (rungs) welded to the side rails. Rung spacing shall be 6 in. on center. Spacing in radii-used fittings shall not exceed 9 in. measured at the center of the tray's width.

F. Tray Dimensions:

1. Cable tray usable load depth shall be 4 in., minimum, or as noted on the drawings.

2. Straight tray sections shall have side rails fabricated as I-beams or C-sections. Supply straight sections in standard 10 ft lengths, except where shorter lengths are needed to facilitate tray assembly lengths shown on drawings.

3. Cable tray width shall be 12 in. or as shown on drawings.

4. Fittings shall have a minimum inside radius of 24 in.

G. Use bolted-type splice plates made as indicated below for each tray type. The resistance of fixed-splice connections between adjacent sections of tray shall not exceed 0.00033 ohms. Splice plate construction shall be such that a splice may be located anywhere within the support span without diminishing rated loading capacity of the cable tray.

1. Aluminum Tray. Splice plates shall be made of aluminum alloy with four square neck carriage bolts and serrated flange locknuts. Hardware shall be zinc plated in accordance with ASTM B 633, *Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel*, SC1. If aluminum cable tray is to be used outdoors, then hardware shall be Type 316 stainless steel.

H. Place cable tray supports so that the support spans do not exceed span ratings of cable tray sections.

1. Construct trapeze supports from 12-gauge, steel-formed shape, channel members 1-5/8 in. by 1-5/8 in. or 1-5/8 in. by 3-1/4 in. with necessary hardware.

2. Support cable trays installed adjacent to walls on wall-mounted brackets.

3. Center hung supports shall be manufactured of 12-gauge, 1-5/8-in. by 1-5/8-in. steel strut with a pipe welded at the middle of the support to provide eccentric loading stability. Support shall withstand 700 pounds in a 60 percent versus 40 percent eccentric loading condition with a safety factor of 3.

4. Use 1/2-in. (minimum) diameter threaded rods to support trapeze hangers and center-hung supports.

I. Install a warning label with the following message on each cable tray section and fitting:

WARNING:

DO NOT USE CABLE TRAY AS A WALKWAY LADDER OR SUPPORT.
USE ONLY AS MECHANICAL SUPPORT FOR CABLES AND TUBING.

J. Provide barrier strips as indicated on the drawings. Fasten barrier strips into the tray with self-drilling screws.

K. Furnish accessories as shown on the drawings and as required to protect, support, and install a cable tray system and associated cables. Accessories include section splice plates, expansion plates, blind-end plates, ladder dropouts, and barriers.

L. Manufacturers: Chalfant, Cooper B-Line, Cope, MP Husky.

2.3 EQUIPMENT GROUNDING CABLE

A. Provide not smaller than 6 American wire gauge (AWG) bare-stranded, soft-temper copper cable that conforms to ASTM B 8, *Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.*

2.4 CABLE TRAY GROUND CLAMPS

A. Use NRTL-listed cable tray ground clamps suitable for use with aluminum cable tray and copper equipment grounding conductor.

B. Manufacturer: O-Z/Gedney "Type CTGC," Crouse-Hinds "TGC40."

2.5 CABLE TRAY/CONDUIT BONDING CLAMPS

A. Use NRTL-listed clamps suitable for mechanically connecting and electrically bonding conduit to steel or aluminum cable tray.

B. Manufacturers: Thomas & Betts "6200 Series," and Crouse-Hinds "LCC Series."

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine spaces to receive cable tray for compliance with installation tolerances and other conditions affecting performance of the raceway system. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 CABLE TRAY INSTALLATION

A. Install cable tray where indicated on the drawings and according to manufacturer's instructions [NECA/NEMA 105 and NEC (NFPA 70)]. Have the manufacturer's instructions available at the construction site.

B. Provide not less than 12 in. of clear space above and to one side of cable trays to permit access for installing and maintaining cables.

C. Align cable trays to be parallel to column lines unless specifically shown otherwise on the drawings.

D. Install supports and seismic anchorage for cable tray as shown on the drawings.

1. Comply with the manufacturer's installation instructions and the requirements of Section 26 0548, "Vibration and Seismic Controls for Electrical Systems."

2. Support cable tray independent of supports for other elements, such as pipes, conduits, ceilings, ducts, and equipment enclosures.

3. Use minimum 1/2-in. threaded rods to support cable tray.

4. Locate cable tray fitting supports so they meet the strength requirements of straight sections. Install fitting supports per NECA/NEMA 105 and in accordance with manufacturer's instructions.

3.3 GROUNDING AND BONDING

A. Ground and bond cable tray under provisions of Section 26 0526, "Grounding and Bonding for Electrical Systems."

1. Provide electrical continuity between tray components.

2. Use anti-oxidant compound to prepare aluminum contact surfaces before assembly.

3. Install not smaller than 6 AWG bare copper equipment grounding conductor along the entire length of tray; bond to each component using cable tray ground clamps. Place grounding conductor on the outside of

one cable tray side rail and complete all bonds before placing any cables in the cable tray.

4. Make mechanical and electrical bond connection between conduits and cable tray using NRTL-listed cable tray/conduit bonding clamps.

5. Bond cable tray to telecom grounding bar using 6 AWG copper conductors.

3.4 LABELING

A. Install red warning labels with 1/2-in. white letters and the following message at visible locations 50 ft on centers on all cable trays in environmental or return air plenums:

USE ONLY PLENUM-RATED CABLES IN THIS CABLE TRAY.

B. Install white labels with 1/2-in. black letters and the following information at visible locations 50 ft on centers on all cable trays:

1. Maximum cable tray loading depth.

2. Allowable cable load in pounds per foot based on the as-installed support span spacing and structural support capability.

3.5 FIELD QUALITY CONTROL

A. Inspect accessible components for cleanliness, mechanical, and electrical integrity, and for presence of damage or deterioration before energizing.

B. After completing installation, cleaning, and testing, touch-up scratches and mars on finish to match original finish.

END OF SECTION

FOR LANL USE ONLY

This project specification is based on LANL Master Specification 26 0536, Rev. 2, dated October 1, 2009.

SECTION 26 0548

VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Provide and install, hangers, supports, anchors, concrete bases, and other positive fastenings for electrical nonstructural components for which designed anchors are shown on the drawings, such that in-service loads and seismic forces are safely transferred to the structure and relative seismic displacements of supporting structures are adequately accommodated.

B. Provide vibration isolation for electrical components as specified in this section or indicated on the drawings.

1.2 RELATED SECTIONS

A. Section 01 2500, "Substitution Procedures."

B. Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

C. Section 03 3001, "Reinforced Concrete."

D. Section 03 1534, "Post-Installed Concrete Anchors Purchase – Normal Confidence."

E. Section 07 8400, "Firestopping."

F. Section 09 9100, "Painting."

G. Section 13 4800, "Sound, Vibration, and Seismic Control."

H. Section 26 0529, "Hangers and Supports for Electrical Systems."

I. Section 26 5100, "Interior Lighting."

J. Section 26 5200, "Emergency Lighting."

1.3 ABBREVIATIONS AND ACRONYMS, DEFINITIONS, AND REFERENCES

A. Refer to Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

1.4 SUBMITTALS

Submit the following in accordance with the requirements of Exhibit I:

A. Catalog Data: Submit catalog data for each type of product specified. Include information substantiating equivalent corrosion resistance to zinc coated steel of alternative treatment, finish, or inherent material characteristic.

B. Material List: Submit schedule showing manufacturer's figure number, size, spacing, features, and application for each required type of hanger, support, sleeve, seal, vibration isolator, and fastener to be used.

C. Test Reports:

1. Post-Installed Concrete Anchors: Submit an ICC Evaluation Service, Inc (ICC-ES) evaluation report stating that the product is compliant with the current edition of the IBC and the intended conditions of use.

2. Pre-set Concrete Anchors: Submit either of the following:

   a. ICC Evaluation Service, Inc (ICC-ES) evaluation report stating that the product is compliant with the current edition of the IBC and the intended conditions of use.

   b. Drawing showing use as an approved component in a fixed equipment anchorage design that have been approved by an agency such as the State of California Office of Statewide Health Planning and Development.

3. Vibration Isolators: Submit either of the following:

   a. ICC Evaluation Service, Inc (ICC-ES) evaluation report stating that the product is compliant with the current edition of the IBC and the intended conditions of use.

   b. Drawing showing use as an approved component in a fixed equipment anchorage design that have been approved by an agency such as the State of California Office of Statewide Health Planning and Development.

D. Shop Drawings: Submit shop drawings showing details of vibration isolators, supports, and seismic control of the electrical nonstructural components listed below. Provide detail drawings along with catalog cuts, templates, and erection and installation details, as appropriate, for the components listed below. Submittals shall be complete in detail; shall indicate thickness, type, grade, class of metal, and dimensions; and shall show construction details, reinforcement, anchorage, and installation with relation to the building construction.

1. Dry transformers that weigh more than 400 pounds.

1.5 QUALITY ASSURANCE

A. Furnish and install hangers and supports that conform to the requirements of the following codes and standards:

1. NFPA 70, National Electric Code (NEC)
2. IBC, International Building Code
3. ASCE 7, Minimum Design Loads for Buildings and Other Structures
4. NECA 1, Standard Practices for Good Workmanship in Electrical Contracting
5. Metal Framing Manufacturers Association

   a. MFMA-4, Metal Framing Standards Publication

   b. MFMA-102, Guidelines for the Use of Metal Framing

B. Where a Nationally Recognized Testing Laboratory (NRTL) has requirements for such products, provide products that are NRTL listed and labeled for the application, installation condition, and the environment in which installed.

1.6 NON-SEISMIC HANGERS AND SUPPORTS

A. Refer to Section 26 0529, "Hangers and Supports for Electrical Systems" for hangers and supports for electrical components not identified on the drawings as requiring vibration isolators or seismic designed anchors or braces.

1.7 RECEIVING, STORING, PROTECTING, AND HANDLING

A. Receive, store, and protect, and handle products according to NECA 1.

PART 2 PRODUCTS

2.1 GENERAL

A. Refer to Section 13 4800, "Sound, Vibration, and Seismic Control" for general seismic control products.

2.2 SUBSTITUTIONS

A. Alternate products may be accepted; follow Section 01 2500, "Substitution Procedures."

B. As is the case with all LANL projects, substitutions are permitted unless noted otherwise; however, "approved equal" seismically controlled nonstructural components must be reviewed and approved by the design structural-engineer-of-record.

2.3 COATINGS AND MATERIALS

A. Furnish products for use indoors that are protected with zinc coating or with treatment of equivalent corrosion resistance using approved alternative treatment, finish, or inherent material characteristic.

B. Furnish products for use outdoors or in damp or corrosive indoor locations with hot-dip galvanized coating or with treatment of equivalent corrosion resistance using approved alternative treatment, finish, or inherent material characteristic.

2.4 BOLTS

A. Furnish bolts, anchor rods, washers, and nuts as specified in Section 13 4800, "Sound, Vibration, and Seismic Control."

2.5 PRE-SET CONCRETE INSERTS

A. Furnish pre-set concrete inserts as shown on the drawings and specified below.

B. Permissible uses and allowable load capabilities of pre-set concrete inserts shall be documented in either of the following two ways:

1. Have an ICC-ES evaluation report stating that the product is compliant with the current edition of the IBC and the intended conditions of use.

2. Be shown as approved components in fixed equipment anchorage designs that have been approved by an agency such as the State of California Office of Statewide Health Planning and Development.

C. Manufacturers:

1. Continuous inserts for wood forms: B-Line "B22I-12" or longer.

2. Spot inserts for wood forms or metal decks: B-Line "B2500" with "N2500" nut, "B2501."

2.6 POST-INSTALLED CONCRETE ANCHORS

A. Furnish post-installed concrete anchors as shown on the drawings and specified below. Each post-installed anchor shall have an ICC-ES evaluation report stating that the product is compliant with the current edition of the IBC and the intended conditions of use.

B. For applications in outdoor, wet, or corrosive locations furnish stainless steel post installed anchors.

C. For Management Level (ML)-3 and ML-4 systems and components furnish anchors as follows:

1. Post-installed expansion, adhesive, and undercut anchors specified in Section 03 1534, "Post-Installed Concrete Anchor Purchase – Normal Confidence."

2. Concrete and masonry screw anchors: Heat-treated carbon steel. Manufacturer: Simpson Strong-Tie "Titen HD."

2.7 BEAM CLAMPS

A. Furnish beam clamps that are NRTL-listed and compliant with Federal Specification WW-H-171E Type 23 or Manufacturers' Standardization Society SP-69 and SP-58 Type 23.

B. Provide beam clamps with a locknut on the setscrew.

C. Provide NRTL-listed restraining strap for each beam clamp. Strap shall be not less than 16 gauge thickness, not less than 1 in. wide, and of sufficient length to wrap around the beam flange not less than 1 in.

2.8 HANGER RODS

A. Furnish mild steel rods that conform to ASTM A 307, Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.

B. Furnish rods that are threaded on both ends, threaded on one end, or continuous threaded with UNC (coarse) thread pitch.

2.9 SWAY BRACING MATERIALS

A. Furnish sway bracing materials (e.g. rods, plates, cable, angles) as shown on the drawings and specified in Section 13 4800, "Sound, Vibration, and Seismic Control."

2.10 FRAMING CHANNEL SYSTEMS

A. Furnish U-channel framing systems that conform to MFMA-4 and are fabricated using minimum 12-gage steel, with 9/16-in.-diameter holes, from 1-1/2 to 1-7/8 in. on center, in the surface opposite the "U" opening.

B. Furnish fittings and accessories that mate and match with U-channel and are of the same manufacturer. Use two-piece, single bolt type conduit straps on U-channel supports.

C. Manufacturers: Unistrut, B-Line, Superstrut.

2.11 REINFORCED CONCRETE

A. Refer to Section 03 3001, "Reinforced Concrete."

B. Furnish housekeeping pad anchors to connect concrete bases to the structural floor.

1. Material: ductile iron.

2. Anchorage to concrete base: two #3 reinforcing bars

3. Anchorage to structural floor: post-installed stud-type anchor as specified in Section 03 1534, "Post-Installed Concrete Anchors Purchase – Normal Confidence" for ML-3 or ML-4 of the component.

4. Manufacturer: Mason Industries "HPA."

PART 3 EXECUTION

3.1 GENERAL

A. Refer to Section 13 4800, "Sound, Vibration, and Seismic Control" for general seismic protection installation requirements.

B. Install hangers, supports, vibration isolation, and seismic control according to the drawings, the requirements in this section, and the requirements of the applicable codes. Where overlap exists, the more stringent of the requirements will govern.

C. Conform to manufacturer's instructions and recommendations for installation of hangers, supports, anchors, seismic controls, and vibration isolators.

D. Do not use wire or perforated strap for permanent electrical supports.

E. Anchor each item of electrical equipment as shown on the drawings.

F. Refer to Section 26 5100, "Interior Lighting" for installation requirements for interior luminaires.

G. Refer to Section 26 5200, "Emergency Lighting" for installation requirements for emergency luminaires and exit signs.

3.2 EXAMINATION

A. Examine surfaces to receive hangers, supports, and seismic control for compliance with installation tolerances and other conditions affecting performance of the system. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.3 SEISMIC RELATIVE DISPLACEMENTS

A. Furnish and install flexible joints, fittings, or hangers capable of accommodating 4 in. of seismic relative displacement for horizontal conduits larger than 2-1/2-in. trade size, cable trays, busways, etc. attached on either side of a building seismic or expansion joint.

B. Furnish and install flexible joints, fittings, or hangers capable of accommodating 4 in. of seismic relative displacement for horizontal conduits larger than 2-1/2-in. trade size, cable trays, busways, etc. attached to separate structures.

3.4 SLEEVES AND SEALS

A. Furnish and install and install sleeves in concrete slabs and walls and all other fire- rated floors and walls for installation of conduits, cable trays, wireways, busways, etc.

B. Furnish and install sleeves through fire-rated walls or floor construction that conform to the requirements in Section 07 8400, "Firestopping." Follow manufacturer's instructions to restore original fire rating of wall or slab.

C. Size sleeves in interior non-fire-rated walls as indicated on the drawings or as required to provide clearances that will permit differential movement of conduits, cable trays, wireways, busways, etc. without the items striking the pipe sleeve.

D. Furnish seals for electrical conduit penetrations of slabs on grade and exterior walls below grade and where indicated. Tighten sleeve seal screws until sealing grommets have expanded to form watertight seal.

E. Request inspection of firestop installations through the LANL Subcontract Technical Representative (STR) both before and after installation of firestop materials.

3.5 SWAY BRACES

A. Transverse Sway Bracing

1. Install transverse sway bracing for conduits, cable trays, wireways, busways, etc as shown on the drawings.

B. Longitudinal Sway Bracing

1. Install longitudinal sway bracing for conduits, cable trays, wireways, busways, etc. as shown on the drawings.

C. Anchor Rods, Angles and Bars

1. Bolt anchor rods, angles, and bars to either electrical component clamps hangers at one end and to cast-in-place concrete or masonry insert, or clip angles bolted to the steel structure, on the other end.
2. Furnish bolts for attachment of anchors as shown.
3. Rods shall be solid metal or pipe.

3.6 CONCRETE BASES

A. Install a reinforced concrete base for each item of floor- mounted electrical equipment.

1. Construct bases as dimensioned and detailed on the drawings.
2. Make bases not less than 5 in. thick.
3. Make bases level to within 1/8 in. per 3-ft distance in any direction.

B. Anchor each concrete base to the structural floor.

1. Install housekeeping pad anchors in accordance with the manufacturer's instructions.
2. Attach housekeeping pad anchors to the structural floor using post installed concrete anchors as shown on the drawings.

3. Attach housekeeping pad anchors to the concrete base reinforcing steel using two #3 reinforcing bars per anchor.

C. Support each switchboard, motor control center and transformers smaller than 300 kVA on a formed concrete equipment base.

1. Form concrete equipment bases using framing lumber with form release compounds. Refer to Section 03 3001, "Reinforced Concrete."

2. Construct concrete base not less than 4 in. larger in both directions than supported unit.

3. Install reinforcing as shown on the drawings. Refer to Section 03 3001, "Reinforced Concrete."

4. Place pre-set anchors, conduits, and sleeves using the equipment manufacturer's installation template or instructions. Install post-installed anchors in accordance with POST-INSTALLED CONCRETE ANCHORS article below.

5. Place concrete and provide a level, steel trowel finish on top; chamfer top edges and corners. Refer to Section 03 3001, "Reinforced Concrete."

D. Cure concrete not less than seven days before installing equipment.

3.7 POST-INSTALLED CONCRETE ANCHORS

A. Install post-installed concrete anchors as shown on the drawings. Install and test post-installed concrete anchors in accordance with in Section 03 1534, "Post-Installed Concrete Anchors Purchase – Normal Confidence."

B. Masonry screw anchors: Use in accordance with NECA 1 and the product's ICC-ES report conditions of use.

C. The use of lead-cinch drop-in anchors is not allowed.

3.8 FASTENING

A. Refer to Section 13 4800, "Sound, Vibration, and Seismic Control."

B. Use masonry screw anchors in accordance with the product's ICC-ES report conditions of use.

C. Use beam clamps for fastening to structural metal beams, joists, and purlins.

1. Install a restraining strap at each beam clamp. Wrap the restraining strap around the beam flange not less than 1 in. Where purlins or beams do not provide a secure lip for the restraining strap, secure the strap with a self-tapping screw or by through-bolting.

2. Use a locknut on each beam clamp set screw.

D. Use self-tapping screws or machine bolts, nuts, and washers for fastening to metal studs or metal surfaces.

E. The use of lead-cinch drop in anchors is not allowed.

F. Torque threaded fasteners as recommended by the manufacturer's instructions.

3.9 FRAMING CHANNEL SYSTEMS

A. Install framing channel systems as detailed on the drawings and in accordance with MFMA-103.

3.10 VIBRATION ISOLATION

A. Install and adjust vibration isolators as indicated on the drawings in accordance with the manufacturer's installation instructions.

B. Make flexible electrical connections to equipment supported by vibration isolators.

3.11 HANGER RODS

A. Use minimum 3/8-in.-diameter threaded rod; use larger diameter rod as indicated on the drawings, in other sections, or in the supported equipment manufacturer's installation instructions.

B. Install a locknut at every hanger rod connection.

3.12 PAINTING

A. Paint exposed hangers and supports to match finish of adjacent surfaces.

B. Refer to Section 09 9100, "Painting" for materials and installation requirements.

END OF SECTION

FOR LANL USE ONLY

This project specification is based on LANL Master Specification 26 0548, Rev. 1, dated February 14, 2011.

SECTION 26 0553

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Component Identification Tags.

B. Equipment Nameplates.

C. Outlet Labels.

D. Wire Markers.

E. Voltage Markers.

F. Warning Signs.

G. Arc Flash and Shock Hazard Warning Labels.

H. Working Space Markers.

I. Underground Warning Tape.

J. One-Line Diagrams and Operating Instructions.

1.2 RELATED SECTIONS

A. Section 01 2500, "Substitution Procedures."

B. Section 01 4000, "Quality Requirements."

C. Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

D. Section 09 9100, "Painting."

1.3 ABBREVIATIONS AND ACRONYMS, DEFINITIONS, AND REFERENCES

A. Refer to Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

1.4 LANL PERFORMED WORK

A. None.

1.5 SUBMITTALS

A. Submit the following submittals in accordance with the requirements of Exhibit I:

1. Catalog Data:

a. Submit manufacturer's catalog literature for each product.

2. Schedule:

a. Submit electrical identification schedule including list of wording, symbols, letter size, color coding, tag number, location, and function.

3. Samples:

a. Submit two samples of each type of printed identification products applicable to the Project.

b. Submit two nameplates illustrating materials and engraving quality.

4. Manufacturer's Installation Instructions:

a. Submit installation instructions, indicating special procedures and installation requirements.

1.6 REGULATORY REQUIREMENTS

A. Work identified in this section shall be done under a Quality Assurance Program in accordance with Section 01 4000, "Quality Requirements."

B. Conform to requirements of the *National Electrical Code* (NEC) (NFPA 70); *Standard for Electrical Safety in the Workplace* (NFPA 70E); and *Code of Federal Regulations* (CFR) "Occupational Safety and Health Standards" (29 CFR 1910).

C. Conform to applicable requirements of the following American National Standards Institute, Inc. (ANSI) Standards:

1. ANSI Z535.1, *American National Standard for Safety Colors.*

2. ANSI Z535.2, *American National Standard for Environmental and Facility Safety Signs.*

3. ANSI Z535.3, *American National Standard Criteria for Safety Symbols.*

4. ANSI Z535.4, *American National Standard for Product Safety Signs and Labels.*

5. ANSI Z535.5, *American National Standard for Safety Tags and Barricade Tapes (for Temporary Hazards).*

1.7 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in the Subcontract documents, shop drawings, and manufacturer's wiring diagrams, with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout the Project.

B. Verify electrical equipment designations with the Los Alamos National Laboratory (LANL) through the Subcontract Technical Representative.

PART 2 PRODUCTS

2.1 PRODUCT OPTIONS AND SUBSTITUTIONS

A. Alternate products may be accepted; follow Section 01 2500, "Substitution Procedures."

2.2 COMPONENT IDENTIFICATION TAGS

A. Furnish component identification tags as specified below and scheduled on the drawings to identify electrical equipment using the system designation, equipment identification, technical area number, and building number.

B. Coordinate electrical component identification tag schedule with final equipment identification scheme for the Project.

C. Provide component identification tags with black letters on yellow background with 2 in. by 3 in. dimensions.

D. Provide minimum 48-point size lettering.

E. Provide tags made of one of the following materials:

1. Type 1 (Indoor Applications Only):

a. Laminated plastic adhesive tape with machine-printed letters.
b. Manufacturers: Brother, Seton, and Brady.

2. Type 2:

a. Two-ply plastic nameplate with letters engraved through yellow surface showing black core.

b. Provide ultraviolet (UV) stabilized material for outdoor applications.

c. Manufacturer: Seton Nameplate Corp.

2.3 EQUIPMENT NAMEPLATES

A. Furnish equipment nameplates as specified below and scheduled on the drawings to indicate the following information:

1. Category I Nameplates:

a. Served by Nameplates. Circuit directory information including circuit number, equipment identification, location of equipment serving the item, and the circuit voltage (e.g., 480Y/277V, 480V 3Ø, 208Y/120V, 120/240V).

b. Serves Nameplates. Circuit directory information including circuit number, equipment identification, location of equipment served, and the circuit voltage (e.g., 480Y/277V, 480V 3Ø, 208Y/120V, 120/240V).

B. Coordinate equipment nameplate schedule with equipment numbering scheme provided by the Subcontract Technical Representative.

C. Provide nameplates made of one of the following materials:

1. Type 1 (Indoor Applications Only):

a. Laminated plastic adhesive tape with machine-printed letters.
b. Manufacturers: Brother, Seton, and Brady.

2. Type 2:

a. Two-ply plates with letters engraved through surface color showing core color.

b. Use UV stabilized material for outdoor applications.

c. Manufacturer: Seton Nameplate Corp.

D. Provide 10-point, minimum, size lettering.

E. Provide colors as follows:

1. Category I Nameplates–White or black letters on blue background.

F. Dimensions shall be as follows:

1. Category I Nameplates–1 in. by 2 1/2 in., minimum.

2.4 OUTLET LABELS

A. Furnish a typewritten or machine-printed label for each switch and receptacle outlet indicating circuit number, panelboard, and voltage.

B. Provide labels of the following materials:

1. Laminated plastic adhesive tape with machine-printed letters.
2. Manufacturers: Brother, Seton, and Brady.

C. Provide black, 10-point, minimum, size lettering on a white background.

2.5 WIRE MARKERS

A. Provide wire markers for power, control, instrumentation, alarm, and communication circuit wires.

B. Furnish split sleeve, heat-shrinkable sleeve, or self-laminating adhesive wire markers.

C. Locate a wire marker on each conductor at switchgear, panelboards, pull boxes, outlet and junction boxes, and each load connection.

D. Provide typewritten lettering on wire markers as follows:

1. Power and Lighting Circuits–As-built branch circuit or feeder circuit number.

2. Control Circuits–As-built control wire number indicated on schematic and interconnection diagrams or equipment manufacturer's wiring diagrams.

E. Manufacturers: LEM Products, Inc., Brady, and Panduit.

2.6 VOLTAGE MARKERS

A. Furnish voltage markers for transformers, switchgear, panelboards, starters, motor control centers, safety switches, pull boxes, cabinets, and conduits.

B. Provide flexible, pressure-sensitive, vinyl markers with minimum 1-in. by 4-in. orange background and black letters.

C. Provide voltage markers with lettering indicating the highest voltage present:

1. 208Y/120 Volt System–208 VOLTS.
2. 120/240 and 240 Volt System–240 VOLTS.
3. 480Y/277 and 480 Volt System–480 VOLTS.
4. 13.2 kV Systems–13200 VOLTS.
5. Fire Alarm System–FIRE ALARM.
6. Telephone/Data System–TELEPHONE.

D. Manufacturers: Electromark and LEM Products, Inc.

2.7 WIRING SYSTEM COLOR CODE LABELS

A. In buildings with more than one voltage system, provide wiring system color code labels on each panelboard, switchboard, switchgear, and motor control center.

B. Provide labels with black, 10-point, minimum, size lettering on a white background.

C. Provide information on labels as follows:

THIS BUILDING HAS MULTIPLE WIRING SYSTEMS:
480Y/277V: BROWN, ORANGE, YELLOW, GREY
208Y/120V: BLACK, RED, BLUE, WHITE

D. Provide labels of the following materials:

1. Outdoor labels shall be suitable for a high-UV environment.
2. Provide machine-produced custom labels printed using a thermal transfer process:
   a. Use polyester label stock that is nationally recognized testing laboratory (NRTL)-recognized to UL 969, *Marking and Labeling Systems*, and has a high adhesion adhesive back.
   b. Use printing ribbon recommended by the label stock manufacturer.
3. Use a suitable label-printing machine to generate labels.
4. Manufacturers: Brother, Seton, and Brady.

2.8 EMERGENCY SYSTEM IDENTIFICATION

A. Furnish identification for emergency system generators, transfer switches, transformers, switchgear, panelboards, starters, motor control centers, safety switches, pull boxes, junction boxes, enclosures, and cabinets as require by the NEC (NFPA 70, Article 700).

B. Provide flexible, pressure-sensitive, vinyl markers with minimum 1-in. by 4-in. orange background and black letters indicating "EMERGENCY SYSTEM."

2.9 WARNING SIGNS

A. Furnish warning signs for low-voltage and medium-voltage transformers, switchgear, switchboards, panelboards, motor starters, motor control centers, safety switches, pull boxes, and cabinets.

B. Use flexible warning signs that conform to ANSI Z535.4 and 29 CFR 1910 Danger and Caution specifications.

C. Provide minimum 2-in. by 4-in. warning signs.

D. Provide warning signs with format and lettering as follows:

1. Signal Word–DANGER.
2. Signal Word Panel Color–Red with safety alert symbol.
3. Word Message–
   a. Keep Out!
   b. Hazardous Voltage Inside.
   c. Will Shock, Burn, or Cause Death.
4. Safety Symbol–ISO 3864 "lightning bolt" in yellow triangle.

E. Materials:

1. For indoor applications use flexible, pressure-sensitive, polyester base with polyester over-laminate.

2. For outdoor applications use aluminum signs.

F. Manufacturers: Seton Name Plate Co., Safety Label Solutions, Hazard Communication Systems, and Electromark.

2.10 ARC-FLASH AND SHOCK-HAZARD WARNING LABELS

A. Furnish arc-flash and shock-hazard warning labels for switchgear, transformers, panelboards, industrial control panels, motor controllers (including those furnished with mechanical equipment), motor control centers, safety switches, and other equipment as required by the NEC (NFPA 70) or *Standard for Electrical Safety in the Workplace* (NFPA 70E).

B. Provide warning labels that comply with ANSI Z535.4. Color in top part of WARNING sign shall be ANSI "safety orange." Color in top part of DANGER sign shall be red. All lettering on labels shall be black.

C. Provide either machine-produced custom labels or manually filled-in, pre-printed labels similar in design to those below:

1. Label dimensions shall be approximately 4 in. high by 6 in. wide.

2. Outdoor labels shall be suitable for a high-UV environment.

3. Machine-Produced Custom Labels:

a. Use polyester label stock that is NRTL-recognized to UL 969 and has a high-adhesion adhesive back.

b. Use printing ribbon recommended by the label stock manufacturer.

c. Use a suitable thermal transfer process label-printing machine to generate labels and enter the application-specific information indicated in Paragraph 3.2.

4. Pre-Printed Labels:

a. Use labels printed on self-adhesive, UV-resistant polyester with pressure-sensitive, adhesive back. Provide labels with clear polyester overlay film to protect manually-entered information.

b. Use a black, UV-resistant, industrial permanent marker pen to legibly hand letter the application-specific information indicated in Paragraph 3.2.

D. Use Arc-Flash and Shock-Hazard Warning Label Design #1 for equipment where the calculated arc-flash incident energy does not exceed 33.3 cal/cm^2. See Paragraph 3.2 for an explanation of the application-specific information entries on the label.

Arc-Flash and Shock-Hazard Warning Label Design #1

WARNING	
Arc Flash and Shock Hazard. Appropriate PPE Required.	
## inches	**Arc Flash Protection Boundary. (Arc flash hazard analysis based on:** *SWGR-A main circuit breaker set in energy-reducing maintenance mode.* **)**
##.# cal/sq cm	**Arc flash incident energy at** *##* **inches working distance; use AR clothing and PPE with arc rating ≥ 120% of the incident energy.**
#	**NFPA 70E Hazard/Risk Category PPE for circuit breaker, fused switch, starter, or meter switch operation with doors closed and covers on.**
### V	**Shock Hazard exists when** *door is open or cover is off.*
## inches	**Limited Approach Boundary.**
## inches	**Restricted Approach Boundary.** } **Class** *##* **Gloves,**
# inch	**Prohibited Approach Boundary.** } *####* **V-Rated Tools.**
Equipment I.D.: *######-##-####-#*	**Date of Analysis:** *MM/DD/YYYY .*
##,### A	**Maximum Available Fault Current (RMS symmetrical amperes).**

E. Use Arc Flash and Shock Hazard Warning Label Design #2 for equipment operating at a nominal system voltage of 208Y/120 V and served by a single transformer with a rating less than 125 kVA. See Paragraph 3.2 for an explanation of the information entries on the label.

Arc Flash and Shock Hazard Warning Label Design #2

WARNING

Shock Hazard.
Appropriate PPE Required.

- **Wear at least leather gloves and safety glasses when operating a circuit breaker, fused switch, starter, or meter switch with the equipment covers on.**
- **Wear at least NFPA 70E Hazard/Risk Category 0 clothing and PPE with leather gloves for any tasks performed with the equipment cover open.**

208 V	**Shock Hazard exists when** *cover is open.*	
42 inches	**Limited Approach Boundary.**	
Avoid Contact	**Restricted Approach Boundary**	**Class** 00 **Gloves,**
Avoid Contact	**Prohibited Approach Boundary**	1000 **V-Rated Tools.**

F. Use Arc-Flash and Shock-Hazard Warning Label Design #3 for equipment where the calculated arc-flash incident energy is greater than 33.3 cal/cm^2. See Paragraph 3.2 for an explanation of the application-specific information entries on the label.

Arc-Flash and Shock-Hazard Warning Label Design #3

DANGER

Lethal Arc Flash and Shock Hazard.
Energized Work (Diagnostic or Repair) Prohibited.

## inches	**Arc Flash Protection Boundary.**
##.# cal/sq cm	**Arc flash incident energy at** ## **inches working distance. Prospective arc fault burn, blast, and shrapnel hazards exceed protection capability of useful PPE.**
4	**NFPA 70E Hazard/Risk Category PPE for circuit breaker, fused switch, starter, or meter switch operation with doors closed and covers on.**
### V	**Shock Hazard when** *door is open or cover is off.*
## inches	**Limited Approach Boundary.**
## inches	**Restricted Approach Boundary.**
# inch(es)	**Prohibited Approach Boundary.**

Equipment I.D.: ~~###### ## ####-#~~ **Date of Analysis:** *MM/DD/YYYY .*

##,### A **Maximum Available Fault Current (RMS symmetrical amperes).**

G. Manufacturers: Summit Electric Supply, Seton Name Plate Co., Safety Label Solutions, Hazard Communication Systems, Electromark, and Brady.

2.11 WORKING SPACE FLOOR MARKING

A. Provide black paint and white paint to mark the NEC (NFPA 70)-required working space on the floor at electrical equipment that is likely to require examination, adjustment, servicing, or maintenance while energized.

B. Refer to Section 09 9100, "Painting."

2.12 UNDERGROUND WARNING TAPE

A. Furnish underground warning tape for underground cables, conduits, and duct banks.

B. Use 6-in.-wide, 0.004-in.-thick, polyethylene, underground warning tape; black lettering; and the American Public Works Association background colors:

1. Electric Power or Lighting–Red and
2. Telephone/Data or Alarm–Orange.

C. Provide lettering that indicates the type of service buried as follows:

1. Electric–*"CAUTION ELECTRIC LINE BURIED BELOW."*
2. Telephone/Data–*"CAUTION TELEPHONE LINE BURIED BELOW."*

D. Manufacturer: Utility Safeguard, LLC.

2.13 ONE-LINE DIAGRAM CABINET(S)

A. Provide aluminum framed bulletin board cabinet(s) to display electrical one-line diagram(s) plus special operating instructions and emergency procedures as required.

1. Housing–Extruded aluminum with manufacturer's standard outside dimensions of approximately 36 in. by 48 in. by 3 in. deep.
2. Doors–Two sliding 3/16-in. tempered glass doors with ground-in finger pulls and flat-key tumbler locks.
3. Back Panel–Tackable cork.
4. Finishes–Manufacturer's standard finishes and colors.

B. Manufacturer: Claridge "Imperial Series."

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine surfaces to receive identification products for compliance with installation tolerances and other conditions affecting performance of the identification products. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION–GENERAL

A. Where identification is to be applied to surfaces that require finish, install identification after completion of finish work.

B. Install labels where indicated and at locations for best convenience of viewing without interference with operation and maintenance of equipment.

1. Coordinate installation of identifying devices with location of access panels and doors.

2. Install identifying devices before installing acoustical ceilings and similar concealment.

C. Install electrical identification products only when ambient temperature and humidity conditions for adhesive are within range recommended by the manufacturer.

D. Clean surface where electrical identification product is to be placed.

E. Use manufacturer's recommended adhesive for engraved tags and nameplates.

F. Place electrical identification products centered and parallel to equipment lines.

3.3 COMPONENT IDENTIFICATION TAGS

A. Install component identification tag (as indicated on the drawings) on the front of each piece of electrical equipment including switchgear, transformers, switchboards, panelboards, motor control centers, motor controllers, safety switches, and enclosed circuit breakers.

B. Position tags so they can be read from floor or ground.

3.4 EQUIPMENT NAMEPLATES

A. Install equipment nameplate or nameplates as indicated on the drawings on the front of each piece of electrical equipment including switchgear, transformers, switchboards, panelboards, motor control centers, motor controllers, safety switches, and enclosed circuit breakers.

B. Install Category III nameplate at the branch circuit breaker that provides alternate current power to the fire alarm control panel with wording *"WARNING–AC POWER TO FIRE ALARM CONTROL PANEL–DO NOT TURN OFF WITHOUT AUTHORIZATION."*

C. Circuit directory information Category I nameplates may be omitted from equipment which receives an arc-flash and shock-hazard warning label that includes the required circuit directory information.

D. Position nameplates so they can be read from floor or ground.

3.5 OUTLET LABELS

A. Install outlet label on outside of device cover for each receptacle outlet and light switch.

3.6 WIRE MARKERS

A. Install wire markers on power, control, and communication conductors at each appearance in locations, such as pull boxes, outlet boxes, junction boxes, panelboards, switchgear, motor control centers, controllers, safety switches, enclosed circuit breakers, and load connections.

B. Position markers so they can be read from the front of the enclosure.

3.7 VOLTAGE MARKERS

A. Install voltage markers at the following locations and position markers so they can be read from floor or ground:

1. Front of each medium-voltage transformer.
2. Front and rear of each free-standing low-voltage switchgear or switchboard section.
3. Front of each low-voltage transformer, panelboard, industrial control panel, motor control center, enclosed circuit breaker, safety switch, and motor controller enclosure, including those furnished with mechanical equipment.
4. Cover of each pull box containing low- or medium-voltage conductors.
5. Each 2 in. and larger conduit longer than 6 ft; space markers not more than 20 ft on center.

3.8 WARNING SIGNS

A. Install warning signs at the following locations and position signs so they can be read from floor or ground:

1. Front of each medium-voltage transformer.
2. Front and rear of each low-voltage switchgear or switchboard section.
3. Front of each low-voltage transformer, switchboard, panelboard, industrial control panel, motor control center, enclosed circuit breaker, safety switch, and motor starter enclosure, including those furnished with mechanical equipment.
4. Cover of each pull box containing exposed low- or medium-voltage conductors.

3.9 ARC-FLASH AND SHOCK-HAZARD WARNING LABELS

A. Install arc-flash and shock-hazard warning labels at the following locations and position signs so they can be read from floor or ground:

1. Front of each medium-voltage transformer.
2. Front and rear of each free-standing, low-voltage switchgear or switchboard section.
3. Front of each low-voltage transformer, panelboard, industrial control panel, motor control center, enclosed circuit breaker, safety switch, and motor controller enclosure, including those furnished with mechanical equipment.
4. Cover of each pull box containing exposed low- or medium-voltage conductors.

B. Enter the following application-specific information in the appropriate Arc-Flash and Shock-Hazard Warning Label Design based on the labels provided in Section 2.10 of this specification:

1. Arc-Flash Protection Boundary (e.g., 21.2 in.).

2. Basis for the Arc-Flash Hazard Analysis Calculation (e.g., SWGR-B Main CB set in energy-reducing maintenance mode).

3. Arc-Flash Incident Energy (e.g., 4.3 cal/cm^2).

4. Working Distance (e.g., 18 in.).

5. Hazard/Risk Category Number for Operations with doors closed and covers on (e.g., 0).

6. System Phase-to-Phase Voltage (e.g., 480 V).

7. Condition that exposes worker to an electrical shock hazard (e.g., door is open or cover is off).

8. Limited Approach Boundary (e.g., 42 in.).

9. Restricted Approach Boundary (e.g., 12 in.).

10. Prohibited Approach Boundary (e.g., 1 in.).

11. Class for Insulating Gloves (e.g., 00).

12. Voltage Rating for Insulated or Insulating (e.g., 1000 V).

13. Maximum Available Fault Current (e.g., 26,350 A).

14. Equipment ID Code (e.g., 03410-EP-SWBD-A).

15. Date of Analysis (e.g., 04/06/2011).

3.10 WORKING SPACE FLOOR MARKERS

A. Install floor marking paint on the floor at the locations listed below to indicate the working space required by the NEC (NFPA 70).

1. Front of each medium-voltage transformer.

2. Front and rear of each free-standing, low-voltage switchgear or switchboard section.

3. Front of each low-voltage transformer, switchboard, panelboard, industrial control panel, motor control center, enclosed circuit breaker, safety switch, variable frequency motor controller, and magnetic motor controller enclosure, including those furnished with mechanical equipment.

4. Any other equipment likely to require examination, adjustment, servicing, or maintenance while energized.

B. Dimensions of working space area shall be as follows:

1. Width–The greater of the width of the equipment or 30 in.

2. Depth–

a. 120/240-volt and 208Y/120-volt equipment–3 ft.

b. 480-volt and 480Y/277-volt equipment with exposed live parts on one side of the working space and no live parts on the other side of the working space–3-1/2 ft.

c. 480-volt and 480Y/277-volt equipment with exposed live parts on both sides of the working space–4 ft.

d. 13,200-volt equipment with exposed live parts on one side of the working space and no live parts on the other side of the working space–5 ft.

C. Thoroughly prepare floor surface to receive paint.

D. Paint the NEC (NFPA 70)-required working space area with alternating 3-in. to 6-in.-wide black and white diagonal stripes.

3.11 UNDERGROUND WARNING TAPE

A. Install underground warning tape in trench above underground conduit, 1 ft below ground surface.

3.12 ONE-LINE DIAGRAM CABINET(S)

A. Install one-line diagram cabinet(s) in the main electrical room.

B. Install cabinets in accordance with the manufacturer's instructions.

C. Install the following documents in the cabinets:

1. Electrical one-line diagram(s) of system.

END OF SECTION

FOR LANL USE ONLY

This project specification is based on LANL Master Specification 26 0553, Rev. 2, dated May 25, 2011.

SECTION 26 0700

INDUCTION MOTORS – 500HP AND SMALLER

PART 1 GENERAL

1.1 SECTION INCLUDES

A. This section includes single- and three-phase induction motors rated 500 horsepower and smaller and 600 volts and less for application on equipment provided under other sections and motors furnished loose to Project.

B. This section does not address sealed (hermetic type) motor-compressor parts.

C. This section does not address special-purpose motors such as submersible pump motors.

1.2 RELATED SECTIONS

A. Section 01 2500, "Substitution Procedures."

B. Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

C. Section 01 7839, "Project Record Documents."

D. Section 26 0813, "Electrical Acceptance Testing."

1.3 ABBREVIATIONS AND ACRONYMS, DEFINITIONS, AND REFERENCES

A. Refer to Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

1.4 SUBMITTALS

A. Submit the following in accordance with the requirements of Exhibit I:

1. Catalog Data: Submit catalog data for each motor furnished loose. Indicate nameplate data, standard compliance, electrical ratings and characteristics, and physical dimensions, weights, mechanical performance data, and support points.

2. Calculations: Motor selection calculations including brake horsepower of the load, ambient temperature range at the motor location, and characteristics of moving air stream (if any) at the motor location.

3. Certification: Submit certification that motors meet specified performance, efficiency, and selection requirements.

4. Test Reports: Indicate procedures and results for specified factory testing.

5. Installation instructions including handling, storage, setting, mechanical connections, lubrication, wiring, and testing.

6. Operation and maintenance data:

   a. Operation data including instructions for safe operating procedures.

   b. Maintenance data including assembly drawings, bearing data with replacement sizes, and lubrication instructions.

1.5 QUALITY ASSURANCE

A. Comply with the *National Electrical Code* (NEC) (NFPA 70) for components and installation.

B. Motors shall be listed and labeled by a nationally recognized testing laboratory (NRTL) to the following standards as applicable to the intended use, installation condition, and the environment in which installed:

1. UL 1004-1, *Standard for Rotating Electrical Machines - General Requirements.*
2. UL 1004-2, *Standard for Impedance Protected Motors.*
3. UL 1004-3, *Standard for Thermally Protected Motors.*
4. UL 1004-5, *Standard for Fire Pump Motors.*
5. UL 1004-8, *Standard for Inverter Duty Motors.*

1.6 SERVICE CONDITIONS

A. Motors shall perform satisfactorily in the following service conditions:

1. Elevation: 7,500 ft above sea level.
2. Maximum ambient temperature: 104 °F.
3. Minimum ambient temperature: -20 °F.
4. 24-hour average temperature: not exceeding 86 °F.
5. Maximum solar heat gain: 110 W/ft^2.

1.7 RECEIVING, STORING, PROTECTING, AND HANDLING

A. Receive, store, protect, and handle products according to NECA 1, *Standard Practices for Good Workmanship in Electrical Construction (ANSI)* and NECA 230, *Standard for Selecting, Installing, and Maintaining Electric Motors and Motor Controllers (ANSI).*

B. Upon delivery of motors to site, inspect thoroughly for damage.

C. Store, protect and handle motors following manufacturer's instructions. Provide slings and spreader bars as required. Lift only with lugs provided. Do not lift motors using shaft as an attachment point.

D. Protect products from weather and moisture by covering with plastic or canvas and by maintaining heating within enclosure.

E. For extended outdoor storage, remove motors from equipment and store separately.

1.8 PROJECT RECORD DOCUMENTS

A. Submit the following in accordance with Section 01 7839, "Project Record Documents":

1. Report of field tests showing compliance with and field quality control specified in PART 3 of this section.

PART 2 PRODUCTS

2.1 PRODUCT OPTIONS AND SUBSTITUTIONS

A. Alternate products may be accepted, follow Section 01 2500, "Substitution Procedures."

2.2 MANUFACTURERS

A. Baldor.

B. Emerson Motors.

C. GE Motors.

D. Siemens.

E. TECO-Westinghouse.

2.3 GENERAL CONSTRUCTION AND REQUIREMENTS

A. Motors less than 250 watts for general applications may be equipment manufacturer's standard product and need not conform to these specifications.

B. Provide NRTL-listed motors with electrical and mechanical performance in accordance with NEMA MG-1, *Motors and Generators*, unless specified otherwise in this section.

C. Electrical Service:

1. 3/4 horsepower and smaller: single phase, 60 Hz motors, voltage as indicated on the drawings.

2. Greater than 3/4 horsepower: 3-phase, 60 Hz motors, voltage as indicated on the drawings.

D. Enclosure

1. For clean, dry, indoor locations furnish open drip-proof type motors.

2. For unfiltered air stream locations in manufacturer assembled equipment furnish either totally enclosed non-ventilated (TENV) or totally enclosed fan-cooled (TEFC) type motors.

3. For damp locations furnish totally enclosed fan-cooled (TEFC) type motors.

4. For outdoor locations furnish totally enclosed fan-cooled (TEFC) severe duty type motors that conform to IEEE Std 841, *IEEE Standard for Petroleum and Chemical Industry-Premium-Efficiency, Severe-Duty, Totally Enclosed Fan-Cooled (TEFC) Squirrel Cage Induction Motors-Up to and Including 370 kW (500 hp).*

E. Rating

1. Motors shall be rated on a continuous-duty basis. The output rating shall be available at the shaft at the specified speed, frequency and voltage.

2. De-rate motors for operation at 7500 feet altitude in accordance with NEMA MG-1. Do not use motor service factor to compensate for altitude. Refer to Paragraph 2.7G table below.

F. Nameplates:

1. Each motor shall have a stainless steel nameplate indicating information required by the NEC (NFPA 70) and NEMA MG-1.

2. Additional nameplate information may be required by other paragraphs in this section.

3. Attach nameplates to motor frame with stainless steel fasteners.

G. Wiring Terminations:

1. Terminal lugs shall match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in a terminal box sized to the NEC (NFPA 70), and threaded for conduit.

2. For fractional horsepower motors where connection is made directly, provide conduit connection in end frame.

3. There shall be a frame grounding screw or lug inside terminal cover or terminal box.

H. Motors shall meet NEMA MG-1 noise level standards.

2.4 SINGLE PHASE POWER - SPLIT PHASE MOTORS

A. Use single-phase power, split phase motors for applications less than 1/4 brake horsepower.

B. Split phase motors shall have the following characteristics:

1. Starting Torque. Less than 150 percent of full load torque.

2. Starting Current. Up to seven times full load current.

3. Breakdown Torque. Approximately 200 percent of full load torque.

4. Insulation. Class A (50 °C temperature rise) or better.

5. Service Factor. Minimum of 1.35 for drip-proof motors and 1.0 for enclosed motors.

6. Bearings. Pre-lubricated ball bearings.

2.5 SINGLE PHASE POWER - PERMANENT-SPLIT CAPACITOR MOTORS

A. Use single-phase power, permanent split capacitor motors for shaft-mounted fans or blowers 3/4 brake horsepower and smaller.

B. Permanent split capacitor motors shall have the following characteristics:

1. Starting Torque. Exceeding 1/4 of full load torque.

2. Starting Current. Up to six times full load current.

3. Multiple Speed. Through tapped windings.

4. Insulation. Class A (50 °C temperature rise) or better.

5. Service Factor. 1.0.

6. Bearings. Pre-lubricated ball or sleeve bearings.

7. Integral Protection. Automatic reset overload protector.

2.6 SINGLE PHASE POWER - CAPACITOR START MOTORS

A. Use single-phase power, capacitor start motors for applications 1/4 brake horsepower through 3/4 brake horsepower.

B. Capacitor start motors shall have the following characteristics:

1. Starting Torque. Three times full load torque.

2. Starting Current. Less than five times full load current.

3. Pull-up Torque. Up to 350 percent of full load torque.

4. Breakdown Torque. Approximately 250 percent of full load torque.

5. Motors. Capacitor in series with starting winding. Provide capacitor-start/capacitor-run motors with two capacitors in parallel with run capacitor remaining in circuit at operating speeds.

6. Insulation. Class A (50 °C temperature rise) or better.

7. Service Factor: Minimum of 1.25 for drip-proof motors and 1.0 for enclosed motors.

8. Bearings. Pre-lubricated ball bearings.

2.7 THREE PHASE POWER - SQUIRREL CAGE MOTORS

A. Use 3-phase power, squirrel cage induction motors for applications more than 3/4 brake horsepower

B. 3-phase power, squirrel cage motors shall have the following characteristics:

1. Starting Torque. NEMA Design B characteristics.

2. Locked Rotor Current. NEMA Design B characteristics.

3. Power Output, Locked Rotor Torque, Breakdown or Pull-Out Torque. NEMA Design B characteristics.

4. Design, Construction, Testing, and Performance. Conform to NEMA MG-1 for Design B motors.

5. Insulation System. NEMA Class F or better.

6. Service Factor. 1.15 minimum.

C. Test motors in accordance with NEMA MG-1-12 and IEEE Std 112, *IEEE Standard Test Procedure for Polyphase Induction Motors and Generators*. Each motor shall receive a routine commercial test to verify freedom from electrical or mechanical defects. Provide prototype test reports for each rating.

D. Motors shall be NEMA Standard T-Frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.

E. Motors shall have grease lubricated anti-friction ball bearings, with housings equipped with provision for re-lubrication,

1. The bearings shall have a rated L-10 fatigue life per ANSI/ABMA 9, *Load Ratings and Fatigue Life for Ball Bearings*, of 150,000 hours for direct-coupled applications and 50,000 hours for belted applications minimum. Belted rating shall be based on radial loads and pulley sizes called out in NEMA MG-1. The calculation will be determined from the pulley centerline being at the end of the motor shaft.

2. Bearing cavities and greasing passages shall be thoroughly cleaned of all debris before lubricating. Motors shall be lubricated at the factory with Exxon Mobil Polyrex EM grease, or equal.

3. Stamp ANSI/ABMA bearing identification number on motor nameplate.

F. For belted applications, provide an adjustable sliding base; for applications above 10 horsepower, sliding base shall have two adjusting bolts.

G. General purpose, single-speed motors shall be NEMA Premium labeled motors or motors with full-load nominal efficiency not less than that tabulated below when tested in accordance with IEEE Std 112, Subclause 6.4, Method B.

Nominal Full-Load Efficiency						
Motor HP	Number of Poles / Synchronous Speed, RPM					
	ODP Motors			TEFC Motors		
	2 3600	4 1800	6 1200	2 3600	4 1800	6 1200
1	77.0	85.5	82.5	77.0	85.5	82.5
1.5	84.0	86.5	86.5	84.0	86.5	87.5
2	85.5	86.5	87.5	85.5	86.5	88.5
3	85.5	89.5	88.5	86.5	89.5	89.5
5	86.5	89.5	89.5	88.5	89.5	89.5
7.5	88.5	91.0	90.2	89.5	91.7	91.0
10	89.5	91.7	91.7	90.2	91.7	91.0
15	90.2	93.0	91.7	91.0	92.4	91.7
20	91.0	93.0	92.4	91.0	93.0	91.7
25	91.7	93.6	93.0	91.7	93.6	93.0
30	91.7	94.1	93.6	91.7	93.6	93.0
40	92.4	94.1	94.1	92.4	94.1	94.1
50	93.0	94.5	94.1	93.0	94.5	94.1
60	93.6	95.0	94.5	93.6	95.0	94.5
75	93.6	95.0	94.5	93.6	95.4	94.5
100	93.6	95.4	95.0	94.1	95.4	95.0

H. Do not select motors to operate continuously above rated load in the service factor area.

I. De-rate motors for operation at 7,500 ft altitude in accordance with the following table, taking into consideration the ambient temperature of the motor environment. Select motor based on 104 °F ambient temperature unless motor is in a moving air stream when operating.

Maximum Motor Shaft Load[a] (bhp)						
Motor Nameplate (hp)	Ambient Temperature[b, c, d] (°F)					
0	81.1	85	90	95	100	104[e]
1	1.00	0.98	0.95	0.92	0.89	0.87
1.5	1.50	1.47	1.43	1.38	1.34	1.31
2	2.00	1.96	1.90	1.85	1.79	1.75
3	3.00	2.93	2.85	2.77	2.68	2.62
5	5.00	4.89	4.75	4.61	4.47	4.36
7.5	7.50	7.34	7.13	6.92	6.71	6.55
10	10.0	9.78	9.51	9.23	8.95	8.73
15	15.0	14.7	14.3	13.8	13.4	13.1

Maximum Motor Shaft Load[a] (bhp)						
Motor Nameplate (hp)	Ambient Temperature[b, c, d] (°F)					
20	20.0	19.6	19.0	18.5	17.9	17.5
25	25.0	24.5	23.8	23.1	22.4	21.8
30	30.0	29.3	28.5	27.7	26.8	26.2
40	40.0	39.1	38.0	36.9	35.8	34.9
50	50.0	48.9	47.5	46.1	44.7	43.6
60	60.0	58.7	57.0	55.4	53.7	52.4
75	75.0	73.4	71.3	69.2	67.1	65.5
100	100	97.8	95.1	92.3	89.5	87.3

[a]Motor selection criteria developed from temperature rise considerations in NEMA MG-1-2003, clauses 12.43, 12.51, and 14.4.

[b]Select motor based on 104 °F ambient temperature unless motor is in a moving air stream when operating.

[c]Document selection of an ambient temperature lower than 90 °F.

[d]Do not extrapolate to ambient temperatures below 81.1 or above 104 °F. If the ambient temperature is outside the 81.1 to 104 °F range, refer to NEMA MG-1 and/or the motor manufacturer for guidance.

[e]If ambient temperature exceeds 104 °F, select motor with greater nameplate hp rating in accordance with NEMA MG-1.

J. Where indicated on drawings, provide motors suitable for use with adjustable frequency controllers as follows:

1. Provide motors that comply with Part 31 of NEMA MG-1 for use with pulse width modulation (PWM) adjustable frequency AC controllers.

2. Provide motors that comply with Part 30 or 31 of NEMA MG-1 for use with six step adjustable frequency controllers.

K. For motor Frame Sizes 254T and larger provide three positive thermal coefficient (PTC) thermistors imbedded in motor windings and epoxy encapsulated solid state control relay for wiring into motor starter.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine surfaces to receive motors for compliance with installation tolerances and other conditions affecting performance of the control system. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install motors and accessories in accordance with manufacturer's instructions and NECA 230; have manufacturer's installation instructions available at the construction site.

B. Remove any slushing compound on shaft or other parts using a petroleum-type solvent.

C. Remove shaft shipping braces after motor is placed in its final location.

D. Install motor securely on firm, level foundation.

E. Install shaft coupling or sheave in accordance with manufacturer's instructions. Do not modify motor shaft to accommodate coupling or sheave.

F. Align the motor shaft with the load shaft. Meet the most stringent of the motor manufacturer's requirements for shaft alignment, the driven equipment manufacturer's requirements for shaft alignment, or the following requirements for shaft alignment. The minimum acceptable criteria for motor installation and shaft alignment for motors 10 horsepower and larger are as follows:

1. Load and motor casing distortion (soft foot): Not more than 0.002 in. (0.0508 mm) at each foot. Use stainless steel pre-stamped shims as required in bringing soft foot within acceptable limits.

2. Load and motor shaft runout: Not more than 0.001 in.. If load shaft exceeds criteria contact the LANL Subcontract Technical Representative (STR). If motor shaft runout exceeds criteria, replace the motor.

3. Alignment tolerances for coupled shafts with short couplings:

Speed, rpm	SHAFT OFFSET At center, inch (mm)	ANGULARITY/GAP Inch/10 inches (mm/254 mm)
600	0.005 (0.1270)	0.010 (0.2540)
900	0.003 (0.0762)	0.007 (0.1778)
1200	0.0025 (0.0635)	0.005 (0.1270)
1800	0.002 (0.0508)	0.003 (0.0762)
3600	0.001 (0.0254)	0.002 (0.0508)
7200	0.0005 (0.0127)	0.001 (0.0254)

4. Alignment tolerances for coupled shafts having couplings with spacers:

Speed, rpm	SHAFT OFFSET Per inch (25.4 mm) of spacer length
600	0.0018 (0.0457)
900	0.0012 (0.0305)
1200	0.0009 (0.0229)
1800	0.0006 (0.0152)
3600	0.0003 (0.0076)
7200	0.00015 (0.0038)

G. For belt driven loads use string or straight edge alignment of pulley grooves to minimize offset, angle, and twist so belts are not distorted. Verify roundness of pulleys; replace pulleys with total indicator runout exceeding 0.005 in. Set belt tension as low as possible.

H. Verify that line voltage and phases agree with motor nameplate.

I. Ground motors according to manufacturer's instructions and the requirements in Section 26 0526, "Grounding and Bonding for Electrical Systems."

J. Make electrical connections to motors using materials and methods specified in Section 26 0519, "Low-Voltage Electrical Power Conductors and Cables" and Section 26 0533, "Raceways and Boxes for Electrical Systems." Use flexible conduits, 2 ft minimum lengths, for connections to motor. Use motor lead splicing kits to insulate and seal connections to leads.

E. Setup parameters required for the meter shall be stored in non-volatile memory and retained in the event of a control power interruption. Any battery used to provide non-volatile memory must be serviceable from the front of the meter.

F. The meter shall display the following metered values on a faceplate alphanumeric readout and shall auto range between Units, Kilo-Units, and Mega-Units. The information shall be also available at a remote computer through a communications network:

1. Real-time readings (accuracy expressed as percent of reading)
   a. Current – (Plus or minus 0.075 percent accuracy plus 0.025 percent full scale) true RMS
      1) Phases A, B, and C.
   b. Voltage – (Plus or minus 0.075 percent accuracy plus 0.025 percent full scale) true RMS
      1) Phases A-B, B-C, C-A and
      2) Phases A-N, B-N, C-N.
   c. Power – (Plus or minus 0.15 percent accuracy plus 0.025 percent full scale) true RMS
      1) Real (watts);
      2) Reactive (vars);
      3) Apparent (VA); and
      4) Phases A, B, C, and 3-phase total.
   d. Frequency – (Plus or minus 0.01 Hz) 45 to 67 Hz.
   e. Power Factor – (Plus or minus 0.002 percent accuracy)
      1) 3-phase total.
   f. Individual Harmonics – magnitude and angle.
   g. Percent THD – Current
      1) Phases A, B, and C.
   h. Percent THD – Voltage
      1) Phases A-B, B-C, C-A and
      2) Phases A-N, B-N, C-N.
2. Energy Readings (accuracy expressed as percent of reading):
   a. Real (kWh) – (Plus or minus 0.5 percent accuracy)
      1) 3-phase total.
   b. Apparent (kVAh) – (Plus or minus 0.5 percent accuracy)
      1) 3-phase total.
3. Demand Readings:
   a. Current (amperes) –
      1) Present and
      2) Peak.

1.6 REGULATORY REQUIREMENTS

A. Conform to requirements of the *National Electrical Code* (NEC) (NFPA 70).

B. Conform to requirements of ANSI C12.1, *American National Standard Code for Electricity Metering*.

C. Furnish products listed and labeled by a nationally recognized testing laboratory (NRTL) as suitable for purposes specified and shown.

1.7 COORDINATION

A. Coordinate installation of metering components in the service entrance switchboards and motor control centers.

B. Coordinate the features of the meter and associated instrument transformers with the ratings and characteristics of the circuit to be metered.

C. Coordinate connection of meter KYZ pulse output with Section 25 5000, "Integrated Automated Facility Controls" with the controls Subcontractor.

D. Provide not less than 14 working days notice to LANL STR to arrange for LANL Utilities to inspect, program, and test the meter prior to Project final inspection.

1.8 EXTRA MATERIALS

A. Furnish one spare for every five installed fuses, but not less than one set of three of each size and type.

1.9 RECEIVING, STORING AND PROTECTING

A. Receive, store, and protect, and handle products according to NECA 1, *Standard Practices for Good Workmanship in Electrical Construction*.

PART 2 PRODUCTS

2.1 PRODUCT OPTIONS AND SUBSTITUTIONS

A. Refer to Section 01 2500, "Substitution Procedures."

2.2 DIGITAL ELECTRICAL POWER METER

A. Provide a digital electrical power meter as indicated on the drawings for three-phase services rated 800 amperes or less. Meter shall meet the following standards:

1. Be NRTL listed to UL 508, *Industrial Control Equipment*.
2. Meet requirements of ANSI C12.16, *American National Standard for Solid-State Electricity Meters*.
3. Meet NEMA C12.20, *Electricity Meters 0.2 and 0.5 Accuracy Classes*, class 0.5S for energy revenue metering.

B. The meter shall sample current and voltage signals at a rate high enough to provide true-RMS metering accurate beyond the 30th harmonic.

C. The meter shall be rated for an operating temperature range of minus 25 to 70 °C

D. Meter shall have a current input withstand rating of 15 amperes continuous, 50 amperes for 10 seconds per hour and 500 amperes for 1 second per hour.

SECTION 26 2713

ELECTRICITY METERING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Digital electrical power meter.

B. Test switches.

C. Instrument transformers.

1.2 RELATED SECTIONS

A. Section 01 2500, "Substitution Procedures."

B. Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

C. Section 26 2416 "Panelboards."

D. Section 26 0526, "Grounding and Bonding for Electrical Systems."

E. Section 26 0553, "Identification for Electrical Systems."

F. Section 25 5000, "Integrated Automated Facility Controls"

1.3 ABBREVIATIONS AND ACRONYMS, DEFINITIONS, AND REFERENCES

A. Refer to Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

1.4 LANL PERFORMED WORK

A. LANL Utilities will inspect, test, program, and adjust the meter, meter wiring, Ethernet communication wiring, and Ethernet communications interface.

B. LANL ES-DE Process and Automation Team will inspect and test the RS-485 communication wiring and communications interface.

1.5 SUBMITTALS

A. Submit the following in accordance with the requirements of Exhibit I:

1. Catalog data and manufacturer's technical data, including data proving that materials comply with specified requirements. Provide catalog sheets showing ratings, dimensions, and enclosure details.

2. Installation instructions indicating application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

3. Shop drawing of installation in panelboards.

4. Wiring diagram showing connection of meter and display modules, instrument transformers, test switches, potential fuses, and communications circuits.

5. Operation and maintenance instructions.

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Second half of documents from "LLW Specs" folder

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3.3 FIELD QUALITY CONTROL

A. Perform the following inspections for all field installed motors:

1. Verify that motor nameplate data agrees with drawings and Specifications.
2. Inspect physical and mechanical condition of motor.
3. Verify that motor is properly anchored.
4. Verify that motor is properly grounded.
5. Verify that the area around motor fan cooling air inlets is free of debris that could be drawn into motor or motor fan during operation.
6. Verify that motor is lubricated in accordance with manufacturer's instructions.
7. Before energizing, turn motor shaft by hand to verify free rotation.

B. Perform the following inspections and tests for all field installed motors 10 hp and larger:

1. Verify the tightness of accessible bolted electrical connections with a calibrated torque-wrench.
2. Check electrical connections for high resistance using a low-resistance ohmmeter; investigate any values that deviate from similar connections by more than 50 percent.
3. Perform insulation-resistance tests in accordance with IEEE St 43; investigate if stator phase-to-phase resistance values deviate by more than 10 percent.
4. Before energizing motor with driven equipment, verify proper alignment of motor shaft with load shaft.
5. Verify proper rotation direction as required by the load.

C. Keep records of inspections and tests for each motor; submit them to the LANL STR.

D. Coordinate inspections and tests with those required by Section 26 0813, "Electrical Acceptance Testing."

END OF SECTION

FOR LANL USE ONLY

This project specification is based on LANL Master Specification 26 0700, Rev. 2, dated June 29, 2010.

SECTION 26 0813

ELECTRICAL ACCEPTANCE TESTING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Provide the services of a qualified Electrical Testing Agency (ETA) to perform the functions described below:

1. Pre-functional tests, inspections, and system functional tests of certain electrical systems, equipment, components, and material (SSCs) installed under the scope of this Project; refer to PART 3 of this section.
2. System functional tests after completion of Pre-functional tests on certain electrical SSCs installed under the scope of this Project.
3. The following power system studies based on the installed electrical SSCs:
    a. Final short circuit study,
    b. Final coordination study,
    c. Arc-flash hazard analysis, and
    d. Load flow study.

1.2 RELATED SECTIONS

A. Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

B. Section 26 0519, "Low-Voltage Electrical Power Conductors and Cables."

C. Section 26 0526, "Grounding and Bonding for Electrical Systems."

D. Section 26 2416, "Panelboards."

E. Section 26 2419, "Motor Control Centers."

F. Section 26 2713, "Electricity Metering."

G. Section 26 2816, "Enclosed Switches and Circuit Breakers."

H. Section 26 2913, "Enclosed Controllers."

I. Section 26 2923, "Variable Frequency Motor Controllers."

1.3 ABBREVIATIONS AND ACRONYMS, DEFINITIONS, AND REFERENCES

A. Refer to Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

1.4 LANL PERFORMED WORK

A. None.

1.5 SUBMITTALS

Submit the following in accordance with the requirements of Exhibit I:

A. Certifications:

1. Submit name and qualifications of the ETA.
2. Submit quality assurance program of the ETA.

3. Submit instrument calibration program of the ETA.

4. Submit electrical safety program of the ETA.

5. Submit name and qualifications of the lead engineer or engineering technician performing the required testing services. Include a list of three comparable jobs performed by the individual with specific names and telephone numbers for reference.

B. Test Plans: Submit pre-functional and system functional test plans for each item of equipment or system to be field tested at least 45 days prior to planned testing date. Include applicable procedures, forms, and lists of test equipment. Do not perform testing until test plan and procedures have been approved.

C. Test Reports: Submit certified copies of inspection reports, test reports, and system functional tests. Reports shall include certification of compliance with specified requirements including test instrument calibration, identification of deficiencies, and recommendation of corrective action when appropriate. Type and neatly bind test reports to form a part of the final record. Submit test report not more than 10 days after each test is completed.

D. Calculations: Submit certified copies of power system studies listed below. Calculations shall include certification of compliance with specified requirements, identify deficiencies, and recommend corrective action when appropriate. Type and neatly bind Calculations to form a part of the final record. Submit power system studies in paper format and also in electronic format transmitted on a CD-ROM.

1. Final short circuit study,
2. Final coordination study,
3. Arc-flash hazard analysis, and
4. Load flow study.

1.6 REGULATORY REQUIREMENTS

A. Make inspections and tests in accordance with the following codes and standards:

1. InterNational Electrical Testing Association (NETA) ATS-[current edition], Acceptance Testing Specifications (ANSI). NETA ATS forms a part of this specification to the extent referenced.

2. National Fire Protection Association (NFPA):

   a. NFPA 70, *National Electrical Code* (NEC).

   b. NFPA 70B, *Recommended Practice for Electrical Equipment Maintenance.*

   c. NFPA 70E, *Standard for Electrical Safety in the Workplace.*

3. Institute of Electrical and Electronics Engineers (IEEE):

   a. IEEE Std 242, *IEEE Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems.*

   b. IEEE Std 399, *IEEE Recommended Practice for Industrial and Commercial Power Systems Analysis.*

   c. IEEE Std 1584, *IEEE Guide for Performing Arc-Flash Hazard Calculations.*

4. Los Alamos National Laboratory (LANL):

   a. ISD 101-3 (P 101-3), *Lockout/Tagout for Hazardous Energy Control.*

   b. ISD 101-13 (P 101-13), *Electrical Safety Program.*

   c. AP-341-502, *Management Level Determination.*

1.7 QUALITY ASSURANCE

A. The ETA shall be an independent testing organization which shall function as an unbiased testing authority, professionally independent of the manufacturers, suppliers, and installers of the equipment or systems to be evaluated.

B. The ETA shall be regularly engaged in the testing of electrical equipment devices, installations, and systems.

C. The ETA shall have a documented quality assurance program, documented inspection and test and procedures, and a documented electrical safety program.

D. The ETA shall have successfully completed not less than five acceptance testing, inspection and calibration projects of similar scope to this project.

E. The ETA shall have a calibration program, and test instruments used shall be calibrated in accordance with NETA ATS.

F. Each ETA technician performing testing, inspection, calibration, and adjustments shall be a "qualified person" as defined by NFPA 70E and the NEC.

   1. Technicians performing these electrical tests and inspections shall be trained and experienced concerning the apparatus and systems being evaluated.

   2. Technicians shall be capable of conducting the tests in a safe manner with complete knowledge of the hazards involved and the appropriate safety-related work practices.

   3. Technicians shall be qualified to evaluate the test data and make a judgment on the serviceability of the specific equipment.

G. Testing, inspection, calibration, and adjustments shall be performed or supervised on the Project site by an ETA employee with the following minimum qualifications:

   1. A minimum of 5 years' experience inspecting, testing, and calibrating electrical distribution and generation equipment, systems, and devices, and

   2. One of the following certifications/registrations:

      a. An engineering technician certified to at least Level III in accordance with ANSI/NETA ETT *Standard for Certification of Electrical Testing Technicians* (ANSI), or

      b. An engineering technician certified to at least the NICET ET-grade in Electrical Testing Engineering Technology, or

      c. Only applicable to ML-3 and ML-4 SSCs, as determined by LANL AP-341-502: An engineering technician certified by the ETA's internal training/qualification program. As part of the submittal of qualifications, ETA must provide material demonstrating that its certification program is at least equivalent to ANSI/NETA ETT Level III and that the on-site technician's training and certification is up to date.

1.8 COORDINATION

A. Schedule the project to allow adequate time for electrical pre-functional testing BEFORE equipment or system is energized.

1. Notify the ETA when equipment becomes available for inspections and pre-functional/functional tests.

2. Coordinate work to expedite inspections and tests.

B. Notify the LANL Subcontract Technical Representative (STR) at least 14 days in advance scheduled pre-functional tests, inspections, and system functional tests.

1. Notify the LANL STR again approximately 24 hours before start of testing.

2. The LANL STR will arrange for witnessing of the tests and inspections by appropriate LANL personnel when required by the Test & Inspection Plan, the applicable codes and consensus Standards or when deemed appropriate by the LANL Design Authority.

PART 2 PRODUCTS

A. Not Used.

PART 3 EXECUTION

3.1 GENERAL

A. Perform the installation insulation-resistance, continuity, and rotation tests for electrical SSCs described in each section of these specifications before, and in addition to, tests performed by the ETA that are specified in this section.

B. Supply suitable and stable electrical power, adequate lighting, and heating or ventilation as required at each test site for the ETA to perform the specified acceptance testing.

C. Supply one set of the following to ETA prior to the performance of any final testing:

1. Preliminary short-circuit analysis;

2. Preliminary coordination study and protective device setting table;

3. Complete set of electrical drawings, specifications, and any pertinent Change Orders;

4. Approved construction submittal documents for material and equipment;

5. Site-specific hazard notification and safety training; and

6. Other information necessary for a safe and accurate test and inspection of the system.

3.2 INSPECTION AND TEST PROCEDURES

A. The ETA shall perform the pre-functional tests and inspections.

B. The ETA shall use test methods, follow procedures, and evaluate test values in accordance with the applicable sections of the NETA ATS, the manufacturer's recommendations, and each applicable specification section.

C. Tests identified as optional in NETA ATS are not required unless specified.

D. Place equipment in service only after completion of required tests and evaluation of the test results.

E. The ETA shall perform acceptance tests and inspections on electrical SSCs as identified in the following paragraphs. Perform tests and inspections as specified in the applicable clauses of the NETA ATS and as modified by the following paragraphs:

1. Section 26 0519, "Low-Voltage Electrical Power Conductors and Cables":

a. Test low-voltage conductors using the graded approach indicated in Table 1 of this section.

Table 1. Low Voltage Electrical Power Conductors. [Management Level (ML) as determined by AP-341-502]

Inspection or Test per NETA ATS	ML-3[(a)] and ML-4 SSCs				
	Service > 800A	Feeder > 800A	Branch ≥ 6 AWG	Branch < 6 AWG	Control ≥ 120V
Compare conductor data with drawings and specifications.	X	X	--	--	--
Inspect for physical damage and correct connections.	X	X	--	--	--
Inspect connections for high resistance.	X	X	--	--	--
Inspect compression applied connections for correct cable match and indentation.	X	X	--	--	--
Inspect for correct identification and arrangements.	X	X	--	--	--
Inspect jacket insulation.	X	X	--	--	--
Test connections for high resistance using low-resistance ohmmeter.	X	X	--	--	--
Perform insulation-resistance test on each conductor to ground and other conductors.	X	X	--	--	--
Perform continuity tests to insure correct connections.	X	X	--	--	--
Verify uniform resistance of parallel conductors.	X	X	--		

[(a)]For ML-3 systems the LANL Design Authority may invoke more rigorous electrical acceptance testing requirements.

2. Section 26 0526, "Grounding and Bonding for Electrical Systems":

a. Medium-Voltage Systems: Test grounding and bonding for each system and circuit. LANL will test grounding and bonding of medium-voltage utility systems and circuits.

3. Section 26 2713, "Electricity Metering":

a. LANL will inspect, test, adjust and program revenue-type metering installed under Section 26 2713.

4. Section 26 2816, "Enclosed Switches and Circuit Breakers":

a. ML-3 Enclosed Switches and Circuit Breakers: Test enclosed molded case circuit breakers using the graded approach indicated in Table 2 of this section.

5. Section 26 2923, "Variable Frequency Motor Controllers":

   a. ML-3 Variable Frequency Motor Controllers or Adjustable Speed Drive Systems: Test each variable frequency motor controller or adjustable speed drive system serving a motor larger than 50 hp. Verify that motor overload protection is appropriate for the application.

Table 2. Molded Case Circuit Breakers
[Management Level (ML) as determined by AP-341-502]

Inspection or Test per NETA ATS	ML-3[(a)] and ML-4 SSCs			
	C/B > 800A Frame	C/B ≥ 400A Frame[(b)]	C/B ≥ 150A Frame[(b)]	C/B < 150A Frame[(b)]
Compare nameplate data with drawings and specifications.	X	X	X	X
Inspect physical and mechanical condition.	X	X	X	X
Inspect anchorage and alignment.	X	X	X	--
Verify the unit is clean.	X	X	X	--
Operate the circuit breaker to assure smooth operation.	X	X	X	--
Inspect connections for high resistance.	X	X	X	--
Inspect compression applied connections for correct cable match and indentation.	X	X	X	--
Measure resistance through connections with a low-resistance ohmmeter.	X	X	--	--
Measure insulation-resistance on each pole phase-to-phase and phase-to-ground with the circuit breaker closed and across each open pole.	X	X	--	--
Measure contact/pole resistance.	X	X	--	--
Perform insulation resistance tests on all control wiring,	X	X	--	--
Perform adjustments for final setting in accordance with coordination study.	X	X	--	--
Determine long-time pickup and delay by primary current injection.	X	X	--	--
Determine short-time pickup and delay by primary current injection.	X	X	--	
Determine ground fault pickup and delay by primary current injection.	X	X	--	--
Determine instantaneous pickup by primary current injection.	X	X	--	--
Verify correct operation of auxiliary functions.	X	X	--	--

[(a)]For ML-3 systems the LANL Design Authority may invoke more rigorous electrical acceptance testing requirements.

[(b)]If C/B is part of a switchboard, panelboard, MCC or busway rated >800A.

F. Tests and inspections on the following equipment and systems will be performed by either the installing firm or LANL and are excluded from the scope of this section:

   1. Addressable fire alarm system,
   2. Administrative access control system,

3. Instrumentation and controls systems,
4. Lightning protection system,
5. Medium-voltage utility power cable,
6. Pad-mounted medium-voltage utility switchgear,
7. Pad-mounted utility transformer with medium-voltage primary,
8. Revenue-type electricity metering,
9. Telecommunications system, and
10. Voice paging system.

3.3 SYSTEM FUNCTIONAL TESTS

A. The ETA shall develop and perform system functional tests on the following SSCs in accordance with NETA ATS after completion of the pre-functional test and inspection procedures described above.

1. Section 26 2416, "Panelboards":
   a. Verify proper operation of interfaces with building automation system.
2. Section 26 2419, "Motor Control Centers":
   a. Verify proper operation of interfaces with building automation system.
   b. Verify proper operation of interlock systems.
3. Section 26 2713, "Electricity Metering":
   a. Verify proper operation of interfaces with building automation system.
4. Section 26 2816, "Enclosed Switches and Circuit Breakers":
   a. Verify proper operation of interlock and shunt trip systems.
5. Section 26 2913, "Enclosed Controllers":
   a. Verify proper operation of interfaces with building automation system.
   b. Verify proper operation of interlock systems.
6. Section 26 2923, "Variable Frequency Motor Controllers":
   a. Verify proper operation of interfaces with building automation system.
   b. Verify proper operation of interlock systems.

3.4 THERMOGRAPHIC SURVEY

A. After completion of specified pre-functional test and inspection procedures and system functional tests, the ETA shall perform system thermographic survey of current-carrying devices rated 800 amperes and greater in accordance with NETA ATS.

B. Conduct thermographic survey with circuits and devices operating within 20 percent of the design load. Provide additional circuit loads as required if building loads are inadequate to obtain required circuit loading.

3.5 POWER SYSTEM STUDIES

A. The ETA shall provide power system studies described below based on the installed electrical distribution system and equipment in accordance with procedures described in NETA-ATS and the referenced codes and standards.

1. Include in the study the effect of all portions of the electrical distribution system including alternate sources of power.

2. Address normal system operating configuration plus any plausible alternate configurations and operations that could result in maximum fault condition.

B. Final Short-Circuit Study: Perform final short circuit calculations using procedures outlined in IEEE Std 242.

1. As a minimum, calculate the short-circuit momentary and interrupting duty on the basis of maximum available fault current at each bus in the distribution system down to the following points in the low-voltage system:

a. 480 volt system where available short circuit current is less than 14,000 amperes RMS symmetrical.

b. 208 or 240 volt system where available short circuit current is less than 10,000 amperes RMS symmetrical.

C. Final Coordination Study: Perform final coordination study using procedures outlined in IEEE Std 242.

1. As a minimum, include in the coordination study all voltage classes of equipment from the utility incoming line protective device(s) down to and including each low voltage load protective rated 100 amperes and larger.

D. Arc-Flash Hazard Analysis: Perform arc-flash hazard analysis and shock hazard analyses based on the final short-circuit study and the final coordination study. Use procedures outlined in IEEE Std 1584 and NFPA 70E. Provide the following information in tabular form for the arc-flash warning labels described in Section 26 0553, "Identification for Electrical Systems":

1. Flash hazard boundary (inches) calculated in accordance with IEEE Std 1584 or NFPA 70E.

2. Arc-flash incident energy (cal/cm^2) calculated in accordance with IEEE Std 1584 or NFPA 70E.

3. Working distance (inches) selected from IEEE Std 1584 or NFPA 70E (Annex D) based on equipment type.

4. Hazard/risk category number from NFPA 70E Table 130.7(C)(9) for operations with doors closed and covers on.

5. System phase-to-phase voltage.

6. Condition that exposes worker to electrical shock hazard.

7. Limited Approach Boundary from NFPA 70E Table 130.2(C) based on nominal system phase-to-phase voltage.

8. Restricted Approach Boundary from NFPA 70E Table 130.2(C) based on nominal system phase-to-phase voltage.

9. Prohibited Approach Boundary from NFPA 70E Table 130.2(C) based on nominal system phase-to-phase voltage.

10. Class for insulating gloves based on system voltage (e.g., Class 00 for up to 500 volts).

11. Voltage rating for insulated or insulating tools based on system voltage (e.g., 1000 volts).

12. Equipment ID code based on drawings and including TA number, building number, and system identifier.

13. Date that hazard analysis was performed.

14. "Served from" circuit directory information including the serving equipment ID code, location (e.g., room number), circuit number, and circuit voltage/phases/wires.

15. If applicable, "serves" circuit directory information including the served equipment ID code, location (e.g., room number), circuit number, and circuit voltage/phases/wires.

E. Load Flow Study: Perform load flow study using procedures outlined in IEEE Std 399.

3.6 TEST REPORT

A. The ETA shall include the following information in the final test report:

1. Summary of project;
2. Description of equipment inspected and tested;
3. Description of inspections and tests;
4. Data record resulting from each inspection and test;
5. Results of system functional tests;
6. Power system studies; and
7. Analysis of the tests, identification of deficiencies, and recommendations for corrective action.

B. Include the following minimum information in each data record:

1. Identification of the ETA;

2. Equipment identification: Equipment ID code based on drawings and including TA number, building number, and system identifier;

3. Humidity, temperature, and other conditions that may affect the results of the tests or calibration of test equipment;

4. Date inspection, test, or functional test was performed;

5. Identification and signature of the testing technician;

6. Description of inspections, tests, maintenance, and functional tests performed and recorded;

7. Test equipment used and references to calibration records; and

8. Indication of as-found condition and as-left results.

C. Submit six copies of the complete report to the LANL STR.

3.7 FIELD QUALITY CONTROL

A. Report to the LANL STR, within three working days, any SSC or construction that is found defective based on pre-functional tests or inspections by the ETA.

B. Within 15 days of direction from the LANL STR, rework, repair or replace any SSC or construction that is found defective based on pre-functional tests or inspections.

C. The ETA shall retest any SSC or construction that did not pass pre-functional tests or inspections.

END OF SECTION

FOR LANL USE ONLY

This project specification is based on LANL Master Specification 26 0813, Rev. 1, dated July 8, 2008.

SECTION 26 2213

LOW-VOLTAGE DISTRIBUTION TRANSFORMERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. General-purpose dry-type low-voltage transformers.

1.2 RELATED SECTIONS

A. Section 01 2500, "Substitution Procedures."

B. Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

C. Section 13 4800, "Sound, Vibration, and Seismic Control."

D. Section 26 0526, "Grounding and Bonding for Electrical Systems."

E. Section 26 0553, "Identification or Electrical Systems."

1.3 ABBREVIATIONS AND ACRONYMS, DEFINITIONS, AND REFERENCES

A. Refer to Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

1.4 SUBMITTALS

A. Submit the following in accordance with the requirements of Exhibit I:

B. Catalog Data. Include outline and support point dimensions of transformer enclosures and accessories, unit weight, voltages, kVA, impedance, NEMA TP 1 efficiency, sound level, tap configurations, insulation system type, and rated temperature rise.

C. Certifications signed by manufacturers certifying that their products comply with the specified requirements.

D. Operation and maintenance instructions.

1.5 QUALITY ASSURANCE

A. Comply with the *National Electrical Code* (NEC) (NFPA 70) for components and installation.

B. Provide products that are listed and labeled by a nationally recognized testing laboratory (NRTL) for the application, installation condition, and the environment in which installed.

C. The manufacturer of the transformers shall be a certified ISO 9001 facility.

D. Provide products that comply with the following industry standards:

1. NEMA TP 1, *Guide for Determining Energy Efficiency for Distribution Transformers.*

2. NEMA TP 2, *Standard Test Method for Measuring the Energy Consumption of Distribution Transformers.*

3. NEMA TP 3, *Standard for the Labeling of Distribution Transformer Efficiency.*

4. UL 1561, *Dry-Type General Purpose and Power Transformers.*

1.6 SERVICE CONDITIONS

A. Provide transformers and accessories that will perform satisfactorily in the following service conditions:

1. Elevation of 7,500 ft above sea level.
2. Maximum ambient temperature of 104 °F.
3. 24-hour average temperature not exceeding 86 °F.
4. Load current harmonic factor not exceeding 5 percent THD.

1.7 RECEIVING, STORING, PROTECTING, AND HANDLING

A. Receive, store, protect, and handle products according to NECA 1, *Standard Practices for Good Workmanship in Electrical Construction* and NECA 409, *Recommended Practice for Installing and Maintaining Dry-Type Transformers (ANSI)*.

PART 2 PRODUCTS

2.1 PRODUCT OPTIONS AND SUBSTITUTIONS

A. Alternate products may be accepted; follow Section 01 2500, "Substitution Procedures."

2.2 GENERAL

A. Transformers shall be NRTL-listed to UL 1561 and shall be tested and labeled according to NEMA TP 1, NEMA TP 2, and NEMA TP 3.

B. The efficiency of each transformer shall be NEMA TP 1 Class I when tested in accordance with NEMA TP 2. Transformer efficiency shall be indicated on a label that conforms to NEMA TP 3.

C. Transformers shall be capable of continuous operation without exceeding temperature limits at an elevation of 7,500 ft when de-rated as follows:

1. 97.5 percent of nameplate kVA in a 30 °C average ambient with a maximum cooling air temperature of 40 °C, or

2. 100 percent of nameplate kVA in a 28.5 °C average ambient with a maximum cooling air temperature of 33.75 °C.

D. Transformer coils may be aluminum or copper with continuous wound construction and shall be impregnated with non-hygroscopic, thermosetting varnish. Terminations shall be brazed or welded to the coil conductor.

E. Insulating materials shall be rated as a 220 degree UL component recognized insulation system.

F. Furnish transformers with suitable dielectric materials and adequate air spacing between terminals for operating at an altitude of 7,500 ft.

G. Transformers 15 kVA and larger shall have a minimum of two 2.5 percent full capacity above normal and four 2.5 percent full capacity below normal primary taps.

H. Transformer cores shall be constructed of a high grade, non-aging silicon steel with high magnetic permeability and low hysteresis and eddy current losses. Magnetic flux densities shall be kept well below the saturation point. The core and coil shall be bolted to the base of the enclosure, isolated by means of rubber vibration-absorbing mounts. There shall be no metal-to-metal contact between the core and the enclosure. Sound isolation systems requiring the complete removal of all fastening devices will not be acceptable.

I. The core of the transformer shall be visibly grounded to the enclosure by a flexible grounding conductor sized following applicable UL and NEC Standards.

J. The transformer enclosure shall be ventilated and shall be fabricated of a heavy gauge, sheet steel construction. The entire enclosure shall be finished using a process consisting of degreasing, cleaning and phosphatizing followed by electrostatic deposition of polymer polyester powder and baking cycle to provide a uniform coating of all edges and surfaces. The coating shall be UL recognized for outdoor use. The coating color shall be light or medium grey.

K. Maximum sound levels shall not exceed the following when tested according to IEEE Std C57.12.91.

1. 10 – 50 kVA: 45 dB.
2. 51 – 150 kVA: 50 dB.

L. Transformers 45 KVA and less shall be suitable for wall, floor, or trapeze mounting; transformers larger than 45 KVA shall be suitable for floor or trapeze mounting. Provide mounting accessories required for installation.

M. Provide weather shields for transformers installed outdoors.

N. Provide transformer manufacturer's transformer lug kits with compression type equipment lugs and hardware for connecting conductors to transformer terminals.

2.3 GENERAL-PURPOSE DRY-TYPE TRANSFORMERS

A. Provide factory assembled and tested, energy-efficient, general-purpose, air cooled, two-winding, dry-type transformers with voltage and kVA ratings as indicated on the drawings.

B. General-purpose transformers 15 kVA and larger shall be 150 °C temperature rise above 40 °C ambient. The maximum temperature of the top of the enclosure shall not exceed 50 °C rise above a 40 °C ambient.

C. Manufacturers:

1. Square D Type "EE."
2. Eaton/Cutler-Hammer "DS-3"and "DT-3."
3. Sola/Hevi-Duty "ES" and "ET."

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine surfaces to receive transformers for compliance with installation tolerances and other conditions affecting performance of the control system. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install dry-type transformers where indicated on the drawings and according to manufacturer's instructions. Manufacturer's installation instructions shall be available at the construction site.

B. Install transformers according to NECA 409, *Recommended Practice for Installing and Maintaining Dry-Type Transformers (ANSI)*.

C. Install each floor-mounted transformer on a minimum 5-in.-high reinforced concrete pad. Refer to Section 13 4800, "Sound, Vibration, and Seismic Control," for anchoring materials and methods.

D. Install wall-mounted transformers on wall brackets manufactured by the transformer manufacturer. Do not mount transformers larger than 15 kVA on drywall construction. Do not wall mount transformers larger than 45 kVA. Refer to Section 13 4800, "Sound, Vibration, and Seismic Control," for anchoring materials and methods.

E. Arrange equipment to provide adequate spacing for access, replacement, and for cooling air circulation. Locate the front and rear of each ventilated transformer at least 6 in. from the wall or any obstruction to allow proper air circulation.

F. Use flexible conduits, 2 ft minimum lengths, for connections to transformer case. Make conduit connections to transformer enclosure only at locations designated by the manufacturer's installation instructions.

G. Connect conductors to transformer terminals using transformer manufacturer's lug kits. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not furnished, use those specified in UL 486A and UL 486B.

H. Bond transformers and ground systems served by transformers according to Section 26 0526, "Grounding and Bonding for Electrical Systems."

I. Identify transformers and install warning signs according to Section 26 0553, "Identification or Electrical Systems."

3.3 FIELD QUALITY CONTROL

A. Clean, inspect, test, adjust, and energize transformers in accordance with NECA 409.

1. Inspect each transformer for physical damage, proper connection and grounding, and proper anchorage.

2. Keep records of inspections, tests, and adjustments; submit them to the LANL STR.

B. After completing installation, cleaning, and testing, touch-up scratches and mars on finish to match original finish.

C. Measure primary and secondary voltages and phase rotation, and make preliminary tap adjustments. After normal operating loads have been energized adjust taps to provide the following voltage at points of use; record voltages and tap settings.

System Nominal Voltage	Minimum Load Voltage
480Y/277	460Y/265
208Y/120	200Y/115
120/240	115/230

END OF SECTION

FOR LANL USE ONLY

This project specification is based on LANL Master Specification 26 2213, Rev. 2, dated September 24, 2009.

SECTION 26 2416

PANELBOARDS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Panelboards for feeder and branch circuit loads.

B. Load center type panelboards for 120/240 V single-phase branch circuit loads.

1.2 RELATED SECTIONS

A. Section 01 2500, "Substitution Procedures."

B. Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

C. Section 26 0519, "Low-Voltage Electrical Power Conductors and Cables."

D. Section 26 0526, "Grounding and Bonding for Electrical Systems."

E. Section 26 0529, "Hangers and Supports for Electrical Systems."

F. Section 26 0553, "Identification for Electrical Systems."

G. Section 26 0813, "Electrical Acceptance Testing."

H. Section 26 2713, "Electricity Metering."

I. Section 26 4300, "Surge Protection Devices."

1.3 ABBREVIATIONS AND ACRONYMS, DEFINITIONS, AND REFERENCES

A. Refer to Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

1.4 SUBMITTALS

A. Submit the following in accordance with the requirements of Exhibit I:

1. Catalog Data. Submit catalog data describing each type panelboard, accessory item, and component specified. Include data substantiating that materials comply with specified requirements.

2. Shop Drawings. Submit shop drawings for each panelboard including dimensioned plans and elevations and component lists. Include front and side views of enclosure showing overall dimensions, enclosure type, enclosure finish, unit locations, and conduit entrances. Include the following:

a. Enclosure type with details for types other than NEMA Type 1.

b. Bus configuration and current ratings.

c. Short-circuit current rating of panelboard.

d. Features, characteristics, ratings, and factory settings of individual protective devices and auxiliary components.

3. Wiring Diagrams. Submit detailing schematic wiring diagrams including control wiring, and differentiating between manufacturer-installed and field-installed wiring.

4. Installation Instructions. Indicate application conditions and limitations of use stipulated by Product testing agency specified under Quality Assurance. Include instructions for storage, handling, protection, examination, installation, and starting of Product.

5. Operation and Maintenance Instructions. Submit operation and maintenance instructions. Include instructions for testing circuit breakers.

1.5 QUALITY ASSURANCE

A. Comply with the *National Electrical Code* (NEC) (NFPA 70) for components and installation.

B. Furnish products that are listed and labeled by a nationally recognized testing laboratory (NRTL) for the application, installation condition, and the environment in which installed.

C. Comply with NEMA PB 1, *Panelboards*, NEMA PB 1.1 *General Instructions for Proper Installation, Operation, and Maintenance of Panelboards Rated 600 Volts or Less* and NEMA AB 3, *Molded Case Circuit Breakers and Their Application*.

D. Comply with UL 67, *Panelboards*; UL 50, *Enclosures for Electrical Equipment*; and UL 489, *Molded Case Circuit Breakers*.

E. The manufacturer of the panelboards shall have an ISO 9001:9002-certified quality management system.

F. Furnish products suitable for operation at 7,500-ft altitude.

1.6 RECEIVING, STORING AND PROTECTING

A. Receive, inspect, handle, and store panelboards according to NECA 1, *Standard Practices for Good Workmanship in Electrical Construction (ANSI)* and NECA 407, *Recommended Practice for Installing and Maintaining Panelboards (ANSI)*.

B. Perform receipt inspection of panelboard circuit breakers in accordance with LANL P 840-1, "Procurement Quality." For each panelboard complete a LANL Form 838c, "Quality Assurance Supplement," specifically using clause QC-27 Suspect/Counterfeit Items. Examine each panelboard circuit breaker to verify that it is genuine, new, and unaltered. Report any suspect/counterfeit circuit breakers to the LANL Subcontract Technical Representative and the LANL Suspect/Counterfeit Item Coordinator (SCIC). Indicators of suspect/counterfeit molded-case circuit breakers include the following:

1. Missing date code;
2. Date code is older than two years, or style is no longer manufactured;
3. Factory seals broken or removed;
4. Mislabeled or over-labeled to change size or type;
5. Non-English text in labels;
6. Missing or suspect UL sticker; CE is not an acceptable NRTL;
7. Low quality labeling and/or misspelled words on labels;
8. Outdated manufacturer's label or logo, or refurbisher's name on label;
9. Not received in original, sealed packaging;
10. Screwdriver or wrench marks on terminals;
11. Handle modified to change ampere rating; and
12. Contradicting amperage, voltage, or interrupting ratings.

1.7 EXTRA MATERIALS

A. Furnish six spare keys of each type for panelboard cabinet locks.

B. Furnish one spray can of touch-up paint that matches panelboard finish.

1.8 SERVICE CONDITIONS

A. Provide panelboards and accessories that will perform satisfactorily in the following service conditions:

1. Elevation of 7,500 ft above sea level.

2. Maximum ambient temperature of 104 °F.

3. 24-hour average temperature not exceeding 86 °F.

a. Load current harmonic factor not exceeding 5 percent THD.

B. Conform to NEMA PB1 service conditions during and after installation of panelboards.

PART 2 PRODUCTS

2.1 PRODUCT OPTIONS AND SUBSTITUTIONS

A. Alternate products may be accepted; follow Section 01 2500, "Substitution Procedures."

2.2 PANELBOARDS

A. Furnish panelboards as indicated on the drawings and specified in this section.

B. Panelboards shall be UL67 listed and shall conform to NEMA PB1.

C. Main bus rating for the panelboards described in this section shall not exceed 1200 amperes and main circuit breaker frame size shall not exceed 800 amperes.

D. Where practical combine adjacent panelboards into integrated assemblies of 90-in.-high modular components.

E. Furnish panelboard cabinets for flush or surface mounted as indicted on the drawings.

1. Furnish NEMA Type 1 enclosures, except where the drawings or conditions of installation indicate the following enclosure requirements:

a. NEMA 3S – LLW Utility Building
b. NEMA 4X – Process Area and Wet Lab
c. NEMA 12 – Electrical Room.

2. Cabinets shall be not less than 20 in. wide.

3. Furnish galvanized steel cabinets constructed according to UL 50 requirements.

4. NEMA 1 boxes shall have removable end walls. NEMA 3, 3S, 4X and 12 boxes shall have end walls welded and sealed.

F. Furnish trim fronts that meet the strength and rigidity requirements of UL 50.

1. Each panelboard trim front shall include a door.
2. Fronts for surface-mounted panels shall be same dimensions as box.
3. Fronts for flush panels shall overlap boxes at least 1 in.
4. Fronts shall have ANSI 49 medium gray enamel electro-deposited over cleaned, phosphatized steel.
5. For NEMA 1 panelboards, furnish fronts with hinged door-in-door trim construction. The front shall contain a smaller lockable door, which when open, shall provide access to all device handles and rating labels. The hinged front, when open, shall provide access to all conductors and wiring terminals. The panelboard door shall open by a single lockable latch; the entire hinged front trim shall open by removing screws.
6. Furnish a panelboard circuit directory card in a metal frame mounted inside the panelboard door. The directory card shall include spaces for circuit numbers and sufficient spaces to allow each circuit to be described in sufficient detail to be distinguished from all others.
7. Furnish cylindrical tumbler type locks for doors. Furnish sliding vault locks with 3-point latching for enclosures more than 48 in. high. Key all lock assemblies alike. Furnish two (2) keys with each lock plus spares as required in Paragraph 1.7.

G. Panelboard phase and neutral bus shall be copper. Panelboard bus current ratings shall be determined by heat-rise tests conducted according to UL 67. Panelboards used on 480V and 480Y/277V systems shall have bus insulators and separations rated for 600V.

H. Furnish panelboard box with dimensions as required to accommodate compression lugs on cables for the panelboard mains, neutral bar, and circuit breakers rated 100 amperes and larger. Refer to Section 26 0519, "Low-Voltage Electrical Power Conductors and Cables," for compression lug requirements.

I. Furnish copper equipment ground bus that is adequate for feeder and branch circuit equipment ground conductors. Bond ground bus to cabinet.

J. Panelboards having a main circuit breaker shall be NRTL-listed for use as service entrance equipment.

K. Equip panelboards with mounting brackets, bus connections, and necessary appurtenances, for the future installation of circuit breakers in the "spaces" scheduled on the drawings.

L. Furnish panelboards having NRTL-listed short circuit current ratings not less than the available fault current indicated on the drawings. With the exception of panelboard with a current-limiting main circuit breaker, do not use "series ratings" for circuit breaker interrupting capacities. The short circuit rating for a panelboard without a current-limiting main circuit breaker shall not exceed the lowest interrupting capacity rating of any circuit breaker installed in the panelboard.

M. Furnish panelboards that have a physical means to prevent the installation of more overcurrent protection devices than the number for which it is designed.

Provide panelboards capable of accepting the number of overcurrent device shown on the drawings.

N. Furnish thermal-magnetic circuit breakers that meet the requirements of UL 489 and NEMA AB 3.

1. Furnish circuit breakers of the type, rating, and features as indicated on the drawings.
2. Furnish 600V-rated two-pole and three-pole circuit breakers for 480V or 480Y/277V systems.
3. Furnish circuit breakers with the following minimum NRTL-listed interrupting capacities:
   a. 208Y/120V and 120/240V applications – 10,000 amperes, RMS symmetrical and
   b. 480V and 480Y/277V applications – 14,000 amperes, RMS symmetrical.
4. Furnish field adjustable instantaneous trip setting for circuit breakers with frame size greater than 100 amperes.
5. Do not use tandem circuit breakers.
6. Furnish multi-pole breakers with a common trip.
7. Furnish bolt-on type circuit breakers or circuit breakers that connect to the panel bus through positive gripping connector jaws and are secured by an independent mechanical locking device.
8. Single-pole, 15 and 20 ampere circuit breakers intended to switch fluorescent lighting loads on a regular basis shall have the SWD marking.
9. Circuit breakers intended to switch high intensity discharge lighting loads on a regular basis shall have the HID marking.
10. Furnish UL Class A ground fault interrupter circuit breakers where scheduled on drawings.
11. Furnish circuit breakers with provisions for connecting the size and number of conductors indicated on the drawings. Refer to Section 26 0519, "Low-Voltage Electrical Power Conductors and Cables," for conductor connection requirements.

O. Furnish a permanently-installed handle lock-off device for each circuit breaker.

1. Furnish handle lock-off device that will accept a 1/4-in. padlock shackle.
2. Securely attach the device to the circuit breaker case; the attachment shall not depending on a friction fit or the presence of the panelboard front for the handle lock-off device to remain in place and be functional.

P. Furnish the following accessories, modifications, or special features for panelboards as indicated on the drawings.

1. Surge Protection Devices: Provide Type 1 surge protection device for each panelboard requiring surge protection as indicated on the one-line diagrams. Refer to Section 26 4300, "Surge Protection Devices."

2. Electricity Metering: Provide metering for electrical service panelboards as indicated on the drawings. Refer to Section 26 2713, "Electricity Metering."

Q. Manufacturers:

1. Eaton:

a. 480 V and 480Y/277 V: "PRL3a" and "PRL4."
b. 208Y/120 V and 120/240 V: "PRL1a" and "PRL2a."

2. Siemens:

a. 480 V and 480Y/277 V: "P2", "P3", and "P4."
b. 208Y/120 V and 120/240 V: "P1."

3. Square D:

a. 480 V and 480Y/277 V: "NF" and "I-LINE."
b. 208Y/120 V and 120/240 V: "NQ" and "I-Line."

2.3 LOAD CENTER PANELBOARDS

A. Furnish UL67 listed and labeled load center type panelboards as indicated on the drawings and specified in this section for single-phase 120/240V branch circuit loads.

B. Main bus rating for the load center type panelboards described in this paragraph shall not exceed 100 amperes. Refer to Paragraph 2.2 in this section when main bus rating exceeds 100 amperes.

C. Furnish steel load center cabinets for flush or surface mounted as indicted on the drawings.

D. Furnish NEMA Type 3R, Effluent Tank Pump House.

E. Furnish steel trim fronts that meet the strength and rigidity requirements of UL 50.

1. Fronts for surface-mounted panels shall be same dimensions as box.
2. Fronts for flush panels shall overlap boxes at least 1 in.
3. Fronts shall have medium gray enamel finish.

F. Furnish equipment ground bus that is adequate for feeder and branch circuit equipment ground conductors. Bond ground bus to cabinet.

G. Load centers identified for use as service equipment shall be NRTL-labeled for this application.

H. Furnish thermal-magnetic circuit breakers that meet the requirements of UL 489 and NEMA AB 3.

1. Furnish circuit breakers of the type, rating, and features as indicated on the drawings.

2. Furnish circuit breakers with an NRTL-listed interrupting capacity of 10,000 amperes, RMS symmetrical:

3. Furnish circuit breakers that are not less than 3/4 in. wide; do not use tandem circuit breakers.

4. Furnish 120/240V rated circuit breakers for use on 208Y/120V systems.

5. Furnish 2-pole 120/240V breakers with a common trip.

I. Furnish a permanently-installed handle lock-off device for each load center circuit breaker.

1. Furnish handle lock-off device that will accept a 1/4-in. padlock shackle.

2. Firmly attach the device to the circuit breaker case; the attachment shall not depending on a friction fit or the presence of the load center front for the handle lock-off device to remain in place and be functional.

J. Manufacturers:

1. Eaton: "BR" and "CH."
2. Siemens: "EQ" and "Ultimate."
3. Square D: "QO."

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the control system. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install panelboards where indicated on the drawings and according to manufacturer's instructions, NEMA PB 1.1, NECA 407, and the NEC (NFPA 70). Have the manufacturer's installation instructions available at the construction site.

B. Furnish supports in accordance with the requirements of Section 26 0529, "Hangers and Supports for Electrical Systems."

C. Position panelboards so the top circuit breaker handle is not more than 6 ft-7 in. above the surface of the working space in front of the panelboard.

D. Ground and bond panelboards as required in Section 26 0526, "Grounding and Bonding for Electrical Systems."

E. At flush panelboards install four 1-in. conduits to junction boxes in accessible ceiling space or space designated to be ceiling space in future. Install branch circuit conductors from panelboard spare circuit breakers to junction boxes for future extension.

F. Install an auxiliary gutter with permanently installed terminal blocks where a panel is tapped to a riser at an intermediate location.

3.3 IDENTIFICATION

A. Furnish typed circuit directories for each branch circuit panelboard. Revise directories to reflect circuiting changes required to balance phase loads.

1. Furnish one hard copy and an electronic copy of the panelboard schedule to the Facility Manager at project closeout.

2. Install a plastic-laminated copy of the circuit directory on the inner side of the panelboard door.

B. Identify panelboards and install warning signs and arc-flash warning labels as required in Section 26 0553, "Identification for Electrical Systems."

C. Mark floor in front of panelboards to show NEC (NFPA 70) required working space according to Section 26 0553.

3.4 FIELD QUALITY CONTROL

A. Clean, inspect, test, and energize panelboards in accordance with NECA 407. Exercise each circuit breaker three times to verify smooth mechanical operation.

B. Coordinate inspections and tests with those required by Section 26 0813, "Electrical Acceptance Testing."

C. After completing installation, cleaning, and testing, touch-up scratches and mars on finish to match original finish.

3.5 LOAD BALANCING

A. After Substantial Completion, but not more than two months after Final Acceptance, conduct load-balancing in accordance with NECA 407 and as follows:

1. Do measurements during period of normal working loads as advised by the User.

2. Make load-balancing circuit changes outside the normal occupancy/working schedule of the facility. Arrange with User to avoid disrupting critical services.

3. Recheck loads after circuit changes during a normal load period. Record all load readings before and after changes and submit test records.

END OF SECTION

FOR LANL USE ONLY

This project specification is based on LANL Master Specification 26 2416, Rev. 2, dated August 3, 2009.

SECTION 26 2419

MOTOR CONTROL CENTERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Motor control center (MCC) rated 600 volts and less.

1.2 RELATED SECTIONS

A. Section 01 2500, "Substitution Procedures."

B. Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

C. Section 01 7700, "Closeout Procedures."

D. Section 26 0519, "Low-Voltage Electrical Power Conductors and Cables."

E. Section 26 0526, "Grounding and Bonding for Electrical Systems."

F. Section 26 0533, "Raceways and Boxes for Electrical Systems."

G. Section 26 0553, "Identification for Electrical Systems."

H. Section 26 0813, "Electrical Acceptance Testing."

I. Section 26 2923, "Variable Frequency Motor Controllers."

1.3 ABBREVIATIONS AND ACRONYMS, DEFINITIONS, AND REFERENCES

A. Refer to Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

1.4 SUBMITTALS

A. Provide the following submittals according to the requirements of Exhibit I and Section 01 7700, "Closeout Procedures":

1. Catalog Data. Submit manufacturer's descriptive literature describing each MCC. Include data substantiating that materials comply with specified requirements including a full description of the arc-resistant design features.

2. Shop Drawings. Submit shop drawings for each MCC including dimensioned plans and elevations and component lists. Show ratings, including short time and short circuit ratings, and horizontal and vertical bus ampacities. Include front and side views of enclosure showing overall dimensions, enclosure type, enclosure finish, unit locations, and conduit entrance locations.

3. Wiring Diagrams. Submit interconnecting wiring diagrams pertinent to the class and type specified for the MCC. Submit a schematic diagram of each type of controller unit supplied.

4. Certification. Submit certification by manufacturer's field technical representative that the subcontractor has installed, adjusted, and tested each MCC according to the manufacturer's recommendations.

5. Installation Instructions. Indicate application conditions and limitations of use stipulated by Product testing agency specified in Paragraph 1.5.

Include instructions for storage, handling, protection, examination, installation, and starting of Product, including equipment anchoring requirements to meet the seismic conditions specified in Paragraph 1.8.

6. Operation and Maintenance Instructions.

   a. Submit complete operation and maintenance instructions including step-by-step inspection, and maintenance procedures.

   b. Include the manufacturer's name, equipment model number, service manual, parts list, and brief description of equipment and its basic operational features.

7. Test and Inspection Records. Submit records of inspections, tests, and adjustments performed in Paragraph 3.4.

1.5 QUALITY ASSURANCE

A. MCC shall be listed and labeled to the current edition of UL 845, *UL Standard for Safety for Motor Control Centers,* by a nationally recognized testing laboratory (NRTL) for the application, installation condition, and the environment in which installed.

B. MCC shall be manufactured in a certified ISO 9001:9002 facility.

C. Comply with the *National Electrical Code* (NEC) (NFPA 70) for components and installation.

1.6 COORDINATION

A. Coordinate the features of each motor controller with the ratings and characteristics of the supply circuit, the motor, the required control sequence, the duty cycle of the motor, drive, load, the pilot device, and control circuit affecting controller functions. Furnish controllers that are horsepower rated to suit the motor controlled.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Receive, handle, and store MCC according to NECA 402, *Standard for Installing and Maintaining Motor Control Centers* and NEMA ICS 2.3, *Instructions for Handling, Installation, Operation, and Maintenance of Motor Control Centers Rated Not More Than 600 Volts.*

B. Perform receipt inspection of MCC molded-case circuit breakers in accordance with LANL P 840-1 Procurement Quality. For each MCC complete a LANL Form 838c, "Quality Assurance Supplement," specifically using clause QC-27 Suspect/Counterfeit Items. Examine each MCC molded-case circuit breaker to verify that it is genuine, new, and unaltered. Report any suspect/counterfeit circuit breakers to the LANL Subcontract Technical Representative and the LANL Suspect/Counterfeit Item Coordinator (SCIC). Indicators of suspect/counterfeit molded-case circuit breakers include the following:

1. Missing date code;
2. Date code is older than two years, or style is no longer manufactured;
3. Factory seals broken or removed;
4. Mislabeled or over-labeled to change size or type;
5. Non-English text in labels;
6. Missing or suspect UL sticker; CE is not an acceptable NRTL;
7. Low quality labeling and/or misspelled words on labels;

8. Outdated manufacturer's label or logo, or refurbisher's name on label;
9. Not received in original, sealed packaging;
10. Screwdriver or wrench marks on terminals;
11. Handle modified to change ampere rating; and
12. Contradicting amperage, voltage, or interrupting ratings.

1.8 SERVICE CONDITIONS

A. MCC shall perform satisfactorily in the following service conditions without mechanical or electrical damage or degradation of operating characteristics:

1. Operating elevation of 7,500 ft above sea level.
2. Operating ambient temperature extremes of 32 to 104 °F.
3. 24-hour average operating ambient temperature not exceeding 86 °F.
4. Operating relative humidity: 0 to 95 percent, without condensation.

1.9 EXTRA MATERIALS

A. Furnish six spares of each size and type fuse required.

B. Furnish one spray can of touch-up paint that matches finish for each MCC.

1.10 FIELD MEASUREMENTS

A. Verify field measurements against manufacturer's shop drawings prior to fabrication.

PART 2 PRODUCTS

2.1 PRODUCT OPTIONS AND SUBSTITUTIONS

A. Alternate products may be accepted; follow Section 01 2500, "Substitution Procedures."

2.2 GENERAL

A. Furnish arc-resistant MCC as indicated on the drawings that complies with UL 845 and NEMA ICS 18, *Motor Control Centers*, and is designed to withstand the effects of an internal arcing fault and to direct the internally released energy away from employees.

B. MCC shall have wiring classification Class I, Type A as defined in NEMA ICS 2.

C. MCC shall have NEMA Type 12 industrial duty enclosure as defined in NEMA 250, *Enclosures for Electrical Equipment*, except as otherwise Indicated.

D. MCC sections and components shall have UL 508, *Industrial Control Equipment*, short-circuit current withstand or interrupting ratings equal to or greater than the available fault current, in RMS symmetrical amperes, available at the MCC line terminals.

E. Manufacturers:

1. Square D – "Model 6 Motor Control Center."
2. Allen-Bradley – "CENTERLINE 2100."
3. Eaton – "Freedom 2100 Series."

2.3 STRUCTURE

A. MCC structure shall consist of vertical sections that are bolted together to form a rigid, self-supporting, free-standing assembly and are designed to permit future additions or rearrangement of control units.

B. Design enclosure to be rodent proof with maximum 1/4-in. diameter unprotected openings.

C. Fabricate individual vertical sections from 12 gauge minimum steel continuous top and bottom frames. These steel frames shall be connected by vertical members consisting of cold-rolled steel box-sills at each corner and 12-gauge minimum vertical C-channels.

D. Each MCC shipping section shall have removable lifting angles. Mount each shipping section on steel channel sills.

E. Vertical sections shall be a nominal height of 90 in. and width of 20 in. The depth of all sections shall be 15 to 16 in. nominal.

F. Each section shall have dead-front and dead-back construction. Rear access shall not be necessary for inspection or maintenance. The structure arrangement shall be for front only mounting of units.

G. Each vertical section shall have a conduit entrance area on the top. This opening shall be covered with a bolted flat plate which may be removed and drilled. Provide the bottom of each structure with a rectangular area for termination of conduit.

H. Each vertical section shall have a top and a bottom horizontal wireway, aligned with adjacent sections, to form wireways extending the entire length of the motor control center. End vertical sections shall have cover plates which can be easily removed to allow addition of future vertical sections

I. Furnish each vertical section with a vertical wireway extending the full height of the structure and connecting to the top and bottom wireways. The vertical wireway shall have its own separate hinged door. Provide wire tie retainers in vertical wireway.

J. Doors shall be formed of 16 gauge steel or heavier, with all edges flanged 5/8 in. deep minimum. Doors shall be mounted on adjustable and removable pin type concealed hinges and so arranged that unit doors may be removed without disturbing unit doors above or below.

K. Isolate all power bussing and splice connections from the unit compartments and from the vertical and horizontal wireways.

L. Barriers in the structure and units shall prevent the contact of any energized bus or terminal by a fish tape inserted through the conduit or wireway areas.

2.4 FINISH

A. Paint enclosure and unit parts using an electro-deposition process. Interior and exterior surfaces as well as bolted joints shall have a complete finish coat on and between them. The paint process shall consist of cleaning, rinsing, phosphating, pre-paint rinses, painting, post paint rinses, a bake cure, and cool down.

B. Paint exterior surfaces with medium light gray acrylic enamel. Paint the unit interior surfaces white for greater internal visibility.

C. Furnish all unpainted parts with corrosion-resistant plating or material.

2.5 BUS BARS AND BRACING

A. Main horizontal bus shall extend the entire length of the MCC. Bus shall be fabricated from tin-plated copper with ratings as shown on the drawings.

B. The vertical bus in each section shall be tin-plated copper with a current capacity of not less than 300 amperes. The bus support system shall be high dielectric strength, low moisture absorbing, and high-impact material.

C. Bus assembly shall be braced and NRTL-listed to withstand the mechanical stress caused by fault currents of 42,000 sym. RMS amperes.

D. A continuous copper ground bus, with a minimum current rating of 300 amperes, shall be located in the bottom of the structure, with cable lugs at each end of the line-up. A copper vertical ground bus shall make contact with the plug-in units before the bus stabs engage the vertical bus.

E. Bolted connections at each bus joint shall be front accessible for servicing with a torque wrench. Indicate the location of all splices with a label located on the inside of the vertical wireway door.

2.6 ISOLATION AND INSULATION

A. Horizontal bus access covers and vertical bus covers shall isolate the energized buses to guard against the hazard of accidental contact.

B. Cutouts shall be located in the vertical isolation barriers for stab connections to the vertical bus. A shutter mechanism shall close the cutouts when a plug-in unit is removed. Provide the vertical bus with phase isolation barriers.

C. Isolate all units from one another, above and below, by unit support pans or steel barriers which remain in place when the units are withdrawn.

D. Isolate incoming line compartments from horizontal and vertical wireways by steel barriers.

E. Units shall have a side barrier to provide isolation from the vertical wireway.

2.7 UNITS

A. Furnish combination motor starter units, Size 1 through Size 5, as well as other electrical assemblies including feeder tap units through 225 amperes, with appropriately rated stab assemblies for plug-in type construction. Starter units Size 6 and larger, as well as feeder tap units above 225 amperes, shall be bolt-in construction.

B. Support and guide each plug-in unit so that unit arrangement is easily accomplished. After insertion, each plug-in unit shall be positively held in place.

C. Each plug-in unit shall have a safety grounding device that makes connection to the vertical ground bus before the power stabs engage.

D. An operator mechanism mounted on the unit shall provide the means for operating the disconnect. This operator shall extend through an opening in the unit door and shall clearly indicate whether the disconnect is "ON," "OFF," or

"TRIPPED." This indication shall function whether the compartment door is open or closed.

E. With the disconnect in the "ON" position, a mechanical interlock shall prevent opening of the unit door. This interlock shall be provided with a defeater so that authorized personnel may gain access to the compartment without interrupting service. This interlock shall also prevent unintentional closing of the disconnect when the compartment door is open, a second mechanical interlock shall prevent any possibility of removing or re-inserting the plug-in unit while the disconnect is in the "ON" position.

F. The operator mechanism design shall provide for padlocking the disconnect in the "OFF" position with up to three padlocks.

G. The operator mechanism shall be so designed as to allow easy access to the magnetic trip settings on circuit breakers and motor circuit protectors.

H. Each unit shall have a removable door mounted on removable pin type hinges which allow the door to swing open at least 110 degrees. Doors shall be removable from any location in the center without disturbing any other doors. The unit door shall be fastened to the stationary structure so that it can be closed to cover the unit space when the insert has been removed. The unit doors shall be held closed with 1/4-turn pawl type latches, designed to resist forces during fault conditions.

2.8 INCOMING MAIN AND FEEDER TAP UNITS

A. Furnish incoming main and feeder tap units as indicated on the drawings.

B. Overcurrent devices shall be 600 volt, molded case, thermal magnetic circuit breakers that conform to NEMA AB 1, *Molded Case Circuit Breakers.*

C. The UL-listed interrupting capacity of the circuit breakers shall equal or exceed the maximum available fault current at the motor control center.

D. Provide adequate space for terminating conductors using circumferential compression lugs on main lugs and on main and feeder tap circuit breaker frames larger than 100 amperes.

2.9 CIRCUIT BREAKER TYPE NON-REVERSING STARTER UNITS

A. Furnish starter units containing combination magnetic motor controllers with motor circuit protector disconnects as indicated on the drawings.

B. Motor circuit protector shall conform to UL 845 and NEMA AB 1, *Molded Case Circuit Breakers*, with an integral instantaneous magnetic trip in each pole.

1. Trip units shall be calibrated to coordinate with the actual locked-rotor current of the connected motor and the controller overload relays.

2. Furnish motor circuit protectors that are factory assembled with the controller, interlocked with unit cover or door, and arranged to disconnect the controller.

3. The short circuit rating of the motor circuit protector and starter combination shall equal or exceed the maximum available fault current at the MCC.

4. Furnish motor circuit protectors rated 600 volts when used on 480 volt systems.

C. Controllers shall be AC general purpose Class A magnetic, full-voltage, non-reversing controllers for induction motors rated in horsepower and conforming to the requirements of NEMA ICS 2, *Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts*.

1. Coil shall be of the encapsulated type, 120 volts, 60 Hz.
2. Controllers shall be the sizes and number of poles as indicated on the drawings.
3. Contacts shall be totally enclosed, double-break, silver-cadmium-oxide power contacts. Contact inspection and replacement small be possible without disturbing line or load wiring.
4. Each controller shall have not less than two sets of NEMA ICS 2 field convertible auxiliary contacts in addition to the seal-in contact.

D. Controllers for motors rated up to 100 full-load amperes shall have solid-state overload units with the following characteristics:

1. NEMA Class 10 tripping characteristics,
2. Field selectable motor full load current,
3. Ambient temperature insensitive,
4. Phase loss protection,
5. Manual reset after time delay, and
6. Integral current transformers.

E. Controllers for motors rated from 100 to 300 full-load amperes shall have solid-state overload units with the following characteristics:

1. NEMA Class 10 tripping characteristics,
2. Field selectable/adjustable overload trip current,
3. Phase unbalance and phase loss protection.
4. Manual or electric reset after time delay, and
5. Current sensing using external current transformers with 5 ampere secondary.

F. Controllers shall have heavy duty, 22- or 30-mm metal operator, oil-tight pilot devices as listed below with NEMA ICS 2, Form Z, A600-rated contacts. Mount pilot devices on a removable panel located on the starter, not on the compartment door; there shall be no conductors across the unit door hinge.

1. Selector Switches (Rotary-type):
   a. Use HAND-OFF-AUTO or ON-OFF-AUTO selector switch if controller is connected to an automatic control system.
   b. Unless indicated otherwise on the drawings, selector switch is not required if controller is not connected to an automatic control system.
2. Push Buttons:
   a. Use flush, momentary-contact START and STOP pushbuttons if controller is not connected to an automatic control system.
   b. Unless indicated otherwise on the drawings, START-STOP pushbuttons are not required if controller is connected to an automatic control system.

c. Furnish mushroom head, maintained action, turn-to-release or pull-to-release EMERGENCY STOP pushbutton as indicated on the drawings.

3. Use push-to-test LED type indicating lights as follows:

a. Red RUNNING pilot light,
b. Green STOPPED pilot light, and
c. Additional pilot lights as indicated on the drawings.

4. Push-buttons, pilot lights, and selector switches shall have legend plates.

G. Non-reversing starter units shall be prewired to the Remote I/O provided with the MCC. The Remote I/O shall be configured to allow the status and control function depicted on the Motor Control Diagrams. Each motor starter shall have the following control and status functions available via the Remote I/O.

1. Discrete output from Remote I/O for start/stop control when HOA is in AUTO.
2. Discrete input to Remote I/O for motor status.

H. Each motor overload unit shall have an externally operable manual reset operator.

I. Each motor starter unit shall have a control power transformer with 120 volt secondary and sufficient capacity to operate starter coil and all connected pilot, indicating and control devices, plus 100 percent spare capacity. Primary and secondary circuits of transformer shall be fused. Bond un-fused leg of secondary to enclosure. Use fuse blown indicating fuses mounted in fuse blocks.

J. Adhere to accepted industry standards of neatness and bending radius for wiring of controller units. Use MTW (AWM) wire for control and power wiring. Install wrap-around wire markers at both ends on all control wiring.

K. Pull-apart control terminal blocks shall be mounted on the side or near the bottom of each unit to permit clear and easy access to the terminals. Terminal blocks shall facilitate disconnection and removal of the unit without damage to wiring.

L. Controller shall have auxiliary control relay(s) as indicated in the drawings or as required by sequence of operation. Relays shall be heavy-duty general purpose type, having 115 volt 60 Hertz or 24 VDC operating coils.

M. In units serving loads greater than 100 amperes, provide adequate space for terminating load conductors using circumferential compression lugs.

2.10 REMOTE I/O MODULES

A. Motor Control Center assemblies shall be provided with a factory assembled Remote I/O modules which are configured to provide remote control and indications from the Facility Control System (by others). Remote I/O modules shall be capable of communication with the Facility Control System using Ethernet/IP protocol.

B. Provide Motor Control Centers with pre-wired distributed I/O wiring which originates at Remote I/O modules located within the MCC. Provide 24 VDC power supply with sufficient capacity to supply the I/O modules, communication card and relays. The power supply shall be installed in an MCC unit with a disconnect switch and overcurrent protection.

C. Remote I/O shall be configured to provide the control and status functions depicted on the project Motor Control Diagrams and as described herein.

D. Barriers shall be provided to separate the distributed Remote I/O wiring from power wiring.

E. The Remote I/O cabling system shall be designed to allow separation of the MCC sections into shipping splits.

2.11 VARIABLE FREQUENCY MOTOR CONTROLLERS

A. Furnish starter units containing variable frequency motor controllers as indicated on the drawings.

B. Variable frequency motor controllers shall comply with the applicable requirements of Section 26 2923, "Variable Frequency Motor Controllers."

C. Variable frequency motor controllers shall be prewired to the Remote I/O provided with the MCC. The Remote I/O shall be configured to allow the status and control function depicted on the Motor Control Diagrams. Each variable frequency motor controller has the following control and status functions available via the Remote I/O.

1. Discrete output from Remote I/O for start/stop control when HOA is in AUTO.
2. Analog output from Remote I/O for speed control.
3. Analog input to Remote I/O for speed indication and running status.

2.12 IDENTIFICATION

A. Each unit shall have an identification nameplate label, indicating either a catalog number or serial number description.

B. Each vertical section shall have a stamped metallic identification nameplate, indicating serial number, bus rating and vertical section reference numbering. The nameplate shall be externally mounted near the center of the vertical wireway door of each section.

C. Attach nameplates using sheet metal screws or approved alternate method.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine spaces and surfaces to receive MCCs for compliance with installation tolerances and other conditions affecting performance of the product. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install each MCC where indicated on the drawings in accordance with NECA 402, *Standard for Installing and Maintaining Motor Control Centers*; NEMA ICS 2.3, *Instructions for Handling, Installation, Operation, and Maintenance of Motor Control Centers Rated Not More Than 600 Volts*; and with the manufacturer's written installation instructions.

B. Provide a minimum of 1/2 in. space between the back of MCC and a wall; provide a minimum of 6-in. space for damp locations.

C. Install each MCC on a reinforced concrete housekeeping pad, minimum 5 in. thick.

D. Remove temporary lifting eyes, channels, brackets, and temporary blocking of moving parts from MCC units and components.

E. Ground and bond MCC as required in Section 26 0526, "Grounding and Bonding for Electrical Systems."

F. Install conduits as required in Section 26 0533, "Raceways and Boxes for Electrical Systems."

1. Terminate conduits in the MCC section containing the corresponding device.

2. Install plugged couplings set flush with the top of the concrete pad. After MCC is set in place, extend conduits to 1-1/4 in. above the pad and terminate with insulated grounding bushings.

G. Install conductors as required in Section 26 0519, "Low-Voltage Electrical Power Conductors and Cables."

1. Train conductors neatly in groups; bundle and secure as recommended by manufacturer to withstand fault current.

2. Use compression type lugs to connect all service, feeder, and branch circuit cables greater than 100 amperes.

3. Tighten electrical connectors and terminals, including bus bar and grounding connections, according to the manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A, *Standard for Wire Connectors and Soldering Lugs for Use with Copper Conductors* and UL 486B, *Standard for Wire Connectors for Use with Aluminum Conductors.*

H. Set overload relays in motor controllers to match installed motor characteristics.

3.3 IDENTIFICATION

A. Identify MCC and install warning signs and arc-flash warning labels as required in Section 26 0553, "Identification for Electrical Systems."

B. Provide Category I nameplate for each starter unit or overcurrent protective device. Refer to Section 26 0553.

C. At indoor locations, mark floor in front of motor control center to show NEC required working clearances according to Section 26 0553.

D. Provide neatly typed label inside each motor starter enclosure door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor, and voltage/phase rating.

E. Post one-line diagrams data and operating instructions in accordance with Section 26 0553.

3.4 FIELD QUALITY CONTROL

A. Clean, inspect, test, adjust, and energize MCCs in accordance with the manufacturer's instructions and NECA 402.

1. Inspect each MCC for physical damage, proper alignment, and proper anchorage.

2. Keep records of inspections, tests, and adjustments; submit them to the LANL STR.

B. Coordinate inspections and tests with those required by Section 26 0813, "Electrical Acceptance Testing."

C. After completing installation, cleaning, and testing, touch-up scratches and mars on finish to match original finish.

3.5 MANUFACTURER'S FIELD SERVICE:

A. Provide the services of a factory trained representative from the MCC manufacturer to inspect and certify the installation and to oversee energizing and testing.

B. Manufacturer's representative shall certify in writing that each MCC has been installed, adjusted, and tested in accordance with the manufacturer's recommendations.

C. Provide one full work day of training for up to three owner's representatives at the project site. A manufacturer's qualified representative shall conduct training session. The training program shall consist of instruction on the operation and maintenance of the MCC, starter units, and other major components.

END OF SECTION

FOR LANL USE ONLY

This project specification is based on LANL Master Specification 26 2419, Rev. 3, dated September 14, 2009.

b. Real Power (kW) –

1) Present and
2) Peak.

c. Reactive Power (kVARh) –

1) Present and
2) Peak.

d. Apparent Power (kVA) –

1) Present and
2) Peak.

G. Meter shall be capable of power demand calculations using either of the following user-selectable methods:

1. Thermal demand using a sliding window updated every 15 seconds with window length field selectable from 5 to 60 minutes in 5 minute increments.

2. Block interval with or without sub-intervals. Window length field selectable from 5 to 60 minutes in 5 minute increments. Sub-interval length field selectable from 5 to 60 minutes in 5 minute increments.

H. The meter shall maintain a user selectable combination of trend and event logging information in non-volatile memory. The information shall be available at a remote computer through a communications network. Minimum trend and logging capabilities shall be as follows:

1. One billing log;
2. One custom data log;
3. Event log date and time stamped to seconds;
4. Minimum and maximum of worst-phase date and time stamped; and
5. Alarm and maintenance logs.

I. The meter shall accept inputs from industry standard instrument transformers.

1. The meter shall allow potential connection to circuits up to 600V ac without the use of external potential transformers. External potential transformer ratios up to 500,000:120V ac shall be supported.

J. Meter shall operate with alternate current or direct current control power:

1. 115 to 415V ac, 45 to 67 Hz.
2. 125 to 250V dc

K. The meter shall be equipped with the following digital communications ports.

1. An RS-485 port that is capable of communicating over a twisted pair network using Modbus protocol.

L. Meter shall provide ANSI C12.1 KYZ output pulses that can be user-programmed for kiloWatt hours, kiloVolt Ampere Reactive hours, or kiloVolt Ampere hours. The value of a pulse shall be programmable, allowing control of the maximum pulse rate to meet the requirements of the receiving equipment.

M. Provide a separately mounted display with the following features:

1. High visibility alpha-numeric display to show metering data, minimum and maximum values, alarms, and inputs;

2. Pushbuttons to scroll through menus and select information to display; and

3. Cable connection to the meter.

N. Ethernet communications module capable of at least 10 Base T communications to TCP/IP networks using embedded HTML pages. Communications module shall have an available RS-485 port.

O. Manufacturer: Square D PM820RD Power Meter and PM8ECC Ethernet communications module. No substitution.

2.3 INSTRUMENT TRANSFORMERS

A. Provide current and potential transformers, conforming to NEMA EI 21.1 and ANSI C57.13, metering accuracy class 0.3, of suitable ratio and burden for specified metering.

B. Provide current transformers having 5 amperes secondary and a continuous current rating factor of not less than 1.33.

1. Provide three current transformers for 3-phase, 4-wire wye circuits. Select current transformer primary to match circuit overcurrent device trip rating.

2. Current transformers for low-voltage circuits (600 volt and less) shall have 10 kV BIL.

3. Provide with window opening adequate for the conductors or bus bars.

4. Manufacturer: ABB

a. Type CMF, through 1200:5 at 600 volt or less;

C. Provide potential transformers having 120V ac secondary.

1. Provide three potential transformers for 3-phase, 4-wire wye circuits. Select potential transformer primary to match system line-to-line voltage.

2. Potential transformers for low voltage circuits (600 volt and less) shall have 10 kV BIL.

3. Manufacturer: ABB

a. Type PPW for 480-volt system.

2.4 TEST SWITCHES AND PLUGS

A. Provide semi-flush mounted test switches in meter potential and current circuits to facilitate testing of the meter installation and also external connection of additional portable metering equipment.

B. Provide test switches that comply with ANSI C12.9 and automatically short circuit current transformer circuits when the switches are opened preparatory to inserting the test plug.

C. Test switch shall have potential and shorting type current poles as follows:

1. 4-Wire Wye Systems – Four potential poles and six shorting-type current poles.

D. Provide plastic cover for each test switch.

E. Provide matching test plugs designed for in-service testing.

F. Manufacturers: States "Type FMS"

1. 4-Wire Wye Systems – States FMS-10C.

2.5 POTENTIAL CIRCUIT FUSES

A. Provide UL Class CC, time-delay, 600 -volt, 3-ampere fuses to protect each potential lead to the meter:

1. Provide each fuse with a cover having a blown-fuse indicator and

2. Manufacturer – Bussman "Type FNQ-R fuses, BC Series fuse blocks, and SAMI-7I fuse covers."

2.6 WIRING AND TERMINATIONS

A. Use 12 AWG, THHN-THWN stranded copper, for current transformer secondary circuits that are less than 50 ft. Use 10 AWG, THHN-THWN stranded copper, for current transformer secondary circuits that are more than 50 ft.

B. Use 12 AWG, Type THHN-THWN, stranded copper, for potential transformer secondary circuits.

C. Use crimp-on, nylon insulated, insulation grip, brazed seam terminals for instrument wiring as follows:

1. Use ring tongue terminals for nutted studs. Manufacturer – Burndy "Type TN;"

2. Use flanged fork terminals for barrier terminal strips. Manufacturer – Burndy "YAE-Z;" and

3. Use pin terminals for DIN type terminal blocks. Manufacturer – 3M "MNG-P."

D. Use 18 AWG shielded, twisted pair, type CMP cable for RS-485 connections.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine surfaces to receive meters and associated cabinets, instrument transformers and test blocks for compliance with installation tolerances and other conditions affecting performance of the raceway system. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install metering equipment according to manufacturer's instructions. Have the manufacturer's installation instructions available at the construction site.

B. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not furnished, use those specified in UL 486A, *Standard for Wire Connectors and Soldering Lugs for Use with Copper Conductors.*

C. Identify meter, test switches, instrument transformers, and meter wiring according to Section 26 0553, "Identification for Electrical Systems."

D. Ground meter and enclosure according to manufacturer's instructions and Section 26 0526, "Grounding and Bonding for Electrical Systems."

E. Provide metering components pre-installed within the electrical service entrance equipment. Refer to Section 26 2416, "Panelboards."

1. Install potential transformers and associated potential fuses in dedicated potential transformer compartment;
2. Install current transformers on main bus in accordance with manufacturer's standard details.
3. Install meter in a dedicated metering compartment;
4. Recess-mount meter test switches in metering compartment door;
5. Locate meter display on switchgear metering compartment door approximately 60 in. above the floor; and
6. Interconnect metering components as indicated on the drawings.

F. Provide control power to meter in accordance with the manufacturer's instructions:

1. Use a dedicated, fuse-protected, 120 volt circuit or a dedicated, fuse-protected, control power transformer if potential transformers are required for the metering voltage inputs and
2. Control power may be derived from the fuse-protected metering voltage inputs when potential transformers are not required.

G. Wire current and potential leads through test switch:

1. Install fuse protection in the potential leads on the line side of the test switch and
2. Use shorting-type switches for the current transformer leads.

H. Provide Modbus protocol communications connection between the building automation system and the RS-485 port on the meter:

1. Install conduit pathway for an RS485 cable from the metering cubicle to the appropriate BAS cabinet. Coordinate with the controls Subcontractor and Automation Team.
2. Label the RS-485 cable and leave at least 6 ft of slack at both ends of the RS-485 cable for termination by the controls Subcontractor.

3.3 FIELD QUALITY CONTROL

A. Inspect accessible components for cleanliness, mechanical, and electrical integrity, and for presence of damage or deterioration before energizing.

B. LANL Utilities will inspect, test, program, and adjust the meter, meter wiring, Ethernet communication wiring, and Ethernet communications interface.

C. LANL ES-DE Process and Automation Team will inspect and test the RS-485 communication wiring and communications interface.

D. Correct deficiencies in material, wiring, or installation that may be discovered.

E. After completing installation, cleaning, and testing, touch-up scratches and mars on finish to match original finish.

END OF SECTION

FOR LANL USE ONLY

This project specification is based on LANL Master Specification 26 2713, Rev. 3, dated January 11, 2010.

SECTION 26 2726

WIRING DEVICES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Receptacles.

B. Snap Switches.

C. Wall Plates.

D. Multi-Outlet Assemblies.

E. Occupancy Sensing Lighting Controls.

1.2 RELATED SECTIONS

A. Section 01 2500, "Substitution Procedures."

B. Section 01 4000, "Quality Requirements."

C. Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

D. Section 01 8116, "Facility Environmental Requirements."

E. Section 26 0553, "Identification for Electrical Systems."

F. Section 26 5100, "Interior Lighting."

1.3 ABBREVIATIONS AND ACRONYMS, DEFINITIONS, AND REFERENCES

A. Refer to Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

1.4 LANL PERFORMED WORK

A. None.

1.5 SUBMITTALS

A. Submit the following in accordance with Exhibit I:

1. Product Data.

1.6 QUALITY ASSURANCE

A. Work Identified in this section shall be done under a Quality Assurance Program in accordance with Section 01 4000, "Quality Requirements."

B. Comply with the *National Electrical Code* (NEC) (NFPA 70).

C. Furnish products listed and labeled by a nationally recognized testing laboratory (NRTL) for the application, installation condition, and the environments in which installed.

D. Manufacturers of products addressed in this section shall maintain an ISO 9001:9002-certification (*Quality Management Systems – Requirements*).

1.7 ENVIRONMENTAL REQUIREMENTS

A. See Section 01 8116, "Facility Environmental Requirements."

1.8 RECEIVING, STORING, PROTECTING, AND HANDLING

A. Receive, store, protect, and handle products according to NECA 1, *Standard Practices for Good Workmanship in Electrical Construction*.

1.9 COORDINATION

A. Coordinate with other work, including painting, electrical boxes and wiring installations, to interface installation of wiring devices with other work.

B. Field locations of walls, partitions, doors, windows and equipment may vary from locations shown on the Drawings. Prior to locating sleeves, boxes and chases for roughing-in of conduit and equipment, coordinate with other trades to determine exact field location of the above items. Verify direction of door swings so that local switches are properly located on the strike side of the doorway.

C. Coordinate receptacle requirements for items of equipment provided to the Project under other sections of this Specification or by the Owner.

PART 2 PRODUCTS

2.1 PRODUCT OPTIONS AND SUBSTITUTIONS

A. Alternate products may be accepted; follow Section 01 2500, "Substitution Procedures."

2.2 RECEPTACLES

A. Provide back and side wired, screw pressure terminal, straight-blade and locking type, receptacles as indicated on the drawings.

1. Receptacles shall meet the performance and design requirements of Federal Specification WC596 and UL Standard 498, *Electrical Attachment Plugs and Receptacles*.

2. Receptacle configurations shall be in accordance with NEMA WD 6.

3. Catalog numbers in this article do not indicate receptacle color; see FINISHES article below.

B. For 120 volt convenience receptacles connected to general purpose 20 amperes branch circuits, provide straight-blade NEMA 5-15R, 15 amperes, 125 volts, grounding duplex receptacles. Receptacle mounting strap, ground terminal, and ground contacts shall be formed from one piece of brass alloy. Manufacturer: Hubbell "HBL5262".

C. Where indicated on the Drawings for special-purpose 120 volt duplex receptacles connected to 20 amperes branch circuits, provide straight-blade NEMA 5-20R, 20 amperes, 125 volts, grounding duplex receptacles. Receptacle mounting strap, ground terminal, and ground contacts shall be formed from one piece of brass alloy. Manufacturer: Hubbell "HBL5362".

D. For ground fault circuit interrupter (GFCI) receptacles provide straight-blade NEMA 5-15R, 15 amperes, 125 volts, grounding, "feed through" type, self-testing GFCI, weather-resistant, duplex receptacle that meet the requirements of UL Standard 943, *Ground Fault Circuit Interrupters*. Provide units that can be installed in a 2-3/4-inch deep outlet box without an adapter. Manufacturer: Hubbell "GFR5262SG."

E. Provide straight-blade and twist lock receptacles for special applications as indicated on the drawings. Receptacle types are as follows:

1. Type 1: NEMA 6-15R.
2. Type 2: NEMA L6-15R.
3. Type 3: IEC 60309, 30A, UL.
4. Type 4: NEMA L5-20.
5. Type 5: NEMA L6-15R.

2.3 RECEPTACLES, INDUSTRIAL HEAVY DUTY

A. For NRTL-listed equipment furnished with cords and attachment plugs configured to the current edition of NEMA WD 6, provide the corresponding receptacles. Provide receptacles that meet the performance and design requirements of Federal Specification W-C-596 and UL 498. For equipment not furnished with cords and attachment plugs conforming to NEMA WD 6, provide receptacles and matching plugs as specified below.

B. For 20-, 30-, 60-, and 100-ampere heavy-duty receptacle outlets located in dry, damp, or wet locations provide pin and sleeve-type receptacles that are color coded and uniquely configured to the particular circuit voltage and current rating.

C. Pin and sleeve receptacles shall be NRTL-listed to UL 1682, *Plugs, Receptacles, and Cable Connectors of the Pin and Sleeve Type* and UL-classified to IEC 60309, *Plugs, Socket Outlets, and Couplers for Industrial Purposes* (Parts 1 and 2) and Series II rated for voltages and services.

D. Provide a back box suitable for each particular receptacle device and installation location.

E. Where indicated on the drawings provide 20-, 30-, 60-, and 100-ampere pin and sleeve receptacles with safety interlocks that will prevent making or breaking the receptacle connection under load.

F. For each receptacle provide a matching plug.

G. Manufacturer: Pass & Seymour "IEC 309 Industrial Products."

2.4 CORD AND PLUG SETS

A. Provide cord and plug sets that match voltage and current ratings and number of conductors to requirements of the equipment being connected.

B. Cord shall be 600 volt insulated, stranded copper conductors, with type SO jacket and rated for 90 °C. Grounding conductor not less than that required by the NEC (NFPA 70) and shall have green insulation. Conductor ampacity shall be equipment rating plus 25 percent minimum.

C. Plug shall be male configuration with nylon or polycarbonate body and integral cable-clamping jaws. Match to cord and to receptacle type intended for connection.

2.5 SNAP SWITCHES

A. Provide single-pole, double-pole, three-way, four-way, and illuminated handle snap switches as indicated on the drawings.

B. Switches shall be rated 20-amperes, 120/277-V ac, back and side wired, screw pressure-terminal, quiet-type alternate current switch with yoke grounding screw. Switches shall meet the performance and design requirements of UL 20, General

Use Snap Switches and W-S-896, *Federal Specification – Switches, Toggle and Lock, Flush Mounted (AC).*

C. Manufacturer: Hubbell "HBL1220" series.

2.6 WALL PLATES

A. For flush-mounted interior receptacles and wall switches, provide 0.032-in.-thick (minimum), brushed 302/304 alloy, stainless-steel, smooth, wall plates that meet the requirements of W-P-455A, *Federal Specification – Plate, Wall, Electrical UL.* Manufacturer: Hubbell "S" series.

B. For surface-mounted interior receptacles and switches, furnish galvanized-steel 4-in.^{2} raised surface covers. Receptacles installed in raised covers shall be secured by more than one screw. Manufacturer: RACO "800" series.

C. For GFCI receptacles in damp locations, provide weatherproof, cast-aluminum, hinged, self-closing device covers. Manufacturer: Hubbell "WP26" or "WPFS26."

D. For GFCI receptacles in wet locations, provide cast-aluminum, hinged, self-closing device covers that are weatherproof, whether or not the attachment plug cap is inserted. Manufacturer: Hubbell "WP26M" or "WP26MH."

E. Provide single-, multi-gang-, and combination-type wall plates that mate and match with corresponding wiring devices.

F. Use metal plate-securing screws to match plate finish.

2.7 MULTI-OUTLET ASSEMBLY

A. Furnish multi-outlet assembly that meets the requirements of UL 5, *Surface Metal Electrical Raceways and Fittings* and the NEC (NFPA 70).

B. Components of assemblies shall be products of a single manufacturer designed to be used together to provide a complete matching assembly of raceways and receptacles.

C. Furnish multi-outlet assembly surface metal raceway fabricated from cold-rolled, galvanized steel and coated with standard stocked baked-enamel finish.

D. Raceway shall be of a two piece design with a metal base and a snap-on metal cover.

E. Nominal dimensions of the assembled raceway shall be 1-1/4 in. wide by 3/4 in. high.

F. Furnish fittings required for a complete installation.

G. Provide multi-outlet assembly with pre-wired, single NEMA 5-15R receptacles spaced 9 in. on center and wired alternately to two circuits with three No. 12 American wire gauge (AWG) THHN-insulated conductors and a green THHN-insulated No. 12 AWG ground wire.

H. Manufacturer: Wiremold "Plugmold 2000."

2.8 OCCUPANCY-SENSING LIGHT SWITCHES

A. For laboratory areas, provide one NRTL-listed, ceiling-mount, ultrasonic sensor per 900 ft^2 or fraction thereof. Provide power pack to derive operating voltage for sensor and to switch 20 amperes of ballast-type lighting load; power pack shall be suitable for use in air-handling plenums. Manufacturer: The Watt Stopper "WT-2205" with "BZ-U"-Series power pack.

B. For closets with less than 400 ft^2 area, provide an NRTL-listed, dual voltage (120/277 volts), passive infrared occupancy-sensing wall switch with 180 degree coverage, built-in light-level sensor, adjustable time delay, adjustable sensitivity, and a switching technology that is suitable for electronic ballast inrush currents. Device shall have dual manual buttons and dual relays for user-controlled dual-level lighting switching. Relay contacts shall be rated for at least 1200 watts ballast load at 277 volts. Manufacturer: The Watt Stopper "WI-300."

C. For lobbies, restrooms, and corridors provide an NRTL-listed, ceiling-mount ultrasonic sensor. Sensor shall have isolated relay contacts for interlocking with Heating, Ventilation, and Air Conditioning (HVAC) System controls. Provide power pack to derive operating voltage for sensor and to switch 20 amperes of ballast-type lighting load; power pack shall be suitable for use in air-handling plenums. Manufacturer: The Watt Stopper "WT-1100" with "BZ-U"-Series power pack.

PART 3 EXECUTION

3.1 PREPARATION

A. Verify outlet boxes are installed at proper locations and heights.

B. Verify wall openings are neatly cut and will be completely covered by wall plates.

C. Verify branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

D. Clean debris from outlet boxes before installing devices.

3.2 INSTALLATION

A. Install products following manufacturers' instructions. Have the manufacturers' installation instructions available at the construction site.

B. Install devices plumb, level, and secure.

C. Except as otherwise indicated on the drawings, mount devices flush, with long dimension vertical, and grounding point of receptacles on top. Group adjacent switches and receptacles under single, multi-gang wall plates.

D. Do not use the duplex/split-wire break-off tabs in receptacles as circuit conductors for connecting downstream devices.

E. Cover devices and assemblies during painting.

F. Install wall plates on switch, receptacle, and blank outlets after painting is complete.

G. Install receptacle for electric water cooler within electric water cooler cabinet as recommended by manufacturer.

H. Install galvanized-steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface-mounted outlets.

3.3 DUAL-LEVEL LIGHTING CONTROL

A. Provide dual-level lighting control in spaces 100 ft^2 and larger except for corridors; locker rooms; mechanical, electrical, and telecommunication rooms.

B. Coordinate manual controls with automatic controls so the manual control can reduce the lighting load by at least 50 percent in a reasonably uniform lighting pattern.

C. Coordinate dual-level-lighting controls with luminaire ballasts specified in Section 26 5100, "Interior Lighting."

3.4 GROUNDING

A. Connect wiring device grounding terminal to branch circuit equipment grounding conductor.

B. Connect isolated ground receptacle grounding terminal to the isolated grounding conductor.

3.5 IDENTIFICATION

A. Identify wiring devices with circuit number as required in Section 26 0553, "Identification for Electrical Systems."

3.6 FIELD QUALITY CONTROL

A. Inspect each wiring device for defects before installing.

B. Operate each operable device at least six times with circuit energized; verify proper operation.

C. Test 15- and 20-ampere receptacles for proper polarity and ground continuity using an NRTL-listed test device that impresses a momentary current of at least 15 amperes on the branch circuit conductors and equipment grounding path.

D. Test GFCI receptacle operation with both local and remote fault simulations according to manufacturer recommendations.

1. Verify that GFCI will trip at 5 ±1 mA current and
2. Verify that GFCI does not trip at less than 1.8 mA current.

E. Replace damaged or defective wiring devices.

3.7 CLEANING AND ADJUSTING

A. Clean devices and wall plates. Replace stained or improperly painted wall plates or devices.

B. Adjust devices and wall plates to be flush and level.

C. Adjust time-out controls each occupancy-sensing light switches to the following settings:

1. Open Offices, Laboratories, and Restrooms – longest time-out setting, but not more than 30 minutes.
2. Break Rooms, Storage Rooms, and Copy Machine Rooms – 5-minute time-out setting.
3. Conference Rooms – 10-minute time-out setting.
4. Corridors and Lobbies – 15-minute time-out setting.

END OF SECTION

FOR LANL USE ONLY

This project specification is based on LANL Master Specification 26 2726, Rev. 4, dated November 10, 2011.

SECTION 26 2816

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Safety switches.

B. Fuses.

C. Enclosed circuit breakers.

D. Fractional horsepower motor disconnects.

1.2 RELATED SECTIONS

A. Section 01 2500, "Substitution Procedures."

B. Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

C. Section 26 0519, "Low-Voltage Electrical Power Conductors and Cables."

D. Section 26 0526, "Grounding and Bonding for Electrical Systems."

E. Section 26 0529, "Hangers and Supports for Electrical Systems."

F. Section 26 0533, "Raceways and Boxes for Electrical Systems."

G. Section 26 0553, "Identification for Electrical Systems."

H. Section 26 0813, "Electrical Acceptance Testing."

1.3 ABBREVIATIONS AND ACRONYMS, DEFINITIONS, AND REFERENCES

A. Refer to Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

1.4 SUBMITTALS

A. Submit the following in accordance with the requirements of Exhibit I:

1. Product Data: Submit manufacturer's technical data for each type of safety switch and enclosed circuit breaker, including data proving that materials comply with specified requirements. Provide catalog sheets showing voltage and current ratings, short circuit ratings, dimensions, and enclosure details.

2. Installation Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

1.5 QUALITY ASSURANCE

A. Comply with the *National Electrical Code* (NEC) (NFPA 70) for components and installation.

B. Provide safety switches and circuit breakers that are listed and labeled by a nationally recognized testing laboratory (NRTL) for the application, installation condition, and the environment in which installed.

C. Comply with the following standards as applicable:

1. NEMA AB 3 – Molded Case Circuit Breakers and Their Application
2. NEMA FU 1 Low Voltage Cartridge Fuses
3. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum)
4. UL 50 - Enclosures for Electrical Equipment.
5. UL 489 – Molded Case Circuit Breakers, Molded Case Switches, and Circuit Breaker Enclosures

1.6 RECEIVING, STORING AND PROTECTING

A. Receive, inspect, handle, and store safety switches and enclosed circuit breakers according to the manufacturer's written instructions and NECA 1 *Standard Practices for Good Workmanship in Electrical Construction* (ANSI).

B. Perform receipt inspection of enclosed circuit breakers in accordance with LANL P 840-1 *Procurement Quality*. For each enclosed circuit breaker complete a LANL Form 838c, *Quality Assurance Supplement*, specifically using clause QC-27 Suspect/Counterfeit Items. Examine each circuit breaker to verify that it is genuine, new, and unaltered. Report any suspect/counterfeit circuit breakers to the LANL Subcontract Technical Representative and the LANL Suspect/Counterfeit Item Coordinator (SCIC). Indicators of suspect/counterfeit molded-case circuit breakers include the following:

1. Missing date code.
2. Date code is older than two years, or style is no longer manufactured.
3. Factory seals broken or removed.
4. Mislabeled or over-labeled to change size or type.
5. Non-English text in labels.
6. Missing or suspect UL sticker; CE is not an acceptable NRTL.
7. Low quality labeling and/or misspelled words on labels.
8. Outdated manufacturer's label or logo, or refurbisher's name on label.
9. Not received in original, sealed packaging.
10. Screwdriver or wrench marks on terminals.
11. Handle modified to change ampere rating.
12. Contradicting amperage, voltage, or interrupting ratings.

1.7 SERVICE CONDITIONS

A. Provide safety switches and enclosed circuit breakers that will perform satisfactorily in the following service conditions:

1. Elevation of 7500 feet above sea level.
2. Maximum ambient temperature of 104 °F.
3. 24-hour average temperature not exceeding 86 °F.
4. Maximum solar heat gain: 110 W/sq/ft.

1.8 EXTRA MATERIALS

A. Provide one spray can of touch-up paint that matches finish of switches and enclosed circuit breakers finish.

B. Provide a spare set of three fuses of each type and size installed in fused safety switches.

PART 2 PRODUCTS

2.1 PRODUCT OPTIONS AND SUBSTITUTIONS

A. Alternate products may be accepted; follow Section 01 2500, "Substitution Procedures."

2.2 SAFETY SWITCHES

A. Provide NRTL-listed, NEMA KS 1 Type HD safety switches with ratings and number of poles as indicated on the drawings or as required by the NEC (NFPA 70).

B. Safety switches used as service equipment shall be NRTL labeled for the application.

C. Enclosure type shall be in accordance with NEMA KS 1 and as required by the conditions of installation and use.

D. Fusible safety switches shall have rejection clips for NEMA FU 1, Class R fuses. Provide fuse pullers in 30, 60, and 100 ampere fusible safety switches.

E. Each safety switch shall have an equipment ground bar.

F. Furnish a neutral bar for each safety switch used on a circuit that includes a grounded "neutral" conductor.

G. Each safety switch shall have a factory-installed cover-mounted viewing window positioned over the blades to allow visual verification of ON-OFF status.

H. Provide auxiliary electrical interlock switches with safety switches as indicated on the drawings or as required by the application.

I. Each safety switch shall have provisions for padlocking in the OFF position.

J. Manufacturer: Square D "Class 3110".

2.3 FUSES

A. Provide NRTL-listed, NEMA FU 1 Class R fuses for fusible safety switches as indicated on the drawings, required by the NEC (NFPA 70), or required by the manufacturer of served equipment.

B. Size fuses in accordance with NEC (NFPA 70) requirements based upon load supplied.

C. Provide a cabinet for spare fuses.

D. Manufacturer: Bussman "LPN-RK_SP" (250 V), "LPS-RK_SP" (600 V), and "SFC-FUSE-CAB"

2.4 ENCLOSED CIRCUIT BREAKERS

A. Provide, enclosed molded-case circuit breakers with ratings as indicated on the drawings or as required by the NEC (NFPA 70).

B. Enclosed molded-case circuit breakers shall be NRTL-listed to UL 489.

C. Multi-pole circuit breakers used on 480-volt or 480Y/277-volt systems shall be 600 V rated.

D. Enclosed circuit breakers used as service equipment shall be NRTL labeled for the application.

E. Enclosure type shall be in accordance with UL-50 and as required by the conditions of installation and use.

F. Each enclosed circuit breaker shall have an equipment ground bar.

G. Furnish a neutral bar for each enclosed circuit breaker used on a circuit that includes a grounded "neutral" conductor.

H. Enclosed circuit breakers rated 100 amperes and larger shall be suitable for use with crimp-on compression lugs.

I. Provide enclosed circuit breakers with auxiliary electrical interlock switches as indicated on the drawings or as required by the application.

J. Each enclosed circuit breaker shall have a permanently-installed provision for padlocking in the OFF position.

1. Furnish handle lock-off device that will accept a 1/4-inch padlock shackle.

2. Securely attach the device to the circuit breaker case; the attachment shall not depend on a friction fit or the presence of the enclosure front for the handle lock-off device to remain in place and be functional.

K. Manufacturer: Square D "Class 610" enclosure with F, K, L, or M frame circuit breaker.

2.5 FRACTIONAL HORSEPOWER MOTOR DISCONNECTS

A. Provide general purpose, Class A, manually-operated, full voltage controllers as disconnects for AC fractional horsepower motors.

B. Conform to the requirements of NEMA ICS 2 - *Industrial Control Devices, Controllers, and Assemblies.*

C. Enclosure type shall be in accordance with UL-50 and as required by the conditions of installation and use.

D. Controller shall have a thermal overload unit, red pilot light, and toggle operator.

E. Provide handle guard with provision for padlocking in the OFF position.

F. Manufacturer: Square D "Class 2510".

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine surfaces to receive safety switches and enclosed circuit breakers for compliance with installation tolerances and other conditions affecting performance of the product. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install safety switches and enclosed circuit breakers where indicated on the drawings and according to manufacturer's instructions, NECA 1, and the NEC (NFPA 70). Have the manufacturer's installation instructions available at the construction site.

B. Install each safety switch and enclosed circuit breaker so the interlock bypass will be accessible.

C. Provide supports and seismic anchorage in accordance with the manufacturer's installation instructions and Section 26 0529, "Hangers and Supports for Electrical Systems."

D. Ground and bond safety switches and enclosed circuit breakers as required in Section 26 0526, "Grounding and Bonding for Electrical Systems."

E. Install conduits as required in Section 26 0533, "Raceways and Boxes for Electrical Systems."

F. Install conductors as required in Section 26 0519, "Low-Voltage Electrical Power Conductors and Cables."

1. Use compression type lugs to connect all service, feeder, and branch circuit cables to enclosed circuit breakers rated greater than 100 amperes.

2. Tighten electrical connectors and terminals to the manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A.

G. Install fuses in fusible safety switches as indicated on the drawings or as required to match installed motor or load characteristics. Apply adhesive tag on inside door of each fused switch indicating NEMA fuse class and size installed.

H. Install spare fuse cabinet in the main electrical room.

3.3 IDENTIFICATION

A. Identify safety switches and enclosed circuit breakers and install warning signs and arc-flash warning labels as required in Section 26 0553, "Identification for Electrical Systems."

B. Provide permanent indication of trip rating of each enclosed circuit breaker or fuses installed in each enclosed switch that will be visible without opening cover and exposing energized conductors.

C. Mark floor in front of safety switches and enclosed circuit breakers to show NEC (NFPA 70) required working space according to Section 26 0553.

3.4 FIELD QUALITY CONTROL

A. Clean interior and exterior of safety switches and enclosed circuit breakers.

B. Verify that ratings for safety switches and enclosed circuit breakers match values indicated on the drawings.

C. Verify proper torque of accessible bus connections and mechanical fasteners after installing safety switches and enclosed circuit breakers.

D. Coordinate inspections and tests with those required by Section 26 0813, "Electrical Acceptance Testing."

E. After completing installation, cleaning, and testing, touch-up scratches and mars on finish to match original finish.

END OF SECTION

FOR LANL USE ONLY

This project specification is based on LANL Master Specification 26 2816, Rev. 3, dated December 15, 2009.

SECTION 26 2913

ENCLOSED CONTROLLERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. AC motor control devices rated 600V and less that are not an integral part of equipment or motor control centers.

1. Manual motor controllers for fractional horsepower motors.
2. Magnetic motor controllers, full-voltage, non-reversing.
3. Combination magnetic motor controllers, full-voltage, non-reversing.

1.2 RELATED SECTIONS

A. Section 01 2500, "Substitution Procedures."

B. Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

C. Section 26 0526, "Grounding and Bonding for Electrical Systems."

D. Section 26 0529, "Hangers and Supports for Electrical Systems."

E. Section 26 0548, "Vibration and Seismic Controls for Electrical Systems."

F. Section 26 0553, "Identification for Electrical Systems."

G. Section 26 0813, "Electrical Acceptance Testing."

1.3 ABBREVIATIONS AND ACRONYMS, DEFINITIONS, AND REFERENCES

A. Refer to Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

1.4 SUBMITTALS

A. Submit the following in accordance with requirements of Exhibit I:

1. Catalog data: Submit manufacturer's technical data for each type of motor controller and starter, including data proving that materials comply with specified requirements. Provide catalog sheets showing voltage, controller size, ratings and size of switching and overcurrent protective devices, short circuit ratings, dimensions, and enclosure details.
2. Installation instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified in Paragraph 1.5. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.
3. Operation and maintenance instructions.
4. Test and Inspection Records: Submit records of inspections, tests, and adjustments performed in Paragraph 3.4.
5. Wiring diagrams: Submit the following diagrams for each type of enclosed controller supplied:
   a. Wiring diagram showing the relative locations of controller components and terminals.

b. Elementary diagram with components arranged in a "ladder" format to show sequence of operation of the devices.

1.5 QUALITY ASSURANCE

A. Comply with the *National Electrical Code* (NEC) (NFPA 70) for components and installation.

B. Provide enclosed controllers listed and labeled by a nationally recognized testing laboratory (NRTL) as suitable for purposes specified and shown.

C. The manufacturer of the enclosed controllers shall have an ISO 9001:9002 certified quality management system.

1.6 RECEIVING, STORING AND PROTECTING

A. Receive, store, protect, and handle products according to NECA 1 - Standard Practices for Good Workmanship in Electrical Construction and NECA 230 - Standard for Selecting, Installing, and Maintaining Electric Motors and Motor Controllers.

1.7 COORDINATION

A. Coordinate the features of each enclosed controller with the ratings and characteristics of the supply circuit, the motor, the required control sequence, the duty cycle of the load, the pilot devices, and control circuit affecting controller functions. Provide controllers that are horsepower rated to suit the motor controlled.

1.8 SERVICE CONDITIONS

A. Enclosed controllers shall perform satisfactorily in the following service conditions without mechanical or electrical damage or degradation of operating characteristics:

1. Operating elevation of 7500 feet above sea level.

1.9 EXTRA MATERIALS

A. Furnish one spare for every five installed fuses, but not less than one set of three of each kind.

PART 2 PRODUCTS

2.1 PRODUCT OPTIONS AND SUBSTITUTIONS

A. Alternate products may be accepted; follow Section 01 2500, "Substitution Procedures."

2.2 GENERAL

A. Provide enclosed controllers that are NRTL-listed to UL 508 – *Industrial Control Equipment* and have a short circuit withstand rating that exceeds the fault current available at the controller line terminals

B. Provide enclosed controllers that conform to the requirements of NEMA ICS 2 - *Industrial Control Devices, Controllers, and Assemblies*

C. Provide enclosures in accordance with ANSI/NEMA ICS 6 - *Enclosures for Industrial Controls and Systems* with Type as required to meet conditions of installation.

2.3 FRACTIONAL HORSEPOWER MANUAL MOTOR CONTROLLERS

A. Provide general purpose, Class A, manually-operated, full-voltage controllers for AC fractional horsepower motors.

B. Provide starter with thermal overload unit, red pilot light, and toggle operator.

C. Provide handle guard with provision for locking in the OFF position.

D. Manufacturers:

1. Allen-Bradley "Bulletin 600"
2. Eaton "Type MS"
3. Siemens "Class SMF"
4. Square D "Class 2510 Type F".

2.4 MAGNETIC MOTOR CONTROLLERS – NON-REVERSING:

A. Provide general purpose, Class A, magnetic, full-voltage, non-reversing controllers for alternate current induction motors rated in horsepower.

B. Coil shall be of the encapsulated type. Coil operating voltage shall be 24 volts, 60 Hz or 120VAC 60 Hz as indicated on the drawings.

C. Provide controllers of size and number of poles as indicated on the drawings.

D. Contacts shall be totally enclosed, double-break, silver-cadmium-oxide power contacts. Contact inspection and replacement shall be possible without disturbing line or load wiring.

E. Contactor shall be suitable for at least the number of operations indicated in the NEMA AC-3 utilization category load-life profile for the contactor size.

F. Wiring shall be "straight-through" with all terminals clearly marked.

G. Provide solid-state overload units with the following characteristics for motors rated less than 100 full-load amperes:

1. NEMA Class 10 tripping characteristics.
2. Field selectable motor full load current.
3. Ambient temperature insensitive.
4. Phase loss protection.
5. Manual reset after time delay.
6. Integral current transformers.

H. Provide one set of NEMA ICS 2 field convertible auxiliary contacts in addition to the seal-in contact.

I. Provide cover mounted, heavy duty, 22 mm or 30 mm, metal operator, oil tight pilot devices as listed below with NEMA ICS 2, Form Z, A600 rated contacts.

1. Selector Switches: Rotary type

a. HAND-OFF-AUTO or ON-OFF-AUTO selector switch if controller is connected to automatic control system or may be in the future.

b. ON-OFF selector switch if controller is not connected to automatic control system.

2. Push buttons:

a. Flush, momentary-contact START pushbutton.

b. Flush, momentary-contact STOP pushbutton.

c. Mushroom head, maintained action, turn-to-release or pull-to-release EMERGENCY STOP pushbutton as indicated on the drawings.

3. Push-to-test LED type indicating lights:

a. Red RUNNING pilot light.
b. Green STOPPED pilot light.
c. Additional pilot lights as indicated on the drawings.

4. Provide legend plates for pushbuttons, pilot lights and selector switches.

J. Provide externally operable manual reset operator.

K. Provide a control power transformer in each motor starter. The transformer shall have 24 volt or 120 volt secondary as indicated on the drawings and sufficient capacity to operate starter coil and all connected pilot, indicating and control devices, plus 20 percent spare capacity. Provide fused primary and secondary. Bond un-fused leg of secondary to enclosure. Provide fuses or fuse holders with blown fuse indicators.

L. Manufacturers:

1. Allen-Bradley "Bulletin 509"
2. Eaton "A200" or "Freedom Series"
3. Siemens "Class 14"
4. Square D "Class 8536 Type S".

2.5 CIRCUIT BREAKER TYPE COMBINATION MAGNETIC MOTOR CONTROLLERS - NON-REVERSING

A. Provide combination magnetic motor controllers with motor circuit protector disconnect and controller in a common enclosure.

B. Motor circuit protector shall conform to UL 485 and NEMA AB 1 - *Molded Case Circuit Breakers*, with an integral instantaneous magnetic trip in each pole.

1. Trip units shall be calibrated to coordinate with the actual locked-rotor current of the connected motor and the controller overload relays.

2. Provide motor circuit protectors that are factory assembled with the controller, interlocked with unit cover or door, and arranged to disconnect the controller.

3. Motor circuit protector shall have a color coded externally operated handle. Operating handle shall give positive visual indication of ON-OFF with red and black color coding. Include provisions for padlocking handle in the OFF position.

4. Provide motor circuit protectors rated 600 volts when used on 480 volt systems.

C. Provide general purpose, Class A, magnetic, full-voltage, non-reversing controllers for AC induction motors rated in horsepower.

D. Coil shall be of the encapsulated type. Coil operating voltage shall be 24 volts, 60 Hz or 120VAC 60 Hz as indicated on the drawings.

E. Provide controllers of size and number of poles as indicated on the drawings.

F. Contacts shall be totally enclosed, double-break, silver-cadmium-oxide power contacts. Contact inspection and replacement shall be possible without disturbing line or load wiring.

G. Contactor shall be rated for at least the number of operations indicated in the NEMA AC-3 utilization category load-life profile for the contactor size.

H. Wiring shall be "straight-through" with all terminals clearly marked.

I. Provide solid-state overload units with the following characteristics for motors rated up to 100 full-load amperes:

1. NEMA Class 10 tripping characteristics
2. Field selectable motor full load current.
3. Ambient temperature insensitive.
4. Phase loss and phase unbalance protection.
5. Manual reset after time delay.
6. Integral current transformers.

J. Provide one set of NEMA ICS 2 field convertible auxiliary contacts in addition to the seal-in contact.

K. Provide cover mounted, heavy duty, 22 mm or 30 mm, metal operator, oil tight pilot devices as listed below with NEMA ICS 2, Form Z, A600 rated contacts

1. Selector Switches: Rotary type
   a. HAND-OFF-AUTO or ON-OFF-AUTO selector switch if controller is connected to automatic control system or may be in the future.
   b. ON-OFF selector switch if controller is not connected to automatic control system.
2. Push buttons:
   a. Flush, momentary-contact START pushbutton.
   b. Flush, momentary-contact STOP pushbutton.
   c. Mushroom head, maintained action, turn-to-release or pull-to-release EMERGENCY STOP pushbutton as indicated on the drawings.
3. Push-to-test LED type indicating lights:
   a. Red RUNNING pilot light.
   b. Green STOPPED pilot light.
   c. Additional pilot lights as indicated on the drawings.
4. Provide legend plates for pushbuttons, pilot lights and selector switches.

L. Provide externally operable manual reset operator.

M. Provide a control power transformer [as scheduled on the drawings] in each motor starter. The transformer shall have 24 volt or 120 volt secondary as indicated on the drawings and sufficient capacity to operate starter coil and all connected pilot, indicating and control devices, plus 20 percent spare capacity.

Provide fused primary and secondary. Bond un-fused leg of secondary to enclosure. Provide fuses or fuse holders with blown fuse indication.

N. Manufacturer:

1. Allen-Bradley "Bulletin 513"
2. Siemens "Class 18"
3. Square D "Class 8539 Type S".

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine surfaces to receive control equipment for compliance with installation tolerances and other conditions affecting performance of the control system. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install motor control equipment where indicated on the drawings and according to NECA 230 and the manufacturer's instructions. Manufacturer's installation instructions shall be available at the construction site.

B. Mount with operating mechanism 5'-0" above floor or as indicated on the drawings.

C. Install enclosed controllers plumb. Provide supports in accordance with the requirements of the NEC (NFPA 70) and the following sections:

1. Section 26 0529, "Hangers and Supports for Electrical Systems": applies to enclosed controllers that weigh 20 lb or less and have been assigned an importance factor of 1.0.
2. Section 26 0548, "Vibration and Seismic Controls for Electrical Systems": applies to enclosed controllers that weigh more than 20 lb or have been assigned an importance factor greater than 1.0.

D. Remove temporary blocking of moving parts from controllers.

E. Ground and bond motor controllers and control devices as required in Section 25 0526, "Grounding and Bonding for Electrical Systems."

F. Tighten electrical connectors and terminals according to manufacturers' published torque values. Where manufacturer's torque values are not furnished, use those specified in UL 486E - *Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors*.

G. Set overload relays or install overload heater elements in motor controllers to match installed motor characteristics.

H. Provide neatly typed label inside each motor starter enclosure door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor, and voltage/phase rating. Place label in clear plastic holder.

3.3 IDENTIFICATION

A. Identify enclosed controllers as required in Section 26 0553, "Identification for Electrical Systems."

B. Provide Category I nameplate for each enclosed controller. Refer to Section 26 0553.

C. Install warning signs and arc-flash warning label on the enclosures of each magnetic motor controller and each combination motor controller.

D. At indoor locations, mark floor in front of each enclosed controller to show NEC (NFPA 70) required working clearances according to Section 26 0553.

E. Provide neatly typed label inside each motor starter enclosure door for each magnetic motor controller and each combination motor controller identifying the motor served, nameplate horsepower, full load amperes, code letter, service factor, and voltage/phase rating.

3.4 FIELD QUALITY CONTROL

A. Clean, inspect, test, adjust, and energize enclosed controllers in accordance with the manufacturer's instructions and NECA 230.

B. Verify that the proper overloads are installed and set for the motor nameplate full load current and duty.

C. Using a calibrated torque wrench, verify that tightness of accessible electrical connections match manufacturer's published values or those specified in UL 486E.

D. Verify proper operational response to control devices.

E. Coordinate inspections and tests with those required by Section 26 0813, "Electrical Acceptance Testing."

F. After completing installation, cleaning, and testing, touch-up scratches and mars on finish to match original finish.

END OF SECTION

FOR LANL USE ONLY

This project specification is based on LANL Master Specification 26 2913, Rev. 2, dated June 9, 2011.

SECTION 26 2923

VARIABLE FREQUENCY MOTOR CONTROLLERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Configured adjustable frequency AC controllers (AFCs) for use with NEMA B design AC squirrel-cage induction motors.

1.2 RELATED SECTIONS

A. Section 01 2500, "Substitution Procedures."

B. Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

C. Section 01 7839, "Project Record Documents."

D. Section 25 5000, "Integrated Automated Facility Controls."

E. Section 26 0526, "Grounding and Bonding for Electrical Systems."

F. Section 26 0529, "Hangers and Supports for Electrical Systems."

G. Section 26 0553, "Identification for Electrical Systems."

H. Section 26 0813, "Electrical Acceptance Testing."

1.3 ABBREVIATIONS AND ACRONYMS, DEFINITIONS, AND REFERENCES

A. Refer to Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

1.4 LANL PERFORMED WORK

A. None.

1.5 SUBMITTALS

A. Submit the following in accordance with the requirements of Exhibit I:

1. Catalog Data: Submit catalog data describing each type of AFC. Include data substantiating that materials comply with specified requirements. Provide catalog sheets showing voltage, controller size, ratings and size of switching and overcurrent protective devices, short circuit ratings, dimensions, and enclosure details.

2. Calculations:

   a. Submit calculations showing de-rating and selection of each AFC for the specified altitude, ambient temperature, and carrier frequency.

3. Certification: Submit certification by manufacturer's field technical representative that the subcontractor has installed, adjusted, and tested each AFC according to the manufacturer's recommendations.

4. Shop Drawings: Submit shop drawings for each AFC including dimensioned plans and elevations and component lists. Include front and side views of enclosure showing overall dimensions, enclosure type, enclosure finish, unit locations, and conduit entrances.

5. Installation Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, installation, and starting of Product.

6. Operation and Maintenance Instructions: Submit operation and maintenance instructions.

7. Test Reports: Submit results of required factory tests.

8. Warranty: Provide a 3-year parts warranty, on materials and workmanship, and 1-year labor warranty from the date of field certification by manufacturer's representative of satisfactory operation.

1.6 QUALITY ASSURANCE

A. Comply with the *National Electrical Code* (NEC) (NFPA 70) for components and installation.

B. Provide products that are listed and labeled by a nationally recognized testing laboratory (NRTL) for the application, installation condition, and the environment in which installed.

C. Comply with the applicable requirement of the latest NEMA ICS 3.1 – Safety Standards for Construction and Guide for Selection, Installation and Operation of Adjustable Speed Drive Systems, IEEE 519, and FCC Part 15 Subpart J.

D. The manufacturer of the AFC shall be a certified ISO 9001 facility.

E. The manufacturer's turn around period to repair or replace the AFC shall be no more than 36 hours.

F. Perform the following factory tests on each AFC:

1. Test every power converter (a component of the AFC) with an actual AC induction motor 100% loaded and temperature cycled to the full range of the AFC. Monitor the power converter for correct phase current, phase voltages, and motor speed. Verify current limit operation by simulating a motor overload.

2. Verify proper factory presets by scrolling through all parameters to ensure proper microprocessor settings. Verify proper functioning of all input and output ports.

3. Test all AFC door mounted pilot devices to verify proper function.

4. Functionally test all options including operation of a motor in the bypass mode if supplied. Verify proper setting of motor overload protection.

5. Test the AFC wiring for continuity, shorts, and unintended grounds with all enclosed devices mounted and wired.

1.7 COORDINATION

A. Coordinate the features of each AFC with the ratings and characteristics of the supply circuit, the motor, the required control sequence, the duty cycle of the motor, drive, load, the pilot device, and control circuit affecting controller functions. Furnish AFCs rated to suit the motor controlled in the specified conditions.

B. Coordinate the communications protocol with the building automation system; refer to Section 25 5000, "Integrated Automated Facility Controls."

1.8 SERVICE CONDITIONS

A. AFCs shall perform satisfactorily in the following service conditions without mechanical or electrical damage or degradation of operating characteristics:

1. Operating elevation of 7500 feet above sea level.
2. Operating ambient temperature extremes of 32 to 104 degrees F.
3. 24-hour average operating ambient temperature not exceeding 86 °F.
4. Operating relative humidity: 0 to 95 percent, without condensation.

1.9 RECEIVING, STORING AND PROTECTING

A. Receive, store, and protect, and handle products according to NECA 1—*Standard Practices for Good Workmanship in Electrical Construction*.

1.10 EXTRA MATERIALS

A. Furnish six spares of each size and type fuse required.

1.11 PROJECT RECORD DOCUMENTS

A. Submit the following in accordance with Section 01 7839, "Project Record Documents":

1. Parameter Settings: For each AFC provide a listing of all drive parameter settings that were changed from the manufacturer's default settings.
2. Test reports and certifications indicated in Paragraph 3.3.

PART 2 PRODUCTS

2.1 PRODUCT OPTIONS AND SUBSTITUTIONS

A. Alternate products may be accepted; follow Section 01 2500, "Substitution Procedures."

2.2 ADJUSTABLE FREQUENCY AC CONTROLLER

A. Provide UL508C listed and labeled configured adjustable frequency AC controller(s) (AFCs) as indicated on the drawings and specified in this section. NEMA 1 enclosed AFCs shall be UL-1995 listed for mounting in plenums and compartments handling conditioned air.

B. Each configured AFC shall be an integrated assembly with an externally operated disconnect device, transient voltage surge suppression, current-limiting fuses, line input reactor, power converter, cooling fans, operator interface, control system interface, control power transformer and a suitable enclosure.

C. Provide fusible switch type externally operable disconnect. Disconnect handle shall have provisions for locking in the OFF position with up to 3 padlocks. Mechanical interlocks shall prevent opening the enclosure door with disconnect in the ON position and shall prevent moving disconnect to the ON position with enclosure door open.

D. Provide current-limiting drive branch circuit fuses in the disconnect switch. Select fuses to protect the input rectification circuit. Use Class J fuses with interrupting rating of 200,000 AIC. The series interrupting rating of the AFC and fuses shall be a minimum of 30,000 AIC and shall be stated in the AFC Instruction Manual as required by UL

E. Provide a three phase 3% minimum impedance input line reactor in the AFC cabinet to minimize drive harmonics on the AC line and protect the drive from damaging electrical system transients. Provide additional input filtering as required to limit line current total harmonic distortion (THD) to less than 10 percent.

F. Provide power converter that is microprocessor based using insulated gate bipolar transistors and pulse width modulation (PWM) technology and is suitable for low-noise operation of adjustable torque loads such as centrifugal pumps and fans.

1. Input voltage shall be either 200-230 or 380-480 Vac as indicated on the drawings.

   a. Power converter shall be able to withstand voltage variations of -15 percent to +10 percent and imbalance of 3 percent without tripping or affecting drive performance.

   b. Power converter shall operate with input frequency of 60 Hz and shall withstand a frequency variation of +5 percent to -5 percent.

   c. Power converter displacement power factor shall be not less than 0.95 lagging under any speed or load condition.

   d. The efficiency of the power converter shall be not less than 96 percent at full speed and full load.

   e. Line notches, transients, and harmonics on incoming line shall not affect power converter performance.

   f. Power converter shall include provisions for a DC link inductor. Power converters 100 HP and above shall be supplied with DC link inductor in addition to the input line reactor.

2. Power converter output shall be capable of continuously operating the connected variable torque motor load over the complete speed range at an elevation of 7500 feet in an ambient temperature of +40 degrees C operating at the specified carrier frequency.

   a. Current rating of the power converter shall be based on a carrier frequency of 8 kHz for AFCs 1-75 HP and 4 kHz for AFCs 100-400 HP. All HP ratings shall meet or exceed Table 430.150 of the National Electric Code. Rated three-phase motor full load current, HP, maximum current and rated voltage shall appear on the power converter nameplate.

   b. Power converter output voltage shall vary with frequency to maintain a constant volts/hertz ratio up to 60 Hz output. Constant or linear voltage output shall be provided above 60 Hz.

   c. Power converter rated output voltage shall be programmable to match motor nameplate voltage.

   d. The power converter one-minute overload rating shall be not less than 120 percent of rated current, adjusted for altitude.

   e. The power converter shall be able to operate with its output disconnected for troubleshooting and startup.

   f. PWM carrier frequency shall be field adjustable with a minimum range of 2 kHz to 6 kHz to minimize the level of audible motor noise.

g. Motor acceleration and deceleration shall be programmable from one second to not less than 60 seconds.

h. For fan service, provide controller with not less than three programmable critical frequencies that can be skipped to avoid mechanical resonances.

i. Power converter shall not generate damaging voltage pulses at the motor terminals when located within 200 feet of the motor. Power converter shall comply with NEMA MG1 Section 30.40.4.2.

3. Supply the power converter with interface modules as required to provide the following control functions and external signals:

a. Automatic control using ANSI/ASHRAE Standard 135, ISO 16484-5 approved BACnet compatible network protocol over an RS-485 communications system from the building automation system. This communications port shall provide direct communication between the drive microprocessor and the building automation system. All configuration and control functions shall be accessible through this port and fault diagnostics, start/stop, speed commands, and all drive feedback variables shall be available. Discrete signals such as Bypass Run or Interlock Open shall also be mapped through the drive terminal strip to the system for unitary control. The communications port shall have the ability to be used in a "monitor only" mode where control shall be from a digital controller directly wired to the drive.

b. Six configurable digital inputs, factory pre-set for common HVAC control interface to minimize customization at start up.

c. Two isolated analog inputs with 0-20 mA, 4-20 mA or 0-4 V, 0-8 V, and 0-10 V selectable parameters. Both shall be capable of providing speed feedback for internal PI setpoint control loop. Either may be mapped to communication port for unitary control of temperature, pressure, or other analog control functions.

d. Isolated 0-10 V output signal proportional to speed or load as required to interface with control system

e. Not less than two sets of NEMA ICS 2 field-convertible auxiliary contacts to signal the following conditions:

1) Drive run.
2) Drive fault.

4. Provide the power converter with the following protective features:

a. Class 10 or 20 electronic overload circuit designed to protect AC motor operated by the AFC output from extended overload operation. No additional hardware such as motor overload relays or motor thermostats shall be required.

b. Output phase-to-phase short circuit protection.

c. Output ground fault protection.

d. High input line voltage.

e. Low input line voltage.

f. Loss of input or output phase.

g. Drive overcurrent.

h. Drive over-temperature.

i. Stall protection.

j. Transient voltage surge suppression up to 6000 volts peak per IEEE C62.41.

G. The AFC shall have the capability of riding though power dips up to 10 seconds without a controller trip depending on load and operating condition. The AFC shall automatically restart after a longer power interruption.

H. Provide the following operator interfaces mounted on the cover of:

1. Touch keypad and LCD screen that digitally indicates:

a. Frequency output
b. Voltage output
c. Current output
d. Motor RPM
e. Motor kW
f. Elapsed Time
g. Time Stamped Fault Indication
h. DC Bus Volts
i. Faults
j. PI running, PI setpoint
k. Parameter settings

2. Heavy duty, 22 mm or 30 mm, metal operator, oil tight pilot devices as listed below with NEMA ICS 2, Form Z, A600 rated contacts:

a. Push buttons: Mushroom head, maintained action, turn-to-release emergency STOP pushbutton.

b. Push-to-test LED type indicating lights:

1) White POWER ON pilot light.
2) Yellow FAULT pilot light.
3) Red RUNNING pilot light.
4) Green STOPPED pilot light.

c. Speed Control Selector Switch: Rotary type LOCAL - OFF - REMOTE.

3. Provide legend plates for pushbuttons, pilot lights, potentiometer, and selector switch.

I. Provide labeled terminal block connections for safety interlocks, fault contacts, normal operational functions such as run/stop, remote references, mode control, external emergency stop, and external emergency full-speed.

J. Provide a control power transformer in each enclosed AFC. The transformer shall have 120-volt secondary and sufficient capacity to operate all connected cooling fans, pilot, indicating and control devices, plus 100 percent spare capacity. Provide fused primary and secondary. Bond un-fused leg of secondary to enclosure. Provide fuse blown indicating fuses.

K. Provide auxiliary control relays where required to accomplish interlocks and control sequences. Relays shall be heavy-duty general-purpose type, having 115 volt 60 Hertz operating coils.

L. Provide the AFC with cooling air fan(s) and/or heat sink construction as required for maintaining the temperature of components within operating limits. Provide filtration for cooling air as required for the installation and operating environment.

M. Provide AFC enclosure in accordance with ANSI/NEMA ICS 6 - Enclosures for Industrial Controls and Systems as required to meet conditions of installation and operation.

N. AFCs shall meet the radio frequency energy emission limits of FCC Part Class A and also the IEC 61800-3 – EMC Product Standard for Power Drive Systems emission limits for Restricted Distribution and installation in the First Environment. Installation manual shall include instructions for installing the drive equipment so that it meets the specified emission limits as installed.

O. Manufacturer: Allen-Bradley "1336 Plus II", ABB "ACH 550" or "ACS 550", P11", Square D "Altivar 61".

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine surfaces to receive control equipment for compliance with installation tolerances and other conditions affecting performance of the control system. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install AFCs indicated on the drawings and according to manufacturer's instructions. Manufacturer's installation instructions shall be available at the construction site.

B. Mount with digital display panel 5'-0" above floor or as indicated on the drawings.

C. Install enclosed controllers plumb. Provide supports in accordance with the requirements of Section 26 0529, "Hangers and Supports for Electrical Systems" and the NEC (NFPA 70).

D. Ground and bond motor controllers and control devices as required in Section 26 0526, "Grounding and Bonding for Electrical Systems."

E. Identify motor controllers and install warning signs as required in Section 26 0553, "Identification for Electrical Systems."

F. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not furnished, use those specified in UL Standard 486A-486B.

G. Set overload relays or install overload heater elements in motor controllers to match installed motor characteristics.

H. Provide neatly typed label inside each motor starter enclosure door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor, and voltage/phase rating. Place label in clear plastic holder.

3.3 FIELD QUALITY CONTROL

A. Clean, inspect, test, adjust, and energize AFCs in accordance with the manufacturer's instructions.

1. Inspect each AFC for physical damage, proper alignment, and proper anchorage.

2. Configure AFC parameters to match requirements of the served system.

3. Keep records of inspections, tests, configurations, and adjustments for each AFC; submit them to the LANL STR.

B. Coordinate inspections and tests with those required by Section 26 0813, "Electrical Acceptance Testing."

C. After completing installation, cleaning, and testing, touch-up scratches and mars on finish to match original finish.

3.4 MANUFACTURER'S FIELD SERVICE

A. Provide the services of a factory trained representative from the AFC manufacturer to inspect and certify the installation and to oversee energizing and testing.

B. Manufacturer's representative shall certify in writing that each AFC has been installed, adjusted, and tested in accordance with the manufacturer's recommendations.

C. Provide one full work day of training for up to three owner's representatives at the project site. A manufacturer's qualified representative shall conduct training session. The training program shall consist of instruction on the operation and maintenance of the AFC.

END OF SECTION

FOR LANL USE ONLY

This project specification is based on LANL Master Specification 26 2923, Rev. 2 dated January 12, 2010.

SECTION 26 4100

FACILITY LIGHTNING PROTECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Furnish and install lightning protection system including the following:

1. Integral air terminal system to protect the structure.
2. Interconnecting lightning protection conductors.
3. Grounding and bonding for lightning protection.
4. Lightning protection grounding electrode system.
5. Surge arresters on all conductors entering the structure.

1.2 RELATED SECTIONS

A. Section 01 2500, "Substitution Procedures."

B. Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

C. Section 26 4300, "Surge Protection Devices."

1.3 ABBREVIATIONS AND ACRONYMS, DEFINITIONS, AND REFERENCES

A. Refer to Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

1.4 LANL PERFORMED WORK

A. LANL will inspect the lightning protection system for acceptance.

1.5 PERFORMANCE REQUIREMENTS

A. Protect the entire building including roof projections, chimneys, roof mounted equipment, associated exposed structures, electrical services, antennas, alarm services, and telecommunications services.

B. Design system based on a 150 ft lightning striking distance as defined in NFPA 780.

C. Design grounding system to achieve a ground resistance of not over 25 ohms.

1.6 SUBMITTALS

A. Submit the following in accordance with the requirements of Exhibit I:

1. Catalog data for each component of the lightning protection system, including data substantiating that material complies with specified requirements. Include data for roof adhesive when used.
2. Certifications demonstrating that firms meet qualifications specified in "Quality Assurance" Article to demonstrate capabilities and experience. Include list of completed projects with project names, addresses, names of Architects and Owners, and other information specified.
3. Materials list of lightning protection system components showing quantity and manufacturer's catalog number.

4. Shop drawings, not smaller than 1/8" = 1'-0" scale, showing the type, size, and locations of counterpoise, ground rods, down conductors, through roof/through wall assemblies, roof conductors, air terminals, and bonding connections. Include details of air terminal base and cable fastener installations.

5. Project record documents that accurately record actual locations of counterpoise, ground rods, down conductors, through roof/through wall assemblies, roof conductors, air terminals, and bonding connections.

6. Test reports for all inspection and testing required by this section.

1.7 QUALITY ASSURANCE

A. Comply with NFPA 780 Standard for the Installation of Lightning Protection Systems and UL 96A Installation Requirements for Lightning Protection Systems.

B. Engage a qualified installer to design and install the lightning protection system. Installer shall have either a current LPI Master Installer certification or current UL listing (Category OWAY) for Lightning Protection Installation. The installer shall have successfully completed not less than 5 lightning protection installations of similar scope to this project.

C. LANL will inspect the lightning protection system for acceptance in accordance with NFPA 780 and UL 96A.

D. Provide products that are NRTL listed for lightning protection use.

1.8 SEQUENCING AND SCHEDULING

A. Coordinate installation of lightning protection system with the installation of other building systems and components, including electrical wiring, supporting structures and building materials, and metal bodies requiring bonding to lightning protection systems.

B. Coordinate inspections so lightning protection conductors and bonding connections will be inspected and photographically documented before being covered with concrete or other building materials.

1.9 RECEIVING, STORING, AND PROTECTING

A. Receive, store, protect, and handle products according to NECA 1 Standard Practices for Good Workmanship in Electrical Construction.

B. Handle conductors to prevent nicking, kinking, gouging, flattening, or otherwise deforming or weakening conductor or impairing its conductivity.

PART 2 PRODUCTS

2.1 PRODUCT OPTIONS AND SUBSTITUTIONS

A. Alternate products may be accepted, follow Section 01 2500, "Substitution Procedures."

2.2 LIGHTNING PROTECTION MATERIAL

A. Provide lightning protection materials and components that conform to NFPA 780 and UL 96 Standard for Safety for Lightning Protection Components.

B. Provide lightning protection materials that are galvanically compatible with each other and with surfaces on which they are mounted or which they contact. In general use copper conductors and bronze fittings; use aluminum conductors and fittings only where required for galvanic compatibility.

1. Metals acceptable for contact with copper include copper, nickel, brass, tin, lead, stainless steel, and Monel.

2. Metals acceptable for contact with aluminum include aluminum, magnesium, zinc, galvanized steel, stainless steel, lead, and wrought iron.

3. Provide conductors with protective coatings or oversize conductors where unusual conditions exist which would cause corrosion of conductors.

C. Air terminals:

1. Copper: Provide 1/2 inch-diameter, rounded-tip, solid-copper air terminals.

2. Aluminum: Provide 5/8 inch-diameter, rounded-tip, solid aluminum air terminals.

3. Air terminal tips shall have a tip radius of curvature of from 3/16 inch to 1/2 inch.

4. Provide a cast base for each air terminal that matches the air terminal material, has a bolted pressure type cable connector, will support the terminal in a vertical position, and is suitable for the surface to which it will be attached.

D. Conductors:

1. Copper Main Conductor: Provide copper cable with minimum 17 AWG strand size and a minimum cross sectional area of 57,400 circular mils.

2. Aluminum Main Conductor: Provide aluminum cable with minimum 14 AWG strand size and a minimum cross sectional area of 98,600 circular mils.

3. Copper Bonding Conductor: Provide copper cable with minimum 17 AWG strand size and a minimum cross sectional area of 26,240 circular mils.

4. Aluminum Bonding Conductor: Provide aluminum cable with minimum 14 AWG strand size and a minimum cross sectional area of 41,100 circular mils.

E. Provide bolted pressure type connectors; finger, crimp, or pressure saddle style cable connectors are not acceptable.

F. For installations on standing seam metal roofs provide air terminal bases and cable fasteners that clamp to the standing seams and are compatible with the roofing system and the lightning protection system materials.

G. Provide cast swivel couplings as required to install air terminals vertically.

H. For installations on membrane roofing or other surfaces that must not be penetrated provide attachments for air terminal bases and cable fasteners that do not depend on adhesive alone for proper performance.

1. Provide adhesives for cable fasteners and air terminal bases that are compatible with surface or roofing material to which bases or fasteners are to be attached.

2. Provide bases and fasteners that will stay in position and prevent overturning by using gravity or mechanical attachment.

I. Manufacturers: East Coast Lightning Equipment, Harger Lightning Protection, Thompson Lightning Protection.

2.3 GROUNDING SYSTEM MATERIAL

A. Ground Rods:

1. Provide NRTL listed ground rods as shown on the Drawings.

2. Furnish ground rods that comply with ANSI C135.30 with high-strength steel core and electrolytic-grade copper outer sheath, molten welded to core, approximately 10 feet long, 3/4 inches in diameter.

3. Manufacturers: Blackburn, Thomas & Betts, Harger

B. Chemical Ground Rods:

1. Provide UL listed chemical ground rod(s) as shown on the Drawings.

2. Furnish chemical ground rods fabricated from Type K copper tubing approximately 10 feet long, 2 inches in diameter containing a hygroscopic electrolyte material. Furnish each chemical ground rod with a 24 inch long #4/0 copper pigtail, threaded removable cap, a protective cover box, and bentonite clay backfill material.

3. Manufacturers: Harger CGR Series, Lyncole Industries, Inc., LEC Inc., Superior Grounding Systems

C. Ground Cable:

1. Provide bare stranded, soft temper copper cable that conforms to ASTM B 8, Standard Specification for Concentric-Lay Stranded Copper Conductors.

2. Provide cable size as indicated on the Drawings or specified in this section, 1/0 AWG minimum.

D. Ground Electrode Backfill Material:

1. Provide a bentonite clay or equivalent commercial ground enhancement backfill material for ground rods and cable type electrodes.

2. Backfill material, when at 300% moisture content (weight of water/weight of material) x (100), shall have a resistivity of approximately 250 ohm-cm and a pH of 8 to 10.

3. Manufacturers: WYO-BEN Inc, ERICO

E. Bolted Ground Connectors:

1. Provide NRTL listed copper alloy bolted connectors with silicon bronze hardware for making cable connections to pipes, ground rods, exposed structural steel, roof deck, and wall panels.

2. Manufacturers: Blackburn, Burndy, O.Z.

F. Exothermic Weld Connections:

1. Provide molds and welding material in kit form for exothermic weld connections.

2. Match mold and weld material to material types, shapes and sizes to be joined.

3. Manufacturer: ERICO Cadweld

G. Compression Grounding Connectors:

1. Provide NRTL listed wrought copper connectors, terminals and splices for making compression grounding connections on concentric lay ground electrode cable and bonding connections to reinforcing steel.

2. Furnish connectors that have been tested successfully according to the requirements of IEEE Std. 837 - IEEE Standard for Qualifying Permanent Connections Used in Substation Grounding.

3. Provide hydraulic compression tools and dies that match the connectors.

4. Match connector and die size to material shapes and sizes to be joined.

5. Manufacturer: Blackburn, Burndy.

2.4 SURGE SUPPRESSORS

A. Provide surge suppressors for all power, control, and communications conductors entering the building.

B. Refer to Section 26 4300, "Surge Protection Devices."

2.5 LIGHTNING PROTECTION MAST

A. Provide anchored-base, galvanized steel or aluminum lightning protection mast.

1. Cap: Solid with minimum thickness of 3/16".

2. Mast: Shall serve as the down conductor and maintain a minimum wall thickness of 0.064 as allowed by NFPA 780 4.6.3.5.

3. Height: 20' from base to tip.

B. National Lightning Protection Corporation: HB20 or approved equal.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine surfaces and conditions, with Installer present, for compliance with installation tolerances and other conditions affecting performance of the lightning protection system. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION - GENERAL

A. Install lightning protection system according to NFPA 780, UL 96A, the NEC, as specified in this section, and as shown on the Drawings.

B. Install lightning protection components according to manufacturer's written instructions.

C. Install air terminals on ridges, parapets, and around the perimeter of buildings with flat roofs at spacing not to exceed 20 feet. Install supplemental air terminals as required by and NFPA 780. Permanently and rigidly attach air terminals to prevent overturning. Install swivel adapters as required to position air terminals vertically.

D. On standing seam metal roofs use attachments for air terminal bases and cable fasteners that clamp to the standing seams.

E. On membrane roofing or other surfaces that must not be penetrated, attach air terminal bases and cable fasteners using materials and methods that do not depend on adhesive alone for proper performance. Coordinate with roofing material installer.

1. Acceptable installation methods on membrane roofs include:

a. Mechanical fastening to nailer blocks that are pre-installed by the roofing sub-contractor. Coordinate locations with the roofing subcontractor.

b. Use approved top-fill ballast pans, 6-inch diameter for air terminals and 3-inch diameter for cable fasteners, which are filled with structural-density concrete then attached with adhesive to the membrane roof.

2. Use adhesives that are recommended by manufacturer of the cable fasteners and air terminal bases and are approved by manufacturer of the roofing material. Prepare roof surface and apply adhesives according to manufacturer's instructions.

F. Install roof conductors so they will be visible for inspection and testing.

G. Install down conductors at locations compatible with the building structure and architectural design with consideration given to the location of ground connections.

1. Course exposed down conductors over the extreme outer portions of the exterior of the building, such as corners.

2. Install concealed down conductors on building structural columns. Make connections from roof conductors to down conductors on parapet walls; avoid using through-roof connectors.

H. Install an accessible down conductor disconnect in each down conductor except the one nearest the building electrical service entrance; use 4-bolt tubular splice fittings.

I. Cover down conductors that are subject to physical damage or displacement with Schedule 80 PVC conduit. Cover down conductors from grade level up to 6 ft above grade. Support conduit with conduit clamps spaced not more than 36 inches apart.

3.3 LIGHTNING PROTECTION GROUNDING ELECTRODE SYSTEM

A. Counterpoise Electrode: Install a counterpoise ring around the building or structure. Use minimum 1/0 AWG ground cable located 5 ft outside the building perimeter and at least 6 ft from any electrical system or communications system grounding. Install the counterpoise at least 3 ft below grade. Encase the counterpoise in a 2 inch envelope of ground electrode backfill material slurry.

B. Other Made Electrodes: Where it is not possible to install a counterpoise ring as the lightning protection ground, or the ground must be supplemented, install one or more ground rods located 5 ft outside the building perimeter and at least 6 ft from any electrical system or communications system grounding. Install ground rods in 6 inch diameter augered holes with at least 10 ft separation between rods. Backfill hole with a slurry of ground electrode backfill material.

C. Connect the counterpoise to the main grounding electrode ground bar located near the building electrical service entrance. Interconnections to electrical power, telephone, and piping systems will be made at the main grounding electrode ground bar.

3.4 LIGHTNING PROTECTION CONNECTIONS

A. Clean contact surfaces to which lightning protection connections are to be made. Remove non-conductive coatings such as paint, enamel, and oil film.

B. Use the following connection methods:

1. Use exothermic weld connections for underground or concealed connections of dissimilar materials.
2. Use exothermic weld or compression grounding connections for underground or concealed connections of like materials. Do not use compression grounding connectors for rope lay lightning conductor connections or for lightning protection ground rod connections.
3. Use exothermic weld or bolted connections for accessible connections.
4. Use high strength silicon bronze bolts, nuts, flat washers and toothed lockwashers for making bolted connections.

C. Tighten lightning protection connectors, screws and bolts in accordance with manufacturer's published torque tightening values for connectors and bolts. Where manufacturer's torquing requirements are not indicated, tighten connections to comply with UL 486A and UL 486B. Use a calibrated torque wrench.

D. Use hydraulic compression tools to provide the correct circumferential pressure for compression connectors. Use tools and dies recommended by the manufacturer of the connectors. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed.

E. Install exothermic welds in accordance with manufacturer's instructions and recommendations. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.

F. Make connections in such a manner as to minimize possibility of galvanic action or electrolysis. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.

1. Use electroplated or hot-tin-coated materials to assure high conductivity and make contact points closer in order of galvanic series.
2. Make connections with clean bare metal at points of contact.
3. Make aluminum to steel connections with stainless steel separators and mechanical clamps.
4. Make aluminum to galvanized steel connections with tin-plated copper jumpers and mechanical clamps.
5. Coat and seal connections involving dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

G. Protect lightning protection connections to prevent them from being painted or covered with material such as fire proofing or roofing adhesive.

3.5 SURGE ARRESTER INSTALLATION

A. Refer to Section 26 4300, "Surge Protection Devices."

B. Perform arrester installation only on de-energized equipment.

C. Schedule service de-energizing with Facility Manager.

D. Arrange for the installation of new primary protectors on telecommunications circuits where suitable protectors are missing or damaged.

1. Coordinate installation with the LANL Telecommunications Group.
2. Provide suitable ground connection for the telecommunications primary protectors.

3.6 FIELD QUALITY CONTROL

A. Use test instruments that are capable of measuring within plus or minus 10 percent of the required reading and have current calibration.

B. Test the lightning protection grounding electrode system using the "fall of potential" method. Make test at least 30 days after installation of the electrode and before any connections are made to the electrode. Verify that resistance to earth reading is 25 ohms or less. Supplement grounding electrode if resistance exceeds 25 ohms. Use test instruments that are designed specifically for earth resistance testing. Provide certified test results and instrument calibration information to the LANL STR.

C. Inspect and test the lightning protection system to determine:

1. That the system complies with the current requirements of NFPA 780.
2. That all required bonds are in place and are secure.
3. That all AC power lines, communications, and data lines that enter the facility have surge suppression devices that are properly installed and functional.

D. Take corrective action to correct deficiencies. Provide certified inspection and test results and instrument specifications and calibration information to the STR.

E. An inspection of the lightning protection system will be conducted by the LANL STR prior to system acceptance.

1. Notify the LANL STR 10 working days in advance of the expected completion of the lightning protection system installation. Inspection can be scheduled in parts or by area depending on the system and construction schedule.

2. Promptly correct all deficiencies as required by the LANL STR

END OF SECTION

FOR LANL USE ONLY

This project specification is based on LANL Master Specification 26 4100, Rev. 1, dated July 23, 2008.

SECTION 26 4300

SURGE PROTECTIVE DEVICES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Type 1 surge protective devices (SPDs) for the protection of electrical power circuits not exceeding 1000 V.

B. SPDs for the protection of signal, data, antenna, and control lines.

1.2 RELATED SECTIONS

A. Section 01 2500, "Substitution Procedures."

B. Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

1.3 ABBREVIATIONS AND ACRONYMS, DEFINITIONS, AND REFERENCES

A. Refer to Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

1.4 LANL PERFORMED WORK

A. None.

1.5 SUBMITTALS

Submit the following in accordance with the requirements of Exhibit I:

A. Catalog Data: Submit catalog data describing SPDs. Include data substantiating that proposed products comply with specified requirements.

B. Certifications: For Type 1 SPDs submit UL 1449 Third Edition listing certification showing:

1. Short Circuit Current Rating (SCCR),
2. Voltage Protection Ratings (VPRs) for all modes,
3. Maximum Continuous Operating Voltage rating (MCOV),
4. Nominal discharge current rating (I_n), and
5. Type 1 Device Listing.

C. Electrical Diagrams: Submit internal wiring diagram for each Type 1 SPD illustrating all modes of protection, all field connections, and manufacturer's recommended wire and circuit breaker sizes.

D. Installation Instructions: Submit manufacturer's installation instruction manual.

E. Operation and Maintenance Data: Submit manufacturer's operation and maintenance instructions.

F. Samples: Upon request, submit an un-encapsulated but complete Type 1 SPD for visual inspection; proprietary technology included. MOV type & quantity shall reflect kA ratings on catalog data.

G. Shop Drawings: Submit drawings detailing dimensions and weight of each individual Type 1 SPD intended for mounting external to an electrical assembly.

H. Warranty: Submit a warranty, mutually executed by the SPD manufacturer and the subcontractor, agreeing to replace SPDs that fail in materials or workmanship within five years, beginning on the date of LANL acceptance. This warranty is in addition to, and not a limitation of, other rights and remedies LANL may have under the Subcontract Documents.

1.6 QUALITY ASSURANCE

A. Comply with the *National Electrical Code* (NEC) (NFPA 70) and NFPA 780, *Standard for the Installation of Lightning Protection Systems* for components and installation.

B. Provide SPDs that are listed by a nationally recognized testing laboratory (NRTL) for the application, installation condition, and the environment in which installed. Listing standard shall be the following as applicable:

1. ANSI/UL 1449, *Standard for Safety for Surge Protective Devices, 3rd Edition.*

2. UL 497B, *Standard for Safety for Protectors for Data Communications and Fire Alarm Circuits.*

C. Manufacturer shall maintain an ISO 9001 or 9002 certification.

D. Provide SPDs suitable for use at a nominal altitude of 7500 ft.

1.7 RECEIVING, STORING AND PROTECTING

A. Receive, store, protect, and handle products according to the manufacturer's instructions and NECA 1, *Standard Practices for Good Workmanship in Electrical Construction.*

PART 2 PRODUCTS

2.1 PRODUCT OPTIONS AND SUBSTITUTIONS

A. Alternate products may be accepted; see Section 01 2500, "Substitution Procedures."

2.2 TYPE 1 SPD

A. Provide Type 1 SPD that is NRTL labeled to UL 1449 3rd Edition.

B. Type 1 SPD shall have a UL 1449 3rd Edition Short Circuit Current Rating (SCCR) not less than the following:

System Voltage	Circuit Size	Minimum Short Circuit Current Rating
480Y/277	Any	200 kA
208Y/120	400 A and less	100 kA

C. SPD shall be suitable for use without external or supplemental overcurrent protection. Every suppression component of every mode shall be protected by internal overcurrent and thermal over-temperature controls. SPDs relying upon external or supplementary overcurrent protection will not be considered.

D. SPD shall have a UL 1449 3rd Edition nominal discharge current rating (I_n) of not less than 20 kA.

E. Suppression components shall be thermally-protected 32 mm or larger metal-oxide varistors (MOVs).

F. Type 1 SPD minimum surge current capability (single pulse rated) per phase shall be as indicated for the following applications:

1. Service Equipment:

System Voltage	Equipment Size	Minimum Surge Current Capability
480Y/277	Any	240 kA

2. Panelboards and MCCs that serve one or more electrical circuits that leave the structure to supply another structure and the conductors extend more than 100 feet:

System Voltage	Minimum Surge Current Capability
480Y/277	150 kA
208Y/120	100 kA

3. Panelboards and MCCs that serve one or more electrical circuits that leave the structure to supply equipment that is exposed to lightning (e.g., roof mounted HVAC equipment, parking lot lighting):

System Voltage	Minimum Surge Current Capability
480Y/277	150 kA
208Y/120	100 kA

4. Panelboards and MCCs that serve internal branch circuits that power electronic equipment (e.g., computers, adjustable frequency drives, telecommunications equipment, and laboratory equipment): 100 kA.

G. Type 1 SPD shall provide surge current paths for at least the following modes of protection:

1. L-N, L-G, and N-G for Wye-connected systems;
2. L-L, L-G in Delta-connected systems.

H. Type 1 SPD UL 1449 3rd Edition Voltage Protection Rating (VPR) shall not exceed the following:

System Voltage	L-N	L-G	L-L	N-G
480Y/277	1200V	1200V	2000V	1200V
208Y/120	700V	700V	1200V	700V

I. UL 1449 3rd Edition Maximum Continuous Operating Voltage (MCOV) rating shall be not less than the following:

System Voltage	Allowable System Voltage Fluctuation (%)	Maximum Continuous Operating Voltage
480Y/277	15	320V
208Y/120	25	150V

J. Type 1 SPD shall include not less than the following monitoring and diagnostic features that report the protection status of the SPD:

1. One green LED indicator per phase and one red service LED.
2. For Type 1 SPD with a surge current capacity greater than 100 kA provide an audible alarm with on/off silence function, and one set of NO/NC dry contacts that change state under any fault condition.

K. Where indicated on the drawings or specified in other sections, provide Type 1 SPDs that are factory installed and integrated within the protected electrical switchboards, panelboards, and motor control centers.

L. Provide Type 1 SPD with an integral disconnect switch when a 3-pole circuit breaker is not available for connecting the SPD to the protected bus.

M. Each Type 1 SPD shall pass the manufacturing and production line tests required in UL 1449 3rd Edition.

N. Manufacturers:

1. Advanced Protection Technologies:
   a. Surge Current Capability over 100 KA: "XAS" series,
   b. Surge Current Capability 100 KA or less: "XDS" series.
2. Eaton:
   a. Surge Current Capability over 100 KA: "SPD" series,
   b. Surge Current Capability 100 KA or less: "CVX100" series.
3. Siemens:
   a. Surge Current Capability over 100 KA: "TPS3 01," TPS3 05", "TPS3 06," "TPS3 12."
   b. Surge Current Capability 100 KA or less: "TPS3 11."
4. Square D:
   a. Surge Current Capability over 100 KA: "IMA" and "EMA" series.
   b. Surge Current Capability 100 KA or less: "IMA" and "EMA" series.

2.3 SPD FOR SIGNAL, DATA, ANTENNA, AND CONTROL LINES

A. Provide SPDs suitable for the protection of signal, data, antenna, and control lines.

1. Select SPDs with consideration for aspects such as the frequency, bandwidth, voltage, and current of the signal, data, antenna, or other communications lines and to ensure that insertion losses introduced by the surge protective devices are within acceptable operational limits.
2. Coordinate selection of SPDs for signal, data, antenna, and control lines with owner of equipment that is served by the lines.

B. Provide SPDs for of signal, data, and control lines that provide both common mode and differential mode protection.

C. Provide SPDs for signal, data, control, and alarm lines.

1. Devices shall be listed in accordance with UL 497B.
2. Provide devices with ratings and connectors as required by the application.
3. Manufacturer: Phoenix Contact, EDCO, MCG Electronics.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify mounting area is ready for SPDs.

B. Verify that circuit rough-in is at correct location.

3.2 INSTALLATION

A. Install SPDs where indicated on the drawings or specified below and according to the manufacturer's instructions, NFPA 780, and the NEC (NFPA 70). Have the manufacturer's installation instructions available at the construction site.

B. Service Entrance Equipment:

1. Install a Type 1 SPD that is factory installed and integrated into each low-voltage service equipment.

2. Connect SPD on the load side of the service entrance disconnecting means.

3. Provide a dedicated 3-pole 60 A circuit breaker in the service equipment as the SPD interface device. Locate the circuit breaker in the immediate proximity of the SPD.

C. Power Panelboard or Motor Control Center:

1. Install a Type 1 SPD that is factory installed and integrated into each power panelboard or motor control center that serves electronic equipment (e.g., computers, adjustable frequency drives, and laboratory equipment).

2. Install a Type 1 SPD that is factory installed and integrated into each power panelboard or motor control center that serves one or more electrical circuits that leaves the structure to supply another structure and the conductors extend more than 100 feet.

3. Install a Type 1 SPD that is factory installed and integrated into each power panelboard or motor control center that serves one or more electrical circuits that leaves the structure to supply equipment that is exposed to lightning (e.g., roof mounted HVAC equipment, parking lot lighting).

4. Provide a dedicated 3-pole 30 A circuit breaker in the panelboard or MCC as the SPD interface device. Locate the circuit breaker in the immediate proximity of the SPD

D. Connect Type 1 SPDs to protect each ungrounded (phase) and grounded (neutral) conductor.

E. Install UL 497B listed SPD for each for signal, data, control, and alarm line that enters the structure or exits the structure to serve external detached equipment or other detached structures. Where such signal, data, control, and alarm circuits are longer than 100 ft install UL 497B listed SPD at both ends of the circuit.

F. Install each SPD so it will be accessible for inspection and maintenance and so the condition monitoring indicator will be visible without requiring the removal of cover plates.

G. Install SPDs in a manner that will not limit the use of through-feed lugs, sub-feed lugs, or sub-feeder circuit breakers in panelboards.

H. Install each SPD with minimum possible conductor length and a maximum conductor length of 18 inches.

1. Twist conductors tightly together and keep runs as straight as possible with no sharp bends or kinks.

2. Rearrange circuit breakers in the protected equipment as required to minimize conductor length to the SPD.

I. Provide low-impedance grounding for SPDs.

1. Use approved means to make connections from the SPD to the point where the electrical power system grounded conductor is bonded to the grounding electrode conductor.

2. If the SPD is more than 20 ft away from the electrical system bonding point, make one or more supplementary grounding electrode connections at the surge protective device location. Use the building "main grounding electrode ground bar", "main grounding electrode ground bar extensions", effectively grounded building structural steel, and grounded water pipes as supplementary grounding electrodes.

3. Do not use a lightning protection system down conductor to ground an SPD.

3.3 FIELD QUALITY CONTROL

A. Provide final protection and maintain conditions to ensure that coatings and finishes are without damage or deterioration at final inspection.

B. Repair damage to paint finishes with matching touch-up coating recommended by the manufacturer.

C. Verify that each SPD is correctly connected and that all condition monitoring indicators operate properly.

D. Verify mechanical integrity of each conductor connection.

E. Verify correct grounding of each SPD.

END OF SECTION

FOR LANL USE ONLY

This project specification is based on LANL Master Specification Section 26 4300, Rev. 0, dated June 6, 2011.

SECTION 26 5100

INTERIOR LIGHTING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Interior luminaires and accessories.

B. Lamps.

C. Ballasts.

D. Lighting control equipment.

1.2 RELATED SECTIONS

A. Section 01 2500, "Substitution Procedures."

B. Section 01 4000, "Quality Requirements."

C. Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

D. Section 26 0533, "Raceways and Boxes for Electrical Systems."

E. Section 26 2726, "Wiring Devices."

F. Section 26 5200, "Emergency Lighting."

1.3 ABBREVIATIONS AND ACRONYMS, DEFINITIONS, AND REFERENCES

A. Refer to Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

1.4 LANL PERFORMED WORK

A. None.

1.5 SUBMITTALS

A. Submit the following in accordance with the requirements of Exhibit I:

1. Catalog Data: Submit catalog data describing luminaires, lamps, and ballasts. Include data substantiating that materials comply with specified requirements. Arrange data for luminaires in the order of fixture designation.

2. Performance Curves/Data:

a. Submit certified photometric data for each type of luminaire.

3. Drawings: Submit shop drawings for non-standard luminaires.

4. Warranty: Submit warranties for luminaires and for electronic ballasts.

5. Maintenance Data: Submit maintenance instructions for inclusion in the operations and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Work Identified in this section shall be done under a Quality Assurance Program in accordance with Section 01 4000, "Quality Requirements."

B. Comply with the *National Electrical Code* (NEC) (NFPA 70) and the *2009 International Building Code* (IBC) for components and installation.

C. Provide luminaires listed and labeled by a nationally recognized testing laboratory (NRTL) for the application, installation condition, and the environments in which installed.

D. Use manufacturers that are experienced in manufacturing luminaires, lamps and ballasts similar to those indicated for this Project and have a record of successful in-service performance.

E. Coordinate luminaires, mounting hardware and trim with the ceiling system.

1.7 SERVICE CONDITIONS

A. Luminaires, lamps and ballasts shall perform satisfactorily in the following service conditions:

1. Elevation: 7,500 ft above sea level.

2. Ambient temperature limits: 32 to 104 °F unless indicated otherwise for specific products in PART 2.

1.8 EXTRA MATERIALS

A. Furnish the following extra materials matching products installed. Package with protective covering for storage and identify with labels describing contents.

1. Five (5) percent of quantity of fluorescent lamps of each type, but no fewer than two lamps of each type.

2. One (1) percent of quantity of louvers and lenses of each type, but not less than one of each type.

3. One (1) percent of quantity of ballasts of each type, but not less than one of each type.

1.9 WARRANTY

A. Electronic Ballasts: Submit a warranty, mutually executed by the ballast manufacturer and the installer, agreeing to replace electronic ballasts that fail in materials or workmanship within five years, beginning on the date of Los Alamos National Laboratory (LANL) acceptance. This warranty is in addition to, and not a limitation of, other rights and remedies LANL may have under the Subcontract documents.

1.10 RECEIVING, STORING AND PROTECTING

A. Receive, store, and protect, and handle products according to the following National Electrical Contractors Association (NECA) Installation Standards:

1. NECA/IESNA 500, *Recommended Practice for Installing Indoor Commercial Lighting Systems (ANSI).*

2. NECA/IESNA 502, *Recommended Practice for Installing Industrial Lighting Systems (ANSI).*

PART 2 PRODUCTS

2.1 PRODUCT OPTIONS AND SUBSTITUTIONS

A. Refer to Section 01 2500, "Substitution Procedures."

2.2 INTERIOR LUMINAIRES

A. Furnish interior luminaires that comply with requirements specified below, indicated on the drawings, and as required to meet conditions of installation.

B. Metal parts shall be free from burrs and sharp corners and edges.

C. Metal components shall be formed and supported to prevent sagging and warping.

D. Steel parts shall be finished with manufacturer's standard finish applied over a corrosion-resistant primer. Finish shall be free from runs, streaks, stains, holidays or defects.

E. Doors and frames shall be smooth operating and free from light leakage under operating conditions. Relamping shall be possible without the use of tools. Doors, frames, lenses and diffusers shall be designed to prevent accidental falling during relamping and when secured in the operating position.

F. Luminaires shall have minimum reflecting surface reflectance as follows unless specified otherwise on the drawings:

1. White Surfaces – 85 percent;
2. Specular Surfaces – 83 percent; and
3. Diffusing Specular Surfaces – 75 percent.

G. Lenses, diffusers, covers and globes shall be 100 percent virgin acrylic unless specified otherwise on the drawings. Lenses shall have 0.125 in, minimum thickness. Lenses for fluorescent troffers shall be injection molded.

H. Luminaires shall conform to UL 1598, *Luminaires*. Provide product with damp location listing or wet location listing as required by installation location.

2.3 LAMPS

A. Furnish lamps that comply with requirements specified below and the luminaire schedule on the drawings.

B. Conform to the NEMA C78 standard applicable to each type of lamp.

C. For fluorescent general lighting in interior spaces use T8, T5, or T5HO lamps as indicated on the drawings with the following characteristics:

Characteristic	T8 Lamps	T5 Lamps	T5HO Lamps
Nominal length	48 in.	46 in.	46 in.
Actual length (base face to base face)	47.2 in.	45.2 in.	45.2 in.
Base type	Medium bi-pin	Miniature bi-pin	Miniature bi-pin
Initial Light Output (after 100 hours of operation)	2700 to 2850 lumens	2900 to 3050 lumens	5000 lumens

Characteristic	T8 Lamps	T5 Lamps	T5HO Lamps
Mean Light Output (at 40 percent of rated life)	2440 to 2710 lumens	2660 to 2900 lumens	4600 to 4740 lumens
Nominal Lamp Efficacy	87 lumens per watt at 77 °F	103 lumens per watt at 95 °F	93 lumens per watt at 95 °F
Color temperature:	3500 °K	3500 °K	4100 °K
Minimum Average Life (based on 3-hour switching cycle):	20,000 hours	20,000 hours	30,000 hours
Color rendering index (CRI)	75	85	85
Minimum Starting Temperature:	50 °F	-4 °F	-4 °F
EPA TCLP Compliant:	Yes	Yes	Yes
Ballast Type:	Electronic programmed start	Electronic programmed start with end-of-life shutdown.	Electronic programmed start with end-of-life shutdown.

D. All linear fluorescent lamps shall pass the EPA Toxic Characteristic Leachate Procedure (TCLP) test for mercury by using the lamp sample preparation procedure described in NEMA LL 1, *Procedure for Linear Fluorescent LAML Sample Preparation and TCLP Extraction.*

E. Manufacturers: GE Lighting, North American Phillips, Sylvania.

2.4 FLUORESCENT LAMP BALLASTS

A. For fluorescent luminaires provide NRTL-listed electronic fluorescent ballasts that have the following characteristics:

1. Conform to UL 935, *Fluorescent – Lamp Ballasts* and ANSI/NEMA C82.11, *High-Frequency Electronic Lamp Ballasts (ANSI).*
2. Ballast Protection – Class P.
3. Starting Method – Programmed rapid-start.
4. Power Factor – at least 95 percent.
5. Ballast Factor – at least 0.87.
6. Crest Factor – 1.7 or less.
7. Line Current Total Harmonic Distortion (THD) – less than 15 percent.
8. Minimum Operating Frequency – 40 kHz.
9. Sound Rating – Class A.
10. Minimum Starting Temperature – 0 °F with T5 and T8 lamps.

11. Transient Voltage Protection – ANSI/IEEE C62.41, *IEEE Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits*, location A2.

12. Electro-Magnetic Interference (EMI)/Radio Frequency Interface (RFI)-compliance – Federal Communications Commission (FCC) 47 CFR 18, "Industrial, Scientific, and Medical Equipment," nonconsumer.

13. Ballasts for T5 and T5HO lamps shall have circuitry to shut down the system when lamps reach end-of-life.

B. For dimmer controlled linear and compact fluorescent luminaires in heated interior spaces (maintained above 60 ºF) provide NRTL-listed controllable electronic fluorescent ballasts that have the following characteristics:

1. Conform to UL 935.

2. Ballast Protection – Class P.

3. Dimming Capability Range – 100 to 5 percent of light output, flicker-free.

4. Starting Method – programmed rapid-start at any preset without first having to go to full output.

5. Power Factor – at least 0.95 at full light output and at least 0.90 over the entire dimming range.

6. Ballast Factor – at least 0.87 at full output, less than 10 percent at full dim.

7. Crest Factor – 1.7 or less.

8. Line current THD – less than 20 percent over the entire dimming range.

9. Minimum Operating Frequency – not less than 40 kHz.

10. Sound Rating – Class A.

11. Minimum Starting Temperature – 60 °F.

12. Control Voltage – 0 – 10V dc.

13. Transient Voltage Protection – ANSI/IEEE C62.41, location A2.

14. EMI/RFI-compliance – FCC 47 CFR 18, nonconsumer.

15. Ballasts for T5 and T5HO lamps shall have circuitry to shut down the system when lamps reach end-of-life.

C. Manufacturers: Advance, GE Lighting, Universal, Sylvania.

D. Three and four lamp luminaires shall have two ballasts per luminaire for multilevel switching.

E. For emergency ballasts refer to Section 26 5200, "Emergency Lighting."

F. Provide NRTL-listed luminaire disconnect assembly for each ballast. Manufacturer: IDEAL "PowerPlug", Thomas & Betts "Sta-Con."

2.5 LUMINAIRE ACCESSORIES

A. Provide stud supports, mounting brackets, frames, plaster rings and other accessories required for luminaire installation.

B. Furnish hangers as specified below and as required by conditions of installation:

1. Stem hangers shall be made of 1/2-in. steel tubing with 45 degrees swivel ball hanger fitting and ceiling canopy. Finish the same as the luminaire.

2. Rod hangers shall be made of 1/4 in. threaded zinc-plated steel rod.

3. For high-intensity discharge (HID) luminaires provide hook hangers that are integrated assemblies matched to the luminaire and line voltage; equip with threaded attachment, power cord and locking type plug. Provide a safety chain or cable for each luminaire that will attach to the building structure, the ballast housing, and to the reflector/diffuser assembly.

C. Use NRTL-listed T-bar safety clips for lay-in fluorescent luminaires.

D. Where indicated on the drawings or where lamp breakage is detrimental, such as above food counters, provide open fluorescent luminaires with:

1. Self-locking sockets or lamp retainers (two per lamp).

2. Clear polycarbonate protective lamp sleeves with end caps over each lamp. Sleeve shall have a light transmission of 95 percent and shall be rated for the thermal profile of the lamp and ballast.

2.6 LIGHTING CONTROL EQUIPMENT

A. Provide interior and exterior lighting control as shown on the drawings. Provide the following control devices as indicated on the drawings and Section 26 2726, "Wiring Devices":

1. Occupancy sensors.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install interior lighting system in accordance with the NEC (NFPA 70), manufacturer's installation instructions, approved shop drawings, and the following NECA Installation Standards:

1. NECA/IESNA 500.
2. NECA/IESNA 502.

B. Have the manufacturer's installation instructions available at the Project site.

C. Mounting heights specified or indicated on the drawings are to the bottom of the luminaire for ceiling-mounted fixtures and to the center of the luminaire for wall-mounted fixtures.

D. Where the ceiling forms the protective membrane of a fire resistive assembly, install protective coverings over luminaires in accordance with NRTL requirements.

E. Install slack safety wires as described below for luminaires in or on suspended ceilings.

1. Wire shall be minimum 12-gauge galvanized soft annealed steel wire conforming to ASTM A 641/A 641M, *Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire*.

2. Attach wire to the building structure directly above the attachment point on the box or luminaire; make trapezes of framing channel material as required to span obstacles

3. Secure wire(s) at each end with not less than three tight turns in 1-1/2 in.

F. Install fluorescent emergency luminaires in suspended ceilings as follows:

1. Fasten the four corners of each luminaire to the suspended ceiling main channels or framing members.

a. Use sheet metal screws or bolts to fasten luminaires above exit pathways.

b. Use NRTL-listed clips, sheet metal screws, or bolts or to fasten luminaires that are not above exit pathways.

2. Install two independent slack safety wires per luminaire with dimensions not exceeding 2 ft by 4 ft. Install four independent slack safety wires per luminaire with dimensions exceeding 2 ft by 4 ft. Attach wires to the luminaire not more than 6 inches from the luminaire corners.

3. Where the ceiling forms the protective membrane of a fire resistive assembly, install protective coverings over luminaires in accordance with NRTL requirements.

G. Support pendant-mounted or cable-supported luminaires directly from the structure above using a 9 gauge wire or an approved alternate support without using the ceiling suspension system for direct support.

1. Install seismic restraints for pendant-mounted and cable-supported luminaires.

2. Pendants, rods, cables, or chains 4 ft or longer shall be braced to prevent swaying using three cables at 120 degrees separation.

H. Connect luminaires in suspended ceilings using 6 ft lengths of flexible wiring method arranged accommodate not less than 4 in. of differential seismic movement in any direction. Refer to Section 26 0533, "Raceways and Boxes for Electrical Systems."

3.2 DUAL-LEVEL LIGHTING CONTROL

A. As indicated on the drawings, connect luminaires to provide dual-level control.

B. Coordinate circuiting of luminaires having manual control and automatic control so the manual control can reduce the lighting load by at least 50 percent in a reasonably uniform lighting pattern.

C. Coordinate placement and circuiting of luminaires with daylighting apertures, such as windows.

3.3 LUMINAIRE MAINTENANCE MARKING

A. Each luminaire shall be clearly and permanently marked with a field-applied pressure-sensitive label indicating specific replacement lamps and ballasts. The following information shall be noted in the format "Use Only _____":

1. Lamp diameter code (T5, T5HO, T8, T12), tube configuration (twin tube, quad, triple), base type, and nominal wattage for fluorescent and compact fluorescent luminaires.

2. Start type (preheat, rapid start, programmed start) for fluorescent and compact fluorescent luminaires.

3. Correlated color temperature (CCT) and color rendering index (CRI) for all lamps.

B. Markings shall be located to be readily visible to service personnel, but unseen from normal viewing angles when lamps are in place.

C. Pressure-sensitive labels shall be in accordance with UL 969, *Marking and Labeling Systems.*

3.4 FIELD QUALITY CONTROL

A. Make electrical connections, clean interiors and exteriors of luminaires, install lamps, energize and test luminaires, inspect interior lighting system, and deliver spare parts in accordance with manufacturer's instructions and the following NECA Installation Standards:

1. NECA/IESNA 500.
2. NECA/IESNA 502.

B. Test electronic dimming ballasts for full range dimming capability.

1. Burn-in dimmer controlled fluorescent lamps at full output for not less than 100 hours before dimming.

2. Check for visually detectable flicker over the full dimming range.

C. Prior to turnover to LANL, replace lamps that were installed and used during construction if more than 15 percent of their rated lamp life has been used.

END OF SECTION

FOR LANL USE ONLY

This project specification is based on LANL Specification Section 26 5100, Rev. 3, dated February 10, 2010.

SECTION 26 5200

EMERGENCY LIGHTING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Unit emergency lights.

B. Fluorescent emergency ballasts.

C. Light emitting diode (LED) emergency exit signs.

D. LED exit signs.

1.2 RELATED SECTIONS

A. Section 01 2500, "Substitution Procedures."

B. Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

C. Section 26 0533, "Raceways and Boxes for Electrical Systems."

D. Section 26 0553, "Identification for Electrical Systems."

E. Section 26 2726, "Wiring Devices."

1.3 ABBREVIATIONS AND ACRONYMS, DEFINITIONS, AND REFERENCES

A. Refer to Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

1.4 SUBMITTALS

A. Submit the following in accordance with the requirements of Exhibit I:

1. Catalog Data: Submit catalog data describing emergency lighting. Include data substantiating that materials comply with specified requirements. Arrange data for luminaires in the order of fixture designation.

2. Performance Curves/Data: Submit certified photometric data for emergency lighting units.

3. Warranty: Submit warranties for emergency lighting units and exit signs.

4. Maintenance Instructions: Submit maintenance instructions for inclusion in the operating and maintenance manuals.

1.5 SPARE MATERIALS

A. Furnish the following extra materials matching products installed. Package the extra materials with protective covering for storage and identify with labels describing contents.

B. Lamps: Provide 10 percent of quantity of lamps of each type, but no fewer than two lamps of each type.

1.6 QUALITY ASSURANCE

A. Comply with the *National Electrical Code* (NEC) (NFPA 70), the *Life Safety Code* (NFPA 101), and the *2009 International Building Code* (IBC) for components and installation.

B. Emergency lighting units and exit signs shall be nationally recognized testing laboratory (NRTL)-listed and labeled for their indicated use and location on this project by a NRTL in accordance with UL 924, *Emergency Lighting and Power Equipment*.

C. Use manufacturers that are experienced in manufacturing emergency lighting units similar to those indicated for this Project and have a record of successful in-service performance.

1.7 SERVICE CONDITIONS

A. Emergency lighting products shall perform satisfactorily in the following service conditions:

1. Elevation: 7,500 ft above sea level.
2. Ambient temperature limits: refer to the specific products in PART 2.

1.8 WARRANTY

A. Submit warranties, mutually executed by the manufacturer and the Subcontractor, agreeing to replace emergency lighting products that fail in materials or workmanship within the period specified for each product, beginning on the date of acceptance by Los Alamos National Laboratory (LANL). This warranty is in addition to, and not a limitation of, other rights and remedies LANL may have under the Subcontract documents.

1.9 RECEIVING, STORING AND PROTECTING

A. Receive, store, and protect, and handle products according to NECA 1, *Standard Practices for Good Workmanship in Electrical Construction*; NECA/IESNA 500, *Recommended Practice for Installing Indoor Commercial Lighting Systems*; and NECA/IESNA 502, *Recommended Practice for Installing Industrial Lighting Systems*.

PART 2 PRODUCTS

2.1 PRODUCT OPTIONS AND SUBSTITUTIONS

A. Refer to Section 01 2500, "Substitution Procedures."

B. Provide emergency lighting products that meet the requirements of the *Buy American Act of 1933* (Title 41 – Public Contracts; Chapter 1 – Definitions; §10a-10d).

2.2 FLUORESCENT EMERGENCY BALLAST

A. Furnish an NRTL-listed, self-diagnostic, fully automatic, fluorescent emergency ballast in each luminaire indicated on the drawings.

B. The normal fluorescent luminaire ballast will operate the lamps during normal conditions; during emergency conditions the fluorescent emergency ballast shall operate one or two of the lamps in the luminaire.

C. Fluorescent emergency ballast shall be connectable for operation at either 120 or 277 volts and suitable for indoor dry locations with a temperature range of 32 to 130 °F.

D. Fluorescent emergency ballast shall contain a maintenance-free, sealed high-temperature nickel-cadmium or nickel-metal hydride battery with an expected service life of not less than 7 years.

E. Upon interruption of normal alternating current power, the internal controller shall automatically switch the emergency lighting load to the battery. The battery shall supply the ballast with power to produce 1100 to 1400 lumens of emergency light output for a minimum of 90 minutes.

F. Fluorescent emergency ballast shall have a self-diagnostic system that meets the requirements of NFPA 101 and includes the following features:

1. Automatically perform a self-test of battery and lamps for at least 30 seconds at intervals not exceeding 30 days,

2. Automatically perform a self-test of battery and lamps for at least 90 minutes once per year, and

3. Any failure shall be indicated by a status indicator.

G. Fluorescent emergency ballast shall have an LED charging indicator lamp and a push to test switch for installation on the luminaire at locations and positions that will be visible from the floor and operable without removing or opening luminaire lenses or covers.

H. Fluorescent emergency ballasts shall have not less than a 5 year full warranty.

I. Manufacturer: Bodine "B50ST" IOTA "ISD-80," or approved equal.

2.3 LED EMERGENCY EXIT SIGN

A. Furnish an NRTL-listed, self-diagnostic, fully automatic, LED-illuminated emergency exit sign at each location indicated on the drawings.

B. LED emergency exit sign shall be connectable for operation at either 120 or 277 volts and suitable for indoor dry locations with a temperature range of 32 to 104 °F.

C. Exit sign shall have a die cast aluminum housing, white finish, green stencil face letters, and universal mounting capability with all necessary components for each wall, ceiling, or end mounting application.

D. Exit sign shall be single face or double face with arrows as indicated on the drawings or as required for each location.

E. Exit sign shall have a maintenance-free battery, either nickel-cadmium or nickel-metal hydride. Battery shall be field-replaceable and shall have an expected service life of not less than 7 years.

F. Upon interruption of normal alternating current power, or brownout conditions exceeding a 20 percent drop from nominal voltage, the internal controller shall automatically switch the emergency exit sign lighting load to the battery. Emergency power will be provided for a minimum of 90 minutes. During emergency operation, the battery shall be protected from deep discharge by a low-voltage battery disconnect circuit.

G. Visibility of exit sign during normal or emergency operation shall be not less than that required in UL 924.

H. Exit sign shall have a self-diagnostic system that meets the requirements of NFPA 101 and includes the following features:

1. Automatically perform a self-test of battery and lamps for at least 30 seconds at intervals not exceeding 30 days and
2. Any failure shall be indicated by a status indicator.

I. Exit sign shall perform self-timed tests that are manually initiated through the test button, including:

1. Lamps and battery for at least 30 seconds and
2. Lamps and battery for at least 90 minutes.

J. Exit sign shall provide exterior visual indication of alternating current power status, all self-diagnostic test cycles, and unit malfunctions including:

1. Battery fault,
2. Charger fault, and
3. Lamp fault.

K. LED-illuminated emergency exit sign shall have at least a 5-year full warranty on the unit and electronics and a 5-year full warranty plus additional 5-year pro-rata warranty on the battery.

L. Manufacturer: Chloride "CXLN2GW-IC," LightGuard "DXLN2GWSCT," Mule PCX-2-WWG-SD," or approved equal.

PART 3 EXECUTION

3.1 SPECIAL INSTALLATION INSPECTION

A. Hold for Inspection: Emergency lighting fixture anchorage shall be inspected and approved per the requirements of the IBC as referenced in the Test and Special Inspections Plan (60239831-TPLN-001, Section 5.3.3).

3.2 INSTALLATION

A. Install emergency lighting system in accordance with the NEC (NFPA 70), NECA/IESNA 500, the manufacturer's instructions, and approved shop drawings. Have the manufacturer's installation instructions available at the construction site.

B. Mount exit signs and unit emergency lights with bottom of fixture not less than 6 ft-8 in. or more than 12 ft-0 in. above finished floor.

C. Connect each emergency power system outlet box using a minimum 2 ft length of flexible wiring method to accommodate not less than 4 in. of differential seismic movement in any direction between the outlet box and the non-flexible raceway system. Refer to Section 26 0533, "Raceways and Boxes for Electrical Systems."

D. Securely fasten luminaires, boxes, raised covers, mounting brackets, and blocking using screws, nuts and bolts, or drilled-in anchors suitable for the location.

1. Use flat washers and lock washers to spread forces and assure fastening integrity during and after a seismic event.

2. Each fastening shall be capable of supporting 100 percent of the weight of the luminaire acting in any direction.

3. Spring clips or drywall anchors are not acceptable for supporting emergency luminaires, exit signs or related outlet boxes.

E. Install slack safety wires as described below for emergency luminaires and exit signs on suspended ceilings.

1. Wire shall be minimum 12 gauge, galvanized, soft annealed, steel wire conforming to ASTM A 641/A 641M, *Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.*

2. Attach wire to the building structure directly above the attachment point on the box or luminaire; make trapezes of framing channel material as required to span obstacles

3. Secure wire(s) at each end with not less than three tight turns in 1-1/2 in.

4. Use connection devices at the supporting structure, outlet box, and luminaire that are capable of carrying not less than 100 lb.

F. Install internally illuminated exit signs on suspended ceilings as follows:

1. Attach outlet box for exit sign to suspended ceiling main channels or framing members using a framing channel fastened with sheet metal screws or bolts,

2. Install one slack safety wire per exit sign outlet box, and

3. Attach exit sign to the outlet box using machine screws with flat washers and lock-washers.

G. Install fluorescent emergency luminaires in suspended ceilings as follows:

1. Fasten the four corners of each emergency luminaire to the suspended ceiling main channels or framing members with sheet metal screws or bolts.

2. Install two independent slack safety wires per emergency luminaire with dimensions not exceeding 2 ft by 4 ft. Install four independent slack safety wires per emergency luminaire with dimensions exceeding 2 ft by 4 ft. Attach wires to the luminaire not more than 6 in. from the luminaire corners.

3. Where the ceiling forms the protective membrane of a fire-resistive assembly, install protective coverings over luminaires in accordance with NRTL requirements.

4. Use a flexible wiring method to connect the luminaire that will accommodate not less than 4 in. of differential seismic movement in any direction.

H. Support pendant-mounted or cable-supported emergency luminaires directly from the structure above using a 9 gauge wire or an approved alternate support without using the ceiling suspension system for direct support.

1. Install seismic restraints for pendant-mounted and cable-supported emergency luminaires.

2. Pendants, rods, cables, or chains 4 ft or longer shall be braced to prevent swaying using three cables at 120 degrees separation.

I. Install internally illuminated exit signs on stud walls as follows:

1. Attach each recessed outlet box and raised cover for an exit sign to a stamped steel outlet box bracket that spans between studs. Fasten the outlet box bracket to the studs at each end.

2. Attach exit sign to the outlet box using machine screws with flat washers and lock-washers.

J. Install cord and plug wall-mounted emergency lighting units on stud walls as follows:

1. Install 3/4-in.-thick, 12-in.-high, plywood blocking that will be concealed behind the drywall panel. Blocking shall be centered on the emergency lighting unit, flush with the front surface of the wall studs, span between the wall studs, and securely attached to the wall studs at both ends.

2. Attach the emergency lighting unit case through the drywall panel to the plywood blocking using screws and flat washers.

K. Install internally illuminated exit signs on concrete or masonry walls as follows:

1. If outlet box is not recessed in the wall, attach outlet box to wall surface using two drilled-in anchors and

2. Attach exit sign to the outlet box using machine screws with flat washers and lock-washers.

L. Attach cord and plug connected emergency lighting units to concrete or masonry walls using drilled-in masonry anchors with flat washers.

M. Connect fluorescent emergency ballasts to operate two lamps in multi-lamp emergency luminaires.

N. Install branch circuits for emergency lighting and exit signs in accordance with Article 700 of the NEC (NFPA 70).

1. Connect unit emergency lighting equipment to a branch circuit that serves the general lighting in the area and ahead of any local or remote switches.

2. For 120 volt wall-mounted emergency lights install a NEMA L15-5R single receptacle within 12 in. of the emergency light fixture location. Refer to Section 26 2726, "Wiring Devices."

3. For 277 volt wall-mounted emergency lights install a NEMA L7-15R single receptacle within 12 in. of the emergency light fixture location. Refer to Section 26 2726.

4. Connect severe-duty wall-mounted emergency lights to lighting circuits using a raceway system suitable for the installation environment: refer to Section 26 0533, "Raceways and Boxes for Electrical Systems."

3.3 IDENTIFICATION

A. Identify emergency lighting system components in accordance with the NEC (NFPA 70) and Section 26 0553, "Identification for Electrical Systems."

3.4 ADJUSTING

A. Aim lamps on wall-mounted emergency lighting units to obtain the following illumination of exit pathway:

1. 1 footcandle average,
2. 0.1 footcandle minimum, and
3. Maximum-to-minimum uniformity ratio not exceeding 40 to 1.

B. Test emergency lighting equipment in accordance with the manufacturer's instructions and NECA/IESNA 500.

END OF SECTION

FOR LANL USE ONLY

This project specification is based on LANL Master Specification 26 5200, Rev. 5, dated November 3, 2011.

SECTION 26 5600

EXTERIOR LIGHTING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Exterior Luminaires and Accessories.

B. Lamps.

C. Ballasts.

D. Poles.

E. Pole Foundations.

F. Grounding.

G. Conduit and Wiring.

H. Lighting Controls.

I. Luminaire Ballast Fuses.

1.2 RELATED SECTIONS

A. Section 01 2500, "Substitution Procedures."

B. Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

C. Section 03 3001, "Reinforced Concrete."

D. Section 26 0519, "Low-Voltage Electrical Power Conductors and Cables."

E. Section 26 0526, "Grounding and Bonding for Electrical Systems."

F. Section 26 0533, "Raceways and Boxes for Electrical Systems."

1.3 ABBREVIATIONS AND ACRONYMS, DEFINITIONS, AND REFERENCES

A. Refer to Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

1.4 QUALITY ASSURANCE

A. Comply with the following codes and standards:

1. *National Electrical Code* (NEC) (NFPA 70) for components and installation.

2. AASHTO LTS-5, *Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals*, including interim revisions,

3. *2009 International Building Code* (IBC).

4. ASCE 7-05, *Minimum Design Loads for Buildings and Other Structures.*

5. New Mexico *Night Sky Protection Act of 1978.*

6. The national *Energy Policy Act of 1992* and EnergyStar requirements for lighting products.

B. Provide luminaires listed and labeled by a nationally recognized testing laboratory (NRTL) for the application, installation condition, and the environments in which installed.

C. Use manufacturers that are experienced in manufacturing poles, luminaires, lamps and ballasts similar to those indicated for this Project and have a record of successful in-service performance.

1.5 SERVICE CONDITIONS

A. Elevation: 7,500 ft above sea level.

B. International Building Code and ASCE 7-05 design wind conditions:

1. Exposure Category – C.

2. Basic Wind Speed – 90 mph (3-second gust at 33 ft above ground, mean recurrence interval of 50 years).

3. Importance Factor: – 1.00.

C. Ambient temperatures, deg C (deg F):

1. Annual Averages – 2.1 (35.8) minimum, 15.6 (60.0) maximum, 8.8 (47.9) average.

2. Annual Nighttime Average – 5.4 (41.7).

3. Annual Extremes – 15.0 (5.0) minimum, 31.7 (89.0) maximum.

4. Annual Warmest Day 24-Hour Average – 20.7 (69.3).

5. Annual Warmest Day Nighttime Average – 16.4 (61.6).

D. Maximum Solar Heat Gain: 110 W/ft^2.

E. Lightning Flash Density: 8 flashes to ground per square kilometer per year.

1.6 DEFINITIONS

A. Unless otherwise specified or indicated, terms used in this section are as defined in the NEC (NFPA 70) or the IESNA HB-9, *IESNA Lighting Handbook*.

1.7 SUBMITTALS

A. Submit the following in accordance with the requirements of Exhibit:

1. Catalog Data: Submit catalog data describing poles, luminaires, lamps, ballasts, and pole and luminaire finishes. Include data substantiating that materials comply with specified requirements. Arrange data for luminaires in the order of luminaire designation.

2. Performance Curves/Data: Submit certified photometric data for each type of luminaire.

3. Shop Drawings: Submit manufacturer's drawings for non-standard luminaires.

4. Maintenance Data: Submit maintenance instructions for inclusion in the operations and maintenance manuals.

5. Warranties: Submit warranties for light emitting diode (LED) luminaires.

1.8 EXTRA MATERIALS

A. Furnish the following extra materials matching products installed. Package with protective covering for storage and identify with labels describing contents.

1. LED Luminaires: 5 percent of quantity of LED luminaires of each type, but no fewer than two of each type.

2. Ballasts: 1 percent of quantity of ballasts of each type, but not less than one of each type.

3. Lenses, Diffusers, Covers, Globes, and Guards: 1 percent of quantity of each type, but not less than one of each type.

4. Photoelectric Relays: 5 percent of quantity of photoelectric relays of each type, but not less than two of each type.

5. Fuses: 5 percent of quantity of fuse of each type, but not less than two of each type.

1.9 RECEIVING, STORING AND PROTECTING

A. Receive, inspect, handle, and store products according to the manufacturer's written instructions and NECA/IESNA 501, *Recommended Practice for Installing Exterior Lighting Systems*.

PART 2 PRODUCTS

2.1 PRODUCT OPTIONS AND SUBSTITUTIONS

A. Alternate products may be accepted; follow Section 01 2500, "Substitution Procedures."

2.2 FINISHES

A. Furnish luminaires, poles, and accessories with finishes as scheduled that are resistant to fading, chalking, and other changes due to aging and exposure to heat and ultraviolet light. Acceptable finishes for metals are:

1. Hot-dipped galvanized steel: ASTM A 123/A 123M.

2. Brushed natural aluminum

3. Anodized aluminum: AAMA 611, *Anodized Architectural Aluminum*, Class I.

4. Powder coated aluminum: Fluorocarbon polymer powder coating per AAMA 2605, *Superior Performing Organic Coatings* over chrome phosphate conversion coated aluminum.

5. Powder coated steel: Fluorocarbon polymer powder coating per AAMA 2605, *Superior Performing Organic Coatings* over zinc phosphate conversion coated shot-blasted steel.

B. Reject luminaires, poles, and accessories with finish having runs, streaks, stains, holidays and defects.

C. Replace luminaires, poles, and accessories showing evidence of yellowing, fading, chalking, and other changes indicating failure during warranty period.

D. Use stainless steel for exposed hardware.

2.3 EXTERIOR LUMINAIRES - GENERAL

A. Furnish exterior luminaires that comply with requirements specified in this section and in the luminaire schedule on the drawings.

B. Luminaires shall be NRTL-listed as conforming to UL 1598 - *Luminaires*.

C. Luminaire photometric characteristics shall be based on IESNA approved methods for photometric measurements performed by a recognized photometric laboratory.

D. Each exterior luminaire with light source exceeding 6400 lumens shall comply with the New Mexico Night Sky Protection Act. There shall be no light emitted above a horizontal plane through the lowest light emitting part of the luminaire.

E. Luminaire housing shall be primarily metal.

1. Metal parts shall be free from burrs and sharp corners and edges.
2. Sheet metal components shall be fabricated from corrosion-resistant aluminum, formed and supported to prevent sagging and warping.
3. Exposed fasteners shall be stainless steel.

F. Doors and frames shall be smooth operating and free from light leakage under operating conditions.

1. Relamping shall be possible without the use of special tools.
2. Doors, frames, lenses and diffusers shall be designed to prevent accidental falling during relamping and when secured in the operating position.
3. Door shall be removable for cleaning or replacing lens.

G. Luminaires shall have minimum reflecting surface reflectance as follows unless scheduled otherwise:

1. White surfaces: 85 percent
2. Specular surfaces: 83 percent
3. Diffusing specular surfaces: 75 percent

H. Provide lenses, diffusers, covers and globes as scheduled on the drawings fabricated from materials that are UV stabilized to be resistant to yellowing and other changes due to aging or exposure to heat and ultraviolet radiation.

I. Doors shall have resilient gaskets that are heat-resistant and aging-resistant to seal and cushion lens and refractor.

2.4 LED LUMINAIRES

A. LED luminaires shall conform to UL 1598 and to UL 8250, *Safety Standard for Light-Emitting Diode (LED) Light Sources for Use in Lighting Products*.

B. Products shall be lead and mercury free.

C. Photometric characteristics shall be established using IESNA LM-79-08, *IESNA Approved Method for the Electrical and Photometric Measurement of Solid-State Lighting Products*.

D. Ingress protection for optical assembly shall be IP65 or better in accordance with ANSI/IEC 60529, *Degrees of Protection Provided by Enclosures*.

E. Color characteristics of LED luminaires shall be as follows in accordance with ANSI C78.377, *Specifications for the Chromaticity of Solid State Lighting Products*:

1. Color temperature (deg K): 5000 to 6500
2. Color rendering index: not less than 70

F. LED and driver cooling system shall be passive and shall resist the buildup of debris.

G. LED luminaire output after 50,000 hours of operation shall be not less than 70 percent of the initial lumen output when determined in accordance with IESNA LM-80-08 – *IESNA approved Method for Measuring Lumen Maintenance of LED Lighting Sources.*

H. LED Luminaire Electrical Characteristics:

1. Supply Voltage: 120 V, 208 V, 240 V, 277 V, or 480 V as indicated on the drawings. Provide step-down transformers if required to match driver input voltage rating.
2. Total Harmonic Distortion (current): Not more than 20 percent
3. Power Factor: Not less than 90%
4. RF Interference: Meet FCC 47 CFR Part 15/18
5. Transient Protection: IEEE C62.41 Class A.

I. Warranty:

1. Manufacturer shall replace any luminaires that fail to operate properly within 60 months of the date of LANL acceptance of the installation. Lens yellowing or hazing will be considered a failure.
2. Manufacturer shall replace any luminaires that experience housing or finish failure within 5 years of the date of LANL acceptance of the installation.

J. Manufacturers:

1. RAB "ALED 3T78" and
2. RAB "WPLED 13."

2.5 POLES AND ACCESSORIES

A. Furnish poles and accessories that comply with requirements specified in this section and the luminaire schedule on the drawings.

B. Pole, base, and anchorage shall carry the luminaires, supports, and appurtenances at the indicated height above grade without deflection or whipping.

C. Mountings, fastenings and other appurtenances shall be fabricated from corrosion-resistant materials that are compatible with poles and luminaires and will not cause galvanic action at contact points. Mountings shall correctly position luminaires to provide scheduled light distribution.

D. A reinforced access handhole, minimum 2-1/2 in. by 5 in., shall be located in the wall of each metal pole.

E. A welded 1/2-in. grounding lug shall be accessible through the handhole of each metal pole. Grounding connection shall be designed to prevent electrolysis when used with copper ground wire.

F. Metal poles shall have anchor type bases and galvanized steel anchor bolts, leveling nuts and bolt covers.

G. Where poles are indicated as "breakaway" type on the drawings, each pole shall have a frangible aluminum transformer base that meets the requirements of AASHTO LTS-5.

H. Each non-breakaway metal pole shall have a metal base cover that covers the entire base plate and anchorage.

I. Protect painted, anodized, or brushed pole finishes during shipment and installation. Minimum protection shall consist of spirally wrapping each pole shaft with protective paper secured with tape, and shipping small parts in boxes.

J. Aluminum poles shall be fabricated from corrosion resistant aluminum Alloy 6063-T6 or Alloy 6005-T5 for wrought alloys or Alloy 356-T4 for cast alloys.

1. Poles shall be square or round, tapered or straight as indicated on the drawings.
2. Aluminum poles over 30 feet tall shall include factory-installed vibration dampers.
3. Poles shall be seamless extruded or spun seamless type with minimum 0.188-in. wall thickness.
4. Tops of shafts shall be fitted with a round or tapered cover.
5. Base shall be anchor bolt mounted, made of cast 356-T6 aluminum alloy in accordance with ASTM B 108/B 108M, *Standard Specification for Aluminum-Alloy Permanent Mold Castings* and shall be machined to receive the lower end of shaft. Joint between shaft and base shall be welded.
6. Base cover shall be cast 356-T6 aluminum alloy in accordance with ASTM B 108/B 108M.
7. Hardware, except anchor bolts, shall be either 2024-T4 anodized aluminum alloy or stainless steel.

K. Aluminum mast arms shall be tapered oval tubing continuously welded to pole attachment plate and have span and rise as indicated on the drawings. Provide with same finish as pole.

L. Anchor bolts shall be steel rod having minimum yield strength of 50,000 psi. The top 12 in. of the anchor bolt shall be galvanized in accordance with ASTM A153/A153M.

M. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Holophane Corporation;
2. Hubbell Lighting, Inc.;
3. Lithonia Lighting;
4. Millerbernd Manufacturing Company;
5. Union Metal Corp; and
6. Valmont Industries, Inc.

2.6 GROUNDING

A. Provide grounding for exterior lighting using materials specified in Section 26 0526, "Grounding and Bonding for Electrical Systems."

B. Provide a 10-ft-long, 5/8-in.-diameter, copper-clad ground rod at each pole.

2.7 LIGHTING CONTROL EQUIPMENT

A. Furnish photoelectric relays to control exterior lighting as indicated on the drawings.

1. For photoelectric relays not mounted on luminaires use products conforming to either UL 773 or UL 773A, *Non-industrial Photoelectric Switches for Lighting Control*. Provide the photoelectric relays with single-pole double-throw contacts to switch mechanically-held contactors.

2. Photoelectric relay contacts shall be factory set to turn exterior lighting "ON" at or below 3 footcandles and "OFF" at 4 to 10 footcandles. A time delay shall prevent switching from transient light sources.

B. Furnish a "hand-off-auto" control switch and enclosure to facilitate testing of the lighting system.

C. Furnish one or more multi-pole lighting contactors to control exterior lighting as indicated on the drawings.

1. Mechanically-held or contactors shall conform to NEMA ICS 2 Industrial Controls and Systems: Controllers, Contactors, and Overload Relays.

2. Contactors shall have the number of contacts as indicated on the Drawings or as required by the number of circuits to be controlled. Contacts shall have a minimum rating of 30 amperes at 277 volts AC per pole for ballast loads. Contacts shall be field-convertible from normally-open to normally-closed.

3. Use 120 volts AC operating coils.

4. Provide contactor with NEMA 3R housing if installed outdoors or NEMA 1 housing if installed indoors.

2.8 FUSES AND FUSE HOLDERS

A. Furnish fuse overcurrent protection for each pole-mounted luminaire to isolate faulted ballasts from the lighting circuit.

1. Use 600 volt, Class CC, time-delay, current-limiting fuses.

2. Select fuses rated between 200% and 300% of the luminaire ballast maximum current.

3. Manufacturer: Bussman "LP-CC"

B. Furnish in-line fuse holders for installation in pole hand hole or transformer base.

1. Use non-breakaway type fuse holders unless breakaway poles are indicated on the drawings.

2. Use breakaway type fuse holders where breakaway poles are indicated on the drawings.

3. Load and line terminal sizes and types shall correspond to line and load conductor sizes and quantities.

4. Both breakaway and non-breakaway fuse holders shall have insulating boots.

5. Manufacturers: Ferraz Shawmut "FEC" for phase conductor(s), "FEBN" for neutral conductor.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine areas, spaces, and surfaces to receive exterior luminaire (s) or poles for compliance with installation tolerances and other conditions affecting performance of the product. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install products in accordance with manufacturer's instructions, NECA/IESNA 501, and approved shop drawings.

B. Locations of luminaires and poles shown on the drawings are diagrammatic. Coordinate luminaire locations with building finishes, building structure, paving and striping, utility piping, security fences, and existing trees. Obtain approval for location changes through LANL Subcontract Technical Representative (STR).

C. Set poles and luminaires plumb, square, level and secure.

D. Install surface mounted luminaires directly to an outlet box which is supported from structure.

E. Install lamps in luminaires in accordance with manufacturer's instructions.

3.3 CONCRETE FOUNDATIONS

A. Construct concrete foundations with exterior 4000 psi concrete and reinforcing conforming to Section 03 3001, "Reinforced Concrete."

B. Comply with details on the drawings and manufacturer's recommendations for foundation dimensions, reinforcing, anchor bolts, nuts and washers.

C. Position power conduits and ground rod to terminate within the pole shaft area and 1 in. above the top of the foundation; refer to Section 26 0533, "Raceways and Boxes for Electrical Systems."

D. In addition to power conduits, install a 1-in. PVC conduit in the pole base for the ground lead described below.

E. Cure concrete foundations for 7 full curing days before erecting poles.

3.4 POLE ERECTION

A. Do not install poles without luminaires.

B. Use fabric web slings to raise and set poles.

C. Use leveling nuts or shims to make poles plumb. When leveling nuts are used, set the lower nuts not more than 1 in. from the concrete foundation.

D. Tighten anchor bolt nuts and other pole hardware to torque recommended by manufacturer.

E. After pole is leveled, pack non-shrink grout between anchor base and concrete foundation to provide a full bearing surface. Use a short piece of 1/2-in.-diameter pipe to make a drain hole through grout; arrange to drain condensation from interior of pole.

F. Set embedded poles to depth indicated on the drawings, but not less than 1/6 of pole length below finish grade.

1. Auger holes large enough to permit the use of tampers the full depth of the hole.

2. Backfill in 6-in. layers and thoroughly tamp each layer so compaction of backfill is equal to or greater than that of the undisturbed earth.

3.5 GROUNDING

A. Install grounding for exterior lighting using materials and methods specified in Section 26 0526, "Grounding and Bonding for Electrical Systems."

B. Install a 10-ft-long, minimum 5/8-in.-diameter, copper-clad ground rod at each pole. At metal poles mounted on reinforced concrete foundations, install the ground rod in the concrete foundation.

C. Connect ground lug of metal pole to ground rod using a 6 AWG copper conductor.

D. Connect ground lug of metal pole to circuit equipment grounding conductor.

E. Ground metallic components of lighting unit with non-metallic pole to ground rod using a 6 AWG copper conductor.

3.6 LIGHTING CONTROL SYSTEM

A. Install exterior lighting control system components in accordance with the manufacturers' instructions. Have installation instructions available at the construction site.

B. Install a HAND-OFF-AUTO selector switch in the control system to allow for testing of luminaires.

C. Provide separate control of exterior lighting system as follows:

1. Safety, security, pedestrian walkway, and roadway lighting: "ON" at dusk, "OFF" at dawn.

3.7 FUSES AND FUSE HOLDERS.

A. Install fuse(s) and fuse holders in pole hand hole or transformer base for each luminaire.

1. Install fuse holder and fuse in each phase conductor.

2. Install fuse holder with permanently mounted dummy fuse in neutral conductor.

B. Orient breakaway fuse holders so no energized conductors will be exposed in the event of a pole knockdown.

C. Install insulator boots over fuse holders and tape wrap where conductor enters boot.

3.8 RACEWAYS AND BOXES

A. Install conduit system for exterior lighting using materials and methods specified in Section 26 0533, "Raceways and Boxes for Electrical Systems."

3.9 BUILDING WIRE

A. Install wiring for exterior lighting using materials and methods specified in Section 26 0519, "Low-Voltage Electrical Power Conductors and Cables."

3.10 FIELD QUALITY CONTROL

A. Inspect each installed lighting unit for damage. Replace damaged luminaires, poles, and components.

B. Test installed luminaires for proper operation.

1. Provide instruments to make and record test results.
2. Replace or repair malfunctioning luminaires and components then re-test.
3. Repeat procedure until all luminaires operate properly.

C. Replace inoperative lamps.

D. Check poles for signs of vibration induced by 10 to 30 mph wind: visible swaying, loosened anchor bolt nuts, vibration perceptible by touch, or wires rattling inside pole. Notify the STR and the pole manufacturer – vibration mitigation devices may be required.

3.11 ADJUSTING AND CLEANING

A. Clean each luminaire inside and out, including plastics and glassware. Use methods and materials recommended by manufacturer.

B. Aim adjustable luminaires to provide required light intensities as indicated on the drawings or as directed by the LANL STR.

C. Adjust exterior lighting controls to obtain the following performance unless otherwise indicated on the drawings or directed by the LANL STR:

1. Safety, security, pedestrian walkway, and roadway lighting: "ON" when ambient lighting becomes less than 1.6 times the illuminance design level or 1.5 footcandles, whichever is higher; "OFF" when ambient lighting exceeds approximately 5 footcandles.

END OF SECTION

FOR LANL USE ONLY

This project specification is based on LANL Master Specification 26 5600, Rev. 3, dated December 15, 2009.

SECTION 27 1000

STRUCTURED CABLING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Telecommunications pathways including conduit and cable tray systems.

B. Telecommunications terminal boards.

C. Installation, termination, and testing of LANL-furnished horizontal cables and outlets.

D. Installation of LANL-furnished telecommunications backbone cables.

1.2 RELATED SECTIONS

A. Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

B. Section 26 0526, "Grounding and Bonding for Electrical Systems,"

C. Section 26 0533, "Raceways and Boxes for Electrical Systems."

D. Section 26 0536, "Cable Trays for Electrical Systems."

E. Section 33 7119, "Electrical Underground Ducts and Manholes,"

1.3 ABBREVIATIONS AND ACRONYMS, DEFINITIONS, AND REFERENCES

A. Refer to Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

B. Refer to NECA/BICSI 568, Standard for Installing Commercial Building Telecommunications Cabling, for definitions of terms used in this section.

1.4 LANL-FURNISHED EQUIPMENT FOR SUBCONTRACTOR INSTALLATION (GFE)

A. LANL will furnish the Category 6A UTP horizontal cable required to connect telecommunications outlets.

B. LANL will furnish telecommunications outlet/connectors.

C. LANL will furnish telecommunications backbone cables as required.

1.5 LANL-FURNISHED AND INSTALLED EQUIPMENT

A. LANL will furnish and install telecommunications entrance cable for RLWTF and LLW Utility Building.

B. LANL will furnish and install cross-connect equipment.

C. LANL will furnish and install telecommunications systems electronics equipment. This includes telecommunication room equipment (telecommunication racks, entrance cable termination panels, and surge protective devices).

1.6 LANL PERFORMED WORK

A. LANL will terminate telecommunications backbone cables.

B. LANL will spot-check acceptance tests on Category 6A UTP cables.

1.7 SUBMITTALS

Provide submittals in accordance with the requirements of Exhibit I:

A. Within 30 days after construction Notice to Proceed, submit certifications of the qualifications of the Category 6A UTP horizontal cable installer as described in Paragraph 1.8 of this section.

B. Detailed records of cable routing in accordance with ANSI/TIA/EIA-606-A Administration Standard for the Telecommunications Infrastructure.

C. Provide test reports for each installed and terminated Category 6A UTP horizontal cable in accordance with ANSI/TIA/EIA-568-B.2 Commercial Building Telecommunications Cabling Standard.

1.8 QUALITY ASSURANCE

A. Conform to the requirements of the following telecommunications standards:

1. ANSI/TIA/EIA-568-B.1 – B.3, *Commercial Building Telecommunications Cabling Standard*.

2. ANSI/TIA/EIA-569-A, *Commercial Building Standard for Telecommunications Pathways and Spaces*.

3. ANSI/TIA/EIA-606-A, *Administration Standard for the Telecommunications Infrastructure*.

4. ANSI/J-STD-607-A, *Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications*.

5. NECA/BICSI 568, *Standard for Installing Commercial Building Telecommunications Cabling*.

B. Conform to the requirements of the *National Electrical Code* (NEC) (NFPA 70).

C. Category 6A UTP cable installers shall have the following minimum qualifications:

1. BICSI Registered Installer Level 1 and

2. Certified Systimax installer or directly supervised by a certified Systimax installer.

1.9 COORDINATION

A. Coordinate telecommunications service and interior distribution with the LANL Telecommunications Group.

B. Coordinate installer training and cable termination tool requirements for horizontal cabling installers with the LANL Telecommunications Group.

C. Schedule completion of the telecommunications rooms to allow not less than 5 working days for the LANL Telecommunications Group to install cross-connect equipment before the scheduled start of cable installation. Coordinate schedule with the LANL Telecommunications Group.

D. Order horizontal cabling and outlet/connectors from the LANL Telecommunications Group based on actual count, measurement of conduit and cable tray runs and required slack cable. Place order not less than 10 working days prior to scheduled start of installation.

E. Schedule installation of horizontal cabling and outlet/connectors to start after the completion of application of finishes to walls and after the completion of the telecommunications room(s) to minimize potential for damage to cables.

PART 2 PRODUCTS

2.1 CONDUIT

A. Provide conduits for service, backbone, and horizontal cables as indicated on the drawings or as required for a complete telecommunications pathway system.

B. Select sizes of conduit for horizontal cables on the following basis:

1. Nominal cable diameter: 0.310 in.
2. Minimum conduit size: 1 in. unless specified otherwise.
3. Less than 50 ft between pulling points and only one bend: 40 percent conduit fill.
   a. 1-in. conduit for four cables.
   b. 1-1/4-in. conduit for six cables
4. More than 50 ft between pulling points or two 90-degree bends: 31 percent conduit fill.
   a. 1-1/4-in. conduit for four cables.
   b. 1-1/2-in. conduit for six cables.
5. Number of cables per conduit: Four cables per workstation outlet unless noted otherwise on the drawings.

C. Refer to Section 26 0533, "Raceways and Boxes for Electrical Systems."

2.2 SURFACE METAL RACEWAY

A. Refer to Section 26 0533, "Raceways and Boxes for Electrical Systems."

2.3 INNERDUCT

A. To allow for future communication upgrades, one of the 4" entrance conduits shall be installed with inner duct.

B. Flexible Textile Raceway listed for use outdoor with optical fiber and communication cables.

C. 4-in., 3-cell polyester/nylon textile inner duct with 1,200-lb pull tape with accurate sequential footage markings.

A. Manufacturer: Maxcell.

2.4 RACEWAY MEASURING TAPE

A. Refer to Section 26 0533, "Raceways and Boxes for Electrical Systems".

2.5 SURFACE METAL RACEWAY

A. Refer to Section 26 0533, "Raceways and Boxes for Electrical Systems".

2.6 CABLE TRAY

A. Provide cable tray system for backbone cables and horizontal cables as indicated on the drawings or as required for a complete telecommunications pathway system.

B. Provide ladder type cable tray with maximum 6 in. rung spacing.

C. Select cable tray sizes for horizontal cables based on the larger of:

1. One (1) sq. in. of cable tray per 100 ft^2 of useable floor area served, or
2. Fill ratio of 41.6 percent.

D. Refer to Section 26 0536, "Cable Trays for Electrical Systems."

2.7 OUTLET BOXES

A. Refer to Section 26 0533, "Raceways and Boxes for Electrical Systems."

B. Use 4-11/16-$in.^2$, 2-1/8-in.-deep, outlet boxes with single gang raised device covers for telecommunications and television outlets served by 1-1/4 in. or smaller conduit.

2.8 PULL AND SPLICE BOXES

A. Refer to Section 26 0533, "Raceways and Boxes for Electrical Systems."

B. Provide pull and splice boxes with dimension indicated in TIA/EIA-569-A.

1. Provide boxes for straight pulls with the following minimum dimensions:

Conduit trade-size (in.)	Width (in.)	Length (in.)	Depth (in.)	Width increase per additional conduit (in.)
1	4	16	3	2
1-1/4	6	20	3	3
1-1/2	8	27	4	4
2	8	36	4	5
2-1/2	10	42	5	6
3	12	48	5	6
3-1/2	12	54	6	6
4	15	60	8	8

2. Provide pull boxes for angle or U pulls with minimum dimensions as follows:

a. Have a distance between each conduit entry inside the box and the opposite wall of the box of at least 6 times the trade-size diameter of the largest conduit, this distance being increased by the sum of the trade size diameters of the other conduits on the same row on the same wall of the box, and

b. Have the distance between the nearest edges of each conduit entry enclosing the cam cable at least six times the trade-size diameter of the larger conduit,

c. For a conduit entering the wall of a pull box opposite to a removable cover, have a distance from the wall to the cover of not less than the trade-size diameter of the largest conduit plus six times the diameter of the largest conduit.

3. Provide splice boxes with the following minimum dimensions:

Conduit trade-size (in.)	Width (in.)	Length (in.)	Depth (in.)	Width increase per additional conduit (in.)
1	12	32	4	3
1-1/4	14	36	5	4
1-1/2	18	39	6	4
2	20	42	7	5
2-1/2	24	48	8	6
3	30	54	9	6
3-1/2	36	60	10	7
4	42	66	11	7

2.9 TERMINAL BOARDS

A. Use 3/4-in.-thick, APA Grade A-B interior plywood without voids

B. Paint front, back, and all edges with two coats of white or light gray, intumescent latex, fire-retardant paint with a Class A fire rating. Manufacturer: Benjamin Moore "Retardo Latex Fire Retardant Paint".

2.10 GROUNDING

A. Provide a ground bar for each terminal board.

1. Furnish 12 in. by 4 in. by 1/4-in., copper ground bar with 1-in. standoff insulators.

2. Drill ground bar with 7/16-in. bolt holes at 1-3/4-in. by 2-in. NEMA spacing for two-hole compression lugs.

3. Manufacturers: Cadweld, Harger, Newton Instrument Co.

B. Refer to Section 26 0526, "Grounding and Bonding for Electrical Systems," for additional requirements.

2.11 CATEGORY 6A UTP CABLE (LANL-FURNISHED)

A. Cable is UL listed as type CMP for use in ducts, plenums and air handling spaces.

B. Cable consists of four 23 AWG unshielded twisted pairs; nominal cable outside diameter is 0.310 in.

C. Manufacturer: Systimax GigaSpeed X10D.

2.12 BACKBONE CABLE (LANL-FURNISHED)

A. Copper backbone cable is ARMM cable, 24 AWG, UL listed as type CMR.

B. Fiber optic backbone cable is UL-listed as type OFNP or OFNR, tight buffered cable with a mixture of single-mode and multi-mode fibers.

2.13 TELECOMMUNICATIONS OUTLET/CONNECTORS (LANL-FURNISHED)

A. Each GFE telecommunications outlet will consist of a plastic faceplate with four TIA/EIA-568-B configured RJ45 modular connectors.

B. Cable connections are made to insulation displacing type connectors using an approved punch down tool.

C. Manufacturer: Systimax.

2.14 CROSS-CONNECT EQUIPMENT (LANL-FURNISHED)

A. The GFE will consist of Systimax X10 VisiPatch termination blocks. The quantity of blocks provided will be sufficient for the standard two-connection model work area channel.

B. Horizontal cable connections are made to insulation displacing type connectors using an approved punch down tool.

C. Manufacturer: Systimax X10D.

2.15 TELECOMMUNICATION HAND HOLE (PULL BOX)

A. Provide telecommunication hand hole (pull box) as indicated on the drawings.

B. Refer to Section 33 7119, "Electrical Underground Ducts and Manholes," for additional requirements.

2.16 TELECOMMUNICATION CABLE TO SANITARY LIFT STATION

A. Provide type Category 5e, 24 AWG, 4 pair, water blocked cable.

B. Manufacturer: Belden 7934A or Approved equal.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify interior of building has been protected from weather.

B. Verify mechanical work likely to damage telecommunications cables has been completed.

C. Verify telecommunications pathway installation is complete and supported.

D. Verify that installation of telecommunications rooms is complete.

E. Examine raceways and building finishes receiving telecommunications cables for compliance with installation tolerances and other conditions. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 GENERAL

A. Install telecommunications system according to NECA/BICSI 568, NEC Article 800, and requirements in this section.

B. Maintain separations between telecommunications pathways and sources of electromagnetic interference as indicated in Table 2 of NECA/BICSI 568.

3.3 CABLE TRAY INSTALLATION

A. Install cable tray around the perimeter of each telecommunications room and above the equipment racks.

1. Locate cable tray with edge 8 inc. from perimeter walls.

2. Provide six cable tray dropout fittings in each telecommunications room. Install cable tray dropout fittings at locations directed by the LANL Telecommunications Group.

3. Extend cable tray to each open telecommunications equipment rack.

B. Install cable tray system to distribute horizontal cables from the telecommunications room(s) to locations near the telecommunications outlets. Locate cable tray concealed above corridor lift-out ceilings. Connect to the cable tray in the telecommunications room(s).

C. Install cable tray at least 5 in. away from fluorescent or HID lighting fixtures to prevent electromagnetic interference.

D. Install cable tray so there will be not less than 12 in. above and to the side of tray to permit access for installing and maintaining cables. Locate cable trays below suspended mechanical equipment, piping, and ductwork that would impede access to the cable tray.

E. Refer to Section 26 0536, "Cable Trays for Electrical Systems," for additional installation requirements.

3.4 CONDUIT INSTALLATION

A. Install the telecommunications service entrance conduits as indicated on the drawings. Turn up the telecommunications conduits at the left rear corner of the telecommunications room adjacent to the left wall. Seal the building end of entrance conduits to prevent rodents, water, or gasses from entering the building.

B. Install an individual 1-in. conduit for telecommunications horizontal cables from each telecommunications workstation outlet to the telecommunications terminal board or telecommunications cable tray.

C. Install a 3/4" conduit from the telecommunications room to the fire alarm control panel. Install a 6 in. by 6 in. by 4 in. box adjacent to the fire alarm control panel. Connect box to fire alarm control panel with a 3/4 in. nipple.

D. Install conduit for telecommunications and coaxial cables in maximum lengths of 100 ft with not more than two 90-degree bends or equivalent redirection between any two adjacent conduit openings. Install a pull box at any reverse bend.

E. Use bends on telecommunications conduits 2 in. trade size and smaller with a minimum inner edge radius 6 times the conduit internal diameter.

F. Use bends on telecommunications conduits larger than 2-in. trade size with a minimum inner edge radius 10 times the conduit internal diameter.

G. Do not use conduit bodies for changes in direction or as pull boxes.

H. Install raceway measuring tape in empty raceways. Leave not less than 12 in. of slack at each end of the tape. Secure each end of tape.

I. Install conduits and sleeves projecting through structural floors with opening 4 in. above the floor.

J. Terminate each metallic telecommunications conduit in either an insulated throat fitting or an insulating bushing.

K. Refer to Section 26 0533, "Raceways and Boxes for Electrical Systems," for additional installation requirements.

3.5 INNERDUCT INSTALLATION

A. Install inner duct as indicated on the drawings and per the manufacturer's instructions.

B. Inner duct shall be continuous through hand holes. Leave sufficient slack to maintain minimum bend radius as required.

3.6 OUTLET BOX INSTALLATION

A. Install outlets at locations indicated on the drawings. Telecommunications outlet locations shown on the drawings are in approximate locations unless dimensioned. Verify locations before rough-in.

B. Locate each outlet within 36 in. of a suitable receptacle power outlet.

C. Group and align telecommunications outlets and power outlets so a symmetrical appearance results.

D. Refer to Section 26 0533, "Raceways and Boxes for Electrical Systems," for additional installation requirements.

3.7 TERMINAL BOARD INSTALLATION

A. Install pre-painted terminal board lining three walls of each telecommunications room from the floor to 8 ft above the floor.

B. Install terminal boards plumb, and attach securely to the building structure with fasteners at not more than 24 in. on center vertically and horizontally.

3.8 GROUNDING INSTALLATION

A. Install a ground bar at lower right corner of the left wall terminal board in each telecommunications room.

B. Connect ground bar(s) to the building main electrode ground bar with 4/0 AWG 600V insulated ground cable. If the building structure is steel, bond the ground bar to the nearest structural steel using 6 AWG or larger conductor.

C. Terminate 4/0 AWG ground cable in the telecommunications duct bank on the entrance telecommunications room ground bar.

D. Run grounding cables exposed or, if exposed to physical damage, in Schedule 40 PVC conduits. Do not install grounding cables in ferrous metal conduit.

E. Make connections to ground bar(s) and bonded objects using hydraulically compressed two-hole lugs. Clean connectors and connection points prior to fastening.

F. Bond telecommunications cable tray to the ground bar with minimum 6 AWG. Install a 6 AWG grounding conductor in the cable tray; bond conductor to each cable tray section using listed cable tray ground clamps.

G. Bond all metallic telecommunications raceways to the ground bar per ANSI/J-STD-607-A. Bond individual raceways with 12 AWG or larger conductor. Bond groups of raceways using minimum 6 AWG.

H. Use approved fittings and minimum 12 AWG bonding jumpers to make telecommunications raceways electrically continuous.

I. Use approved fittings to bond telecommunications conduits to cable trays.

J. Refer to Section 26 0526, "Grounding and Bonding for Electrical Systems," for additional installation requirements.

3.9 CROSS CONNECT EQUIPMENT INSTALLATION

A. Cross connect equipment will be furnished and installed by the LANL Telecommunications Group.

B. Entrance and backbone cabling will be furnished and installed by the LANL Telecommunications Group.

C. Cross connect jumpers will be furnished, installed, and tested by the LANL Telecommunications Group.

3.10 CABLE INSTALLATION

A. Handle and install horizontal cable according to cable manufacturers' instructions. Have the manufacturer's installation instructions available at the construction site.

1. Do not subject horizontal cable to a bending radius of less than 4 times the cable outside diameter.
2. Do not subject horizontal cable to more than 25-lb pulling tension.
3. Do not kink or excessively twist cable.
4. Do not skin or damage cable sheath or conductor insulation.

B. Obtain cable handling and installation requirements for backbone cable from the LANL Telecommunications Group.

C. Examine raceways to receive cables for compliance with installation tolerances and other conditions. Do not proceed until unsatisfactory conditions have been corrected.

D. Completely and thoroughly swab raceways before installing cable.

E. Clean foreign matter from interior of boxes and conduits before installing cables.

F. Store cable for 24 hours in the installation area ambient temperature before installing.

G. Do not "through-pull" cables at boxes, fittings or cabinets where a change of raceway alignment occurs.

H. Comply with Article 800 of the NEC (NFPA 70).

I. Install LANL-furnished backbone cables between telecommunications closets. Leave 15 ft of slack at each end. LANL will terminate backbone cables.

J. Install LANL furnished Category 6A UTP horizontal cables from each telecommunications outlet to the telecommunications terminal board or the telecommunications cabinet.

1. Install four cables from each 4-port outlet; this will be typical.
2. Install six cables from each 6-port outlet indicated on the drawings.
3. Leave 15 ft of slack at the cross-connect end and 18 in. of slack at the outlet end.

K. Terminate horizontal telecommunications cables on LANL-furnished telecommunications outlet/connectors in accordance with NECA/BICSI 568 and ANSI/TIA/EIA-568-B, designation T568B, per figure 6-2, Optional Eight Position Jack Pin/Pair Assignments, using an approved punch-down tool. Leave 12 in. of slack in cables. Coil cable into outlet box and install faceplate on outlet box.

L. Terminate horizontal telecommunications cables on cross connect equipment in accordance with NECA/BICSI 568 and ANSI/TIA/EIA568-B using an approved punch-down tool. Terminate cables in ascending order by room number, cubicle or workstation, and port number as directed by the LANL Telecommunications Group.

3.11 IDENTIFICATION

A. Uniquely identify each cable at both ends using a numbering scheme that complies with NECA/BICSI 568 and ANSI/EIA/TIA-606 and instructions from the LANL Telecommunications Group; use a tag produced using a label printing machine.

B. After cables are terminated, label and install LANL-furnished designation strips on the telecommunications outlet/connectors and cross connect equipment as directed by the LANL Telecommunications Group; use labels produced using a label printing machine.

C. Install an identifying label on each conductor connected to the telecommunications ground bar(s). Band both ends of each grounding cable with green plastic tape.

3.12 ACCEPTANCE TESTING

A. Perform acceptance test on each installed and terminated Category 6A UTP horizontal cable per NECA/BICSI 568 and ANSI/TIA/EIA-568-B. Replace cables that do not pass acceptance tests.

B. Perform continuity acceptance test on each installed and terminated coaxial cable. Replace cables that do not pass acceptance tests.

C. Provide records of tests to the LANL Telecommunications Group. LANL may spot test some cables.

END OF SECTION

FOR LANL USE ONLY

This project specification is based on LANL Master Specification 27 1000, Rev. 3, dated July 1, 2008.

SECTION 27 1000

STRUCTURED CABLING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Telecommunications pathways including conduit and cable tray systems.

B. Telecommunications terminal boards.

C. Installation, termination, and testing of LANL-furnished horizontal cables and outlets.

D. Installation of LANL-furnished telecommunications backbone cables.

1.2 RELATED SECTIONS

A. Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

B. Section 26 0526, "Grounding and Bonding for Electrical Systems,"

C. Section 26 0533, "Raceways and Boxes for Electrical Systems."

D. Section 26 0536, "Cable Trays for Electrical Systems."

E. Section 33 7119, "Electrical Underground Ducts and Manholes,"

1.3 ABBREVIATIONS AND ACRONYMS, DEFINITIONS, AND REFERENCES

A. Refer to Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

B. Refer to NECA/BICSI 568, Standard for Installing Commercial Building Telecommunications Cabling, for definitions of terms used in this section.

1.4 LANL-FURNISHED EQUIPMENT FOR SUBCONTRACTOR INSTALLATION (GFE)

A. LANL will furnish the Category 6A UTP horizontal cable required to connect telecommunications outlets.

B. LANL will furnish telecommunications outlet/connectors.

C. LANL will furnish telecommunications backbone cables as required.

1.5 LANL-FURNISHED AND INSTALLED EQUIPMENT

A. LANL will furnish and install telecommunications entrance cable for RLWTF and LLW Utility Building.

B. LANL will furnish and install cross-connect equipment.

C. LANL will furnish and install telecommunications systems electronics equipment. This includes telecommunication room equipment (telecommunication racks, entrance cable termination panels, and surge protective devices).

1.6 LANL PERFORMED WORK

A. LANL will terminate telecommunications backbone cables.

B. LANL will spot-check acceptance tests on Category 6A UTP cables.

1.7 SUBMITTALS

Provide submittals in accordance with the requirements of Exhibit I:

A. Within 30 days after construction Notice to Proceed, submit certifications of the qualifications of the Category 6A UTP horizontal cable installer as described in Paragraph 1.8 of this section.

B. Detailed records of cable routing in accordance with ANSI/TIA/EIA-606-A Administration Standard for the Telecommunications Infrastructure.

C. Provide test reports for each installed and terminated Category 6A UTP horizontal cable in accordance with ANSI/TIA/EIA-568-B.2 Commercial Building Telecommunications Cabling Standard.

1.8 QUALITY ASSURANCE

A. Conform to the requirements of the following telecommunications standards:

1. ANSI/TIA/EIA-568-B.1 – B.3, *Commercial Building Telecommunications Cabling Standard.*

2. ANSI/TIA/EIA-569-A, *Commercial Building Standard for Telecommunications Pathways and Spaces.*

3. ANSI/TIA/EIA-606-A, *Administration Standard for the Telecommunications Infrastructure.*

4. ANSI/J-STD-607-A, *Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications.*

5. NECA/BICSI 568, *Standard for Installing Commercial Building Telecommunications Cabling.*

B. Conform to the requirements of the *National Electrical Code* (NEC) (NFPA 70).

C. Category 6A UTP cable installers shall have the following minimum qualifications:

1. BICSI Registered Installer Level 1 and

2. Certified Systimax installer or directly supervised by a certified Systimax installer.

1.9 COORDINATION

A. Coordinate telecommunications service and interior distribution with the LANL Telecommunications Group.

B. Coordinate installer training and cable termination tool requirements for horizontal cabling installers with the LANL Telecommunications Group.

C. Schedule completion of the telecommunications rooms to allow not less than 5 working days for the LANL Telecommunications Group to install cross-connect equipment before the scheduled start of cable installation. Coordinate schedule with the LANL Telecommunications Group.

D. Order horizontal cabling and outlet/connectors from the LANL Telecommunications Group based on actual count, measurement of conduit and cable tray runs and required slack cable. Place order not less than 10 working days prior to scheduled start of installation.

E. Schedule installation of horizontal cabling and outlet/connectors to start after the completion of application of finishes to walls and after the completion of the telecommunications room(s) to minimize potential for damage to cables.

PART 2 PRODUCTS

2.1 CONDUIT

A. Provide conduits for service, backbone, and horizontal cables as indicated on the drawings or as required for a complete telecommunications pathway system.

B. Select sizes of conduit for horizontal cables on the following basis:

1. Nominal cable diameter: 0.310 in.
2. Minimum conduit size: 1 in. unless specified otherwise.
3. Less than 50 ft between pulling points and only one bend: 40 percent conduit fill.
   a. 1-in. conduit for four cables.
   b. 1-1/4-in. conduit for six cables
4. More than 50 ft between pulling points or two 90-degree bends: 31 percent conduit fill.
   a. 1-1/4-in. conduit for four cables.
   b. 1-1/2-in. conduit for six cables.
5. Number of cables per conduit: Four cables per workstation outlet unless noted otherwise on the drawings.

C. Refer to Section 26 0533, "Raceways and Boxes for Electrical Systems."

2.2 SURFACE METAL RACEWAY

A. Refer to Section 26 0533, "Raceways and Boxes for Electrical Systems."

2.3 INNERDUCT

A. To allow for future communication upgrades, one of the 4" entrance conduits shall be installed with inner duct.

B. Flexible Textile Raceway listed for use outdoor with optical fiber and communication cables.

C. 4-in., 3-cell polyester/nylon textile inner duct with 1,200-lb pull tape with accurate sequential footage markings.

A. Manufacturer: Maxcell.

2.4 RACEWAY MEASURING TAPE

A. Refer to Section 26 0533, "Raceways and Boxes for Electrical Systems".

2.5 SURFACE METAL RACEWAY

A. Refer to Section 26 0533, "Raceways and Boxes for Electrical Systems".

2.6 CABLE TRAY

A. Provide cable tray system for backbone cables and horizontal cables as indicated on the drawings or as required for a complete telecommunications pathway system.

B. Provide ladder type cable tray with maximum 6 in. rung spacing.

C. Select cable tray sizes for horizontal cables based on the larger of:

1. One (1) sq. in. of cable tray per 100 ft^2 of useable floor area served, or
2. Fill ratio of 41.6 percent.

D. Refer to Section 26 0536, "Cable Trays for Electrical Systems."

2.7 OUTLET BOXES

A. Refer to Section 26 0533, "Raceways and Boxes for Electrical Systems."

B. Use 4-11/16-$in.^2$, 2-1/8-in.-deep, outlet boxes with single gang raised device covers for telecommunications and television outlets served by 1-1/4 in. or smaller conduit.

2.8 PULL AND SPLICE BOXES

A. Refer to Section 26 0533, "Raceways and Boxes for Electrical Systems."

B. Provide pull and splice boxes with dimension indicated in TIA/EIA-569-A.

1. Provide boxes for straight pulls with the following minimum dimensions:

Conduit trade-size (in.)	Width (in.)	Length (in.)	Depth (in.)	Width increase per additional conduit (in.)
1	4	16	3	2
1-1/4	6	20	3	3
1-1/2	8	27	4	4
2	8	36	4	5
2-1/2	10	42	5	6
3	12	48	5	6
3-1/2	12	54	6	6
4	15	60	8	8

2. Provide pull boxes for angle or U pulls with minimum dimensions as follows:

a. Have a distance between each conduit entry inside the box and the opposite wall of the box of at least 6 times the trade-size diameter of the largest conduit, this distance being increased by the sum of the trade size diameters of the other conduits on the same row on the same wall of the box, and

b. Have the distance between the nearest edges of each conduit entry enclosing the cam cable at least six times the trade-size diameter of the larger conduit,

c. For a conduit entering the wall of a pull box opposite to a removable cover, have a distance from the wall to the cover of not less than the trade-size diameter of the largest conduit plus six times the diameter of the largest conduit.

3. Provide splice boxes with the following minimum dimensions:

Conduit trade-size (in.)	Width (in.)	Length (in.)	Depth (in.)	Width increase per additional conduit (in.)
1	12	32	4	3
1-1/4	14	36	5	4
1-1/2	18	39	6	4
2	20	42	7	5
2-1/2	24	48	8	6
3	30	54	9	6
3-1/2	36	60	10	7
4	42	66	11	7

2.9 TERMINAL BOARDS

A. Use 3/4-in.-thick, APA Grade A-B interior plywood without voids

B. Paint front, back, and all edges with two coats of white or light gray, intumescent latex, fire-retardant paint with a Class A fire rating. Manufacturer: Benjamin Moore "Retardo Latex Fire Retardant Paint".

2.10 GROUNDING

A. Provide a ground bar for each terminal board.

1. Furnish 12 in. by 4 in. by 1/4-in., copper ground bar with 1-in. standoff insulators.

2. Drill ground bar with 7/16-in. bolt holes at 1-3/4-in. by 2-in. NEMA spacing for two-hole compression lugs.

3. Manufacturers: Cadweld, Harger, Newton Instrument Co.

B. Refer to Section 26 0526, "Grounding and Bonding for Electrical Systems," for additional requirements.

2.11 CATEGORY 6A UTP CABLE (LANL-FURNISHED)

A. Cable is UL listed as type CMP for use in ducts, plenums and air handling spaces.

B. Cable consists of four 23 AWG unshielded twisted pairs; nominal cable outside diameter is 0.310 in.

C. Manufacturer: Systimax GigaSpeed X10D.

2.12 BACKBONE CABLE (LANL-FURNISHED)

A. Copper backbone cable is ARMM cable, 24 AWG, UL listed as type CMR.

B. Fiber optic backbone cable is UL-listed as type OFNP or OFNR, tight buffered cable with a mixture of single-mode and multi-mode fibers.

2.13 TELECOMMUNICATIONS OUTLET/CONNECTORS (LANL-FURNISHED)

A. Each GFE telecommunications outlet will consist of a plastic faceplate with four TIA/EIA-568-B configured RJ45 modular connectors.

B. Cable connections are made to insulation displacing type connectors using an approved punch down tool.

C. Manufacturer: Systimax.

2.14 CROSS-CONNECT EQUIPMENT (LANL-FURNISHED)

A. The GFE will consist of Systimax X10 VisiPatch termination blocks. The quantity of blocks provided will be sufficient for the standard two-connection model work area channel.

B. Horizontal cable connections are made to insulation displacing type connectors using an approved punch down tool.

C. Manufacturer: Systimax X10D.

2.15 TELECOMMUNICATION HAND HOLE (PULL BOX)

A. Provide telecommunication hand hole (pull box) as indicated on the drawings.

B. Refer to Section 33 7119, "Electrical Underground Ducts and Manholes," for additional requirements.

2.16 TELECOMMUNICATION CABLE TO SANITARY LIFT STATION

A. Provide type Category 5e, 24 AWG, 4 pair, water blocked cable.

B. Manufacturer: Belden 7934A or Approved equal.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify interior of building has been protected from weather.

B. Verify mechanical work likely to damage telecommunications cables has been completed.

C. Verify telecommunications pathway installation is complete and supported.

D. Verify that installation of telecommunications rooms is complete.

E. Examine raceways and building finishes receiving telecommunications cables for compliance with installation tolerances and other conditions. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 GENERAL

A. Install telecommunications system according to NECA/BICSI 568, NEC Article 800, and requirements in this section.

B. Maintain separations between telecommunications pathways and sources of electromagnetic interference as indicated in Table 2 of NECA/BICSI 568.

3.3 CABLE TRAY INSTALLATION

A. Install cable tray around the perimeter of each telecommunications room and above the equipment racks.

1. Locate cable tray with edge 8 inc. from perimeter walls.

2. Provide six cable tray dropout fittings in each telecommunications room. Install cable tray dropout fittings at locations directed by the LANL Telecommunications Group.

3. Extend cable tray to each open telecommunications equipment rack.

B. Install cable tray system to distribute horizontal cables from the telecommunications room(s) to locations near the telecommunications outlets. Locate cable tray concealed above corridor lift-out ceilings. Connect to the cable tray in the telecommunications room(s).

C. Install cable tray at least 5 in. away from fluorescent or HID lighting fixtures to prevent electromagnetic interference.

D. Install cable tray so there will be not less than 12 in. above and to the side of tray to permit access for installing and maintaining cables. Locate cable trays below suspended mechanical equipment, piping, and ductwork that would impede access to the cable tray.

E. Refer to Section 26 0536, "Cable Trays for Electrical Systems," for additional installation requirements.

3.4 CONDUIT INSTALLATION

A. Install the telecommunications service entrance conduits as indicated on the drawings. Turn up the telecommunications conduits at the left rear corner of the telecommunications room adjacent to the left wall. Seal the building end of entrance conduits to prevent rodents, water, or gasses from entering the building.

B. Install an individual 1-in. conduit for telecommunications horizontal cables from each telecommunications workstation outlet to the telecommunications terminal board or telecommunications cable tray.

C. Install a 3/4" conduit from the telecommunications room to the fire alarm control panel. Install a 6 in. by 6 in. by 4 in. box adjacent to the fire alarm control panel. Connect box to fire alarm control panel with a 3/4 in. nipple.

D. Install conduit for telecommunications and coaxial cables in maximum lengths of 100 ft with not more than two 90-degree bends or equivalent redirection between any two adjacent conduit openings. Install a pull box at any reverse bend.

E. Use bends on telecommunications conduits 2 in. trade size and smaller with a minimum inner edge radius 6 times the conduit internal diameter.

F. Use bends on telecommunications conduits larger than 2-in. trade size with a minimum inner edge radius 10 times the conduit internal diameter.

G. Do not use conduit bodies for changes in direction or as pull boxes.

H. Install raceway measuring tape in empty raceways. Leave not less than 12 in. of slack at each end of the tape. Secure each end of tape.

I. Install conduits and sleeves projecting through structural floors with opening 4 in. above the floor.

J. Terminate each metallic telecommunications conduit in either an insulated throat fitting or an insulating bushing.

K. Refer to Section 26 0533, "Raceways and Boxes for Electrical Systems," for additional installation requirements.

3.5 INNERDUCT INSTALLATION

A. Install inner duct as indicated on the drawings and per the manufacturer's instructions.

B. Inner duct shall be continuous through hand holes. Leave sufficient slack to maintain minimum bend radius as required.

3.6 OUTLET BOX INSTALLATION

A. Install outlets at locations indicated on the drawings. Telecommunications outlet locations shown on the drawings are in approximate locations unless dimensioned. Verify locations before rough-in.

B. Locate each outlet within 36 in. of a suitable receptacle power outlet.

C. Group and align telecommunications outlets and power outlets so a symmetrical appearance results.

D. Refer to Section 26 0533, "Raceways and Boxes for Electrical Systems," for additional installation requirements.

3.7 TERMINAL BOARD INSTALLATION

A. Install pre-painted terminal board lining three walls of each telecommunications room from the floor to 8 ft above the floor.

B. Install terminal boards plumb, and attach securely to the building structure with fasteners at not more than 24 in. on center vertically and horizontally.

3.8 GROUNDING INSTALLATION

A. Install a ground bar at lower right corner of the left wall terminal board in each telecommunications room.

B. Connect ground bar(s) to the building main electrode ground bar with 4/0 AWG 600V insulated ground cable. If the building structure is steel, bond the ground bar to the nearest structural steel using 6 AWG or larger conductor.

C. Terminate 4/0 AWG ground cable in the telecommunications duct bank on the entrance telecommunications room ground bar.

D. Run grounding cables exposed or, if exposed to physical damage, in Schedule 40 PVC conduits. Do not install grounding cables in ferrous metal conduit.

E. Make connections to ground bar(s) and bonded objects using hydraulically compressed two-hole lugs. Clean connectors and connection points prior to fastening.

F. Bond telecommunications cable tray to the ground bar with minimum 6 AWG. Install a 6 AWG grounding conductor in the cable tray; bond conductor to each cable tray section using listed cable tray ground clamps.

G. Bond all metallic telecommunications raceways to the ground bar per ANSI/J-STD-607-A. Bond individual raceways with 12 AWG or larger conductor. Bond groups of raceways using minimum 6 AWG.

H. Use approved fittings and minimum 12 AWG bonding jumpers to make telecommunications raceways electrically continuous.

I. Use approved fittings to bond telecommunications conduits to cable trays.

J. Refer to Section 26 0526, "Grounding and Bonding for Electrical Systems," for additional installation requirements.

3.9 CROSS CONNECT EQUIPMENT INSTALLATION

A. Cross connect equipment will be furnished and installed by the LANL Telecommunications Group.

B. Entrance and backbone cabling will be furnished and installed by the LANL Telecommunications Group.

C. Cross connect jumpers will be furnished, installed, and tested by the LANL Telecommunications Group.

3.10 CABLE INSTALLATION

A. Handle and install horizontal cable according to cable manufacturers' instructions. Have the manufacturer's installation instructions available at the construction site.

1. Do not subject horizontal cable to a bending radius of less than 4 times the cable outside diameter.

2. Do not subject horizontal cable to more than 25-lb pulling tension.

3. Do not kink or excessively twist cable.

4. Do not skin or damage cable sheath or conductor insulation.

B. Obtain cable handling and installation requirements for backbone cable from the LANL Telecommunications Group.

C. Examine raceways to receive cables for compliance with installation tolerances and other conditions. Do not proceed until unsatisfactory conditions have been corrected.

D. Completely and thoroughly swab raceways before installing cable.

E. Clean foreign matter from interior of boxes and conduits before installing cables.

F. Store cable for 24 hours in the installation area ambient temperature before installing.

G. Do not "through-pull" cables at boxes, fittings or cabinets where a change of raceway alignment occurs.

H. Comply with Article 800 of the NEC (NFPA 70).

I. Install LANL-furnished backbone cables between telecommunications closets. Leave 15 ft of slack at each end. LANL will terminate backbone cables.

J. Install LANL furnished Category 6A UTP horizontal cables from each telecommunications outlet to the telecommunications terminal board or the telecommunications cabinet.

1. Install four cables from each 4-port outlet; this will be typical.
2. Install six cables from each 6-port outlet indicated on the drawings.
3. Leave 15 ft of slack at the cross-connect end and 18 in. of slack at the outlet end.

K. Terminate horizontal telecommunications cables on LANL-furnished telecommunications outlet/connectors in accordance with NECA/BICSI 568 and ANSI/TIA/EIA-568-B, designation T568B, per figure 6-2, Optional Eight Position Jack Pin/Pair Assignments, using an approved punch-down tool. Leave 12 in. of slack in cables. Coil cable into outlet box and install faceplate on outlet box.

L. Terminate horizontal telecommunications cables on cross connect equipment in accordance with NECA/BICSI 568 and ANSI/TIA/EIA568-B using an approved punch-down tool. Terminate cables in ascending order by room number, cubicle or workstation, and port number as directed by the LANL Telecommunications Group.

3.11 IDENTIFICATION

A. Uniquely identify each cable at both ends using a numbering scheme that complies with NECA/BICSI 568 and ANSI/EIA/TIA-606 and instructions from the LANL Telecommunications Group; use a tag produced using a label printing machine.

B. After cables are terminated, label and install LANL-furnished designation strips on the telecommunications outlet/connectors and cross connect equipment as directed by the LANL Telecommunications Group; use labels produced using a label printing machine.

C. Install an identifying label on each conductor connected to the telecommunications ground bar(s). Band both ends of each grounding cable with green plastic tape.

3.12 ACCEPTANCE TESTING

A. Perform acceptance test on each installed and terminated Category 6A UTP horizontal cable per NECA/BICSI 568 and ANSI/TIA/EIA-568-B. Replace cables that do not pass acceptance tests.

B. Perform continuity acceptance test on each installed and terminated coaxial cable. Replace cables that do not pass acceptance tests.

C. Provide records of tests to the LANL Telecommunications Group. LANL may spot test some cables.

END OF SECTION

FOR LANL USE ONLY

This project specification is based on LANL Master Specification 27 1000, Rev. 3, dated July 1, 2008.

SECTION 27 3000

VOICE COMMUNICATIONS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Zoned overhead voice communications paging system.

1.2 RELATED SECTIONS

A. Section 01 2500, "Substitution Procedures."

B. Section 01 4000, "Quality Requirements."

C. Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

D. Section 26 0526, "Grounding and Bonding for Electrical Systems."

E. Section 26 0533, "Raceways and Boxes for Electrical Systems."

F. Section 26 0553, "Identification for Electrical Systems."

G. Section 27 1000, "Structured Cabling."

1.3 ABBREVIATIONS AND ACRONYMS, DEFINITIONS, AND REFERENCES

A. Refer to Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

1.4 LANL-FURNISHED AND INSTALLED EQUIPMENT

A. LANL will furnish and install telecommunication racks per Section 27 1000, "Structured Cabling." These racks will contain sufficient space for the equipment identified in this section.

1.5 SUBCONTRACTOR-FURNISHED AND INSTALLED EQUIPMENT

A. Subcontractor shall furnish and install all equipment identified in this section.

1.6 QUALITY ASSURANCE

A. Work Identified in this section shall be done under a Quality Assurance Program in accordance with Section 01 4000, "Quality Requirements."

B. Comply with the *National Electrical Code* (NEC) (NFPA 70) for components and installation.

C. Provide products that are listed and labeled by a nationally recognized testing laboratory (NRTL) for the application and environment in which installed.

1.7 SUBMITTALS

A. Submit the following in accordance with the requirements of Exhibit I:

1. Catalog data for zone paging controllers, paging amplifiers, cable, terminal blocks, speakers, back boxes, and baffles.

2. Wiring diagram of system showing zone paging controller, paging amplifiers, paging system terminal blocks, and all paging zones.

3. Calculations for speaker line wire selections, speaker line losses, and amplifier selection.

4. Proposed programming for zone paging controller.

5. As-built documents showing programming of zone paging controller, paging system speaker outlets, routing and size of raceways, junction boxes, and pull boxes.

6. As-built records of cable routing and speaker circuiting.

7. Test and inspection report for the completed installation.

1.8 COORDINATION

A. Coordinate location of the paging system equipment in the telecommunications room(s) with the LANL Telecommunications Group through the LANL Subcontract Technical Representative (STR).

B. Schedule completion of the paging system installation to allow not less than 5 working days for the LANL Telecommunications Group to install paging system equipment before the scheduled start of paging system testing. Coordinate schedule for the installation of the paging system equipment in the telecommunications room(s) with the LANL Telecommunications Group through the LANL STR.

1.9 RECEIVING, STORING AND PROTECTING

A. Receive, store, and protect, and handle products according to NECA 1, *Standard Practices for Good Workmanship in Electrical Construction*.

PART 2 PRODUCTS

2.1 PRODUCT OPTIONS AND SUBSTITUTIONS

A. Alternate products may be accepted; follow Section 01 2500, "Substitution Procedures."

2.2 ZONE PAGING CONTROLLER

A. Provide a zone paging controller that will enable one way paging from the telephone system to one, multiple, or all of the paging zones in all the buildings.

B. The zone paging controller shall allow direct connection to loop start or ground start trunk telephone systems and PBX or key paging ports via an RJ11 plug.

C. The zone paging controller shall be field programmable using DIP switches and using the DTMF keys of a telephone. Non-volatile, solid-state storage shall retain programming information during power interruptions.

D. Paging zone outputs shall be compatible with the paging amplifier(s) specified in this section.

E. Housing shall have provisions for wall mounting with all connections and controls front accessible. Provide accessory rack-mounting brackets.

F. Provide a suitable NRTL-listed 12 V dc power supply.

G. Zone paging controller shall be registered under Part 69 of FCC rules.

H. Manufacturer: Bogen Model PCM2000 Zone Paging System with PCMPS2 power supply.

2.3 PAGING AMPLIFIER

A. Provide NRTL-listed telephone paging amplifier(s) with minimum power rating as per the drawings. Each amplifier shall provide its full rated output with less than 1 percent distortion.

B. Paging amplifier inputs shall include:

1. 600-ohm balanced telephone line and
2. Low-impedance balanced microphone

C. Externally accessible controls on the paging amplifier shall include:

1. Page volume,
2. Automatic level control,
3. Bass control, and
4. Treble control.

D. Output from each amplifier shall be a 25 volt balanced line with thermal and electronic overload protection.

E. Amplifier housings shall have provisions for wall mounting with all connections and controls front accessible. Provide accessory rack-mounting brackets.

F. Power source: 120V ac, 60 Hz.

G. Bogen Model TPU250 as per the drawings.

2.4 RACEWAYS AND BOXES

A. Provide conduit raceway system for voice communication system wiring.

B. Use minimum 4x4 metal outlet boxes for speaker wiring. Provide a solid metal cover for each box.

C. Use flexible metal conduit for connection from outlet boxes to speakers installed in accessible ceilings.

D. Select conduits to limit cable fill to 40 percent of conduit area.

E. Refer to Specification Section 26 0533, "Raceways and Boxes for Electrical Systems," for materials and installation requirements.

2.5 SPEAKER CABLE

A. Provide speaker cable, 18-gauge minimum, stranded conductors, single-twisted pair, non-shielded , PVC insulation and jacket:

1. 10 AWG – Belden #8810 or West Penn #C210;
2. 12 AWG – Belden #8477 or West Penn #227;
3. 14 AWG – Belden #8473 or West Penn #226;
4. 16 AWG – Belden #8471 or West Penn #225; and
5. 16 AWG – Waterproof – West Penn #AQ225.

2.6 SPEAKER ASSEMBLIES

A. For recessed speakers in lay-in ceiling systems provide pre-assembled drop-in units consisting of the following components:

1. 1 ft x 2 ft steel panel with perforated face and off-white finish;
2. 8-in. cone-type loudspeaker with 10 oz ceramic magnet;
3. 70/25-volt transformer with tap selector switch for 4, 2, 1, 0.5, and 0.25 watts;
4. Coated steel speaker back-box; and
5. Support rail crossbar.
6. Manufacturer – Bogen #CSD1X2.

B. For recessed speakers in suspended dry-wall or plaster ceilings provide recessed ceiling speaker assemblies consisting of the following components:

1. 12.75-in. diameter steel baffle with white powder-coat finish and welded speaker mounting studs;
2. 8-in. cone-type loudspeaker with 10 oz ceramic magnet; and
3. 70/25-volt transformer with taps for 4, 2, 1, 0.5, and 0.25 watts.
4. Manufacturer – Bogen #S86T725PG8U.
5. Lined and coated steel speaker back-box with support rail: Bogen #CS1EZ.

C. For speakers in noisy or outdoor locations provide re-entrant horn speaker assemblies consisting of the following components:

1. 15 watt horn and driver in a weather-proof housing;
2. 70/25-volt transformer with weatherproof rotary tap switch for 15, 7.5, 1.8, 0.94, and 0.46 watts;
3. Mounting bracket with horizontal and vertical adjustment; and
4. Manufacturer's standard painted finish on all parts.
5. Manufacturer – Bogen #SPT-15A.

2.7 WIRING DUCT

A. Provide non-metallic wiring duct that is NRTL listed to UL 1565, *Positioning Devices*.

B. Duct and cover material shall be rated as low flammability per UL94V-0 and low smoke generating per ASTM E 662.

C. Select duct size so wire fill will not exceed 50 percent of duct cross-sectional area.

D. Manufacturers: Panduit Type TMC.

2.8 TERMINAL BLOCKS

A. Provide DIN rail mounted, double-deck, push-on style terminal blocks with associated mounting rails, markers, end/intermediate plates, and jumpers.

B. Terminal blocks shall be rated for 28 to 12 AWG solid or stranded wires.

C. Manufacturer: WAGO #281-619.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that interior of building is protected from weather.

B. Verify that work of other trades likely to damage paging system components is completed.

C. Examine building finishes that are to receive paging system components and cables for compliance with installation tolerances and other conditions. Do not proceed with installation until unsatisfactory conditions have been corrected.

D. Paging device locations and conduit routings shown on drawings are approximate unless dimensioned.

1. Locate paging system components as required to meet project conditions.
2. Route conduits and cables as required by project conditions.
3. Where conduit routing is not shown, and destination only is indicated, determine exact routing and lengths required to meet project conditions.

3.2 TERMINAL BLOCK INSTALLATION

A. Furnish and install terminal blocks on the telecommunications room plywood backboard above the location indicated on the drawings for the voice communications (paging) equipment.

1. Provide an individual terminal for each speaker cable and arrange terminal blocks by paging system zone.
2. Mount terminal blocks approximately 6 ft above the floor.

3.3 CONDUIT AND BOX INSTALLATION

A. Install an outlet box within 6 ft of each speaker assembly location in accessible suspended ceilings. Install a 1/2-in. flexible metal conduit from outlet box to speaker back-box located in accessible suspended ceilings.

B. Install an outlet box at each wall-mounted speaker and each horn-type speaker. Conduit may be connected directly to speaker back-boxes located in non-accessible suspended ceilings.

C. Install conduit system for paging system cables starting above the paging system terminal blocks in the telecommunications room and extending to all paging system outlet boxes.

D. Refer to Section 26 0533, "Raceways and Boxes for Electrical Systems," for additional installation requirements.

3.4 SPEAKER ASSEMBLY INSTALLATION

A. Install speaker assemblies at locations indicated on the drawings and as required to provide uniform coverage for each occupied space at the lowest sound power level possible but at least 6 dB above the ambient noise.

1. In spaces with less than 70-dB ambient noise install ceiling-mounted speakers so the distance between speakers is approximately twice the ceiling height.

2. In corridors and in similar long, narrow spaces install ceiling-mounted speakers along the center of the space at approximately 8-ft intervals.

3. In spaces with greater than 70-dB ambient noise or outdoors install horn speakers.

B. Install speaker assemblies in accordance with the manufacturer's instructions. Have the manufacturer's installation instructions available at the construction site.

C. Coordinate speaker assembly locations with building finishes, building structure, mechanical ductwork and grills, lighting fixtures, and automatic sprinkler system.

D. Where the ceiling forms the protective membrane of a fire resistive assembly, install protective coverings over speaker assemblies in accordance with the *UL Fire Resistance Directory*.

E. Do not support speaker assemblies by ceiling acoustical panels or by dry-wall ceiling or wall panels.

1. Mount recessed speaker assemblies with at least two 3/4-in. support rails or with tile bridges attached to suspended ceiling support system.

2. Where recessed speaker assemblies are supported from a suspended ceiling support system, install not less than two independent support rods or wires attached to the building structure.

3. Install surface mounted speakers directly to outlet boxes that are supported from structure, framing, or suspended ceiling support system.

F. Mount wall-mounted speakers with center not less than one foot below the ceiling grid but no higher than 9 ft above floor level.

G. Adjust speaker baffle to fit adjacent surface.

H. Connect speakers for 25V, 0.5 watt tap operation unless otherwise noted on the drawings.

3.5 GROUNDING INSTALLATION

A. Bond metallic paging system raceways to the paging system equipment cabinet using approved fittings.

B. Use approved fittings and minimum 12 AWG bonding jumpers to make paging system raceways electrically continuous.

C. Bond the paging system conduits to the ground bar in the telecommunications room using 6 AWG ground cable.

D. Refer to Section 26 0526, "Grounding and Bonding for Electrical Systems," for installation requirements.

3.6 PAGING SYSTEM CABLE INSTALLATION

A. Install paging system cables according to NECA 1, the NEC (NFPA 70), and requirements in this section.

B. Completely and thoroughly swab raceways before installing cable.

C. Clean foreign matter from interior of boxes before installing cables.

D. Store cable for 24 hours in the installation area ambient temperature before installing.

E. Comply with Article 800 of the NEC (NFPA 70).

F. Install speaker wiring as a 25-ohm balanced line.

G. Terminate speaker cables on the terminal blocks in the telecommunications room.

1. Use an individual terminal block position for each speaker cable and arrange terminations by paging system zone.

2. Dress the cables in a neat and orderly manner extending to the termination blocks from the bottom.

3. Use wiring duct to manage cables from the paging system conduits to the terminal blocks, from the terminal blocks to the paging amplifiers, and between the paging amplifiers and the zone paging controller.

4. Secure cables with Velcro cable ties.

H. The LANL Telecommunications Group will make connections from the paging system equipment cabinet to the paging system equipment rack.

3.7 IDENTIFICATION

A. Uniquely identify each speaker cable at both ends using a numbering scheme that indicates the paging zone.

B. Uniquely identify signal cables interconnecting the paging zone controller, paging amplifier(s) and terminal blocks with a "from-to" numbering scheme.

C. Uniquely identify terminal block positions using a numbering scheme that indicates the paging zone.

D. Identify paging system cable under provisions of Section 26 0553, "Identification for Electrical Systems;" use a tag-produced using a label printing machine.

3.8 PAGING AMPLIFER INSTALLATION

A. Install paging amplifier(s) in accordance with the manufacturer's instructions and the approved construction submittal documents. Have the manufacturer's installation instructions and approved construction submittal documents available at the construction site.

B. Mount paging amplifiers on Government-furnished equipment (GFE) rack in telecommunications room.

C. Connect paging amplifiers to speaker wiring and to zone paging controller in accordance with approved wiring diagrams.

D. Use multi-outlet assembly in telecommunications room as 120V ac power source.

3.9 ZONE PAGING CONTROLLER INSTALLATION

A. Install zone paging controller in accordance with the manufacturer's instructions and approved construction submittal documents. Have the manufacturer's installation instructions and approved construction submittal documents available at the construction site.

B. Mount zone paging controller on GFE rack in telecommunications room.

C. Provide a telephone outlet with RJ11 jack next to the zone paging controller.

D. Connect the zone paging controller to paging amplifiers and in telephone system in accordance with approved construction submittal wiring diagrams.

E. Use multi-outlet assembly in telecommunications room as 120V ac power source.

F. Program the zone paging controller in accordance with the manufacturer's instructions and approved construction submittal programming documents

3.10 FIELD QUALITY CONTROL

A. Upon installation of wires and cables and before electrical circuitry is energized, show product capability and compliance with requirements and verify by testing that conductors are free from shorts and unintentional grounds.

B. Inspect each installed speaker assembly for damage. Replace damaged components.

C. Test installed paging system for proper operation and output volume.

1. Provide instruments to make and record test results.

2. Replace or repair malfunctioning components then re-test.

3. Verify that system can be accessed and controlled from the telephone system.

4. Adjust transformer taps as required to obtain a paging signal in each that is within 3 dB of the levels listed below.

a. Enclosed Offices – 61 dBA (6 dB above a 55 dBA ambient);
b. Open Plan Offices – 76 dBA (6 dB above a 70 dBA ambient);
c. Laboratories – 76 dBA (6 dB above a 70 dBA ambient);
d. Corridors – 71 dBA (6 dB above a 65 dBA ambient); and
e. Mechanical Rooms – 91 dBA (6 dB above an 85 dBA ambient).

D. Submit test and inspection report for the completed installation.

END OF SECTION

FOR LANL USE ONLY

This project specification is based on LANL Master Specification 27 3000, Rev.3, dated July 1, 2008.

SECTION 28 1321

ADMINISTRATIVE ACCESS CONTROL SYSTEM ROUGH-IN

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Administrative access control system rough-in that originates in the telecommunications room and extends to each access-controlled door for LANL-furnished badge readers, door contacts, and contractor-furnished electric strikes.

B. Access controlled doors include:

1. At each interior or exterior door identified on the drawings install the access control system hardware.

1.2 RELATED SECTIONS

A. Section 01 2500, "Substitution Procedures."

B. Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

C. Section 08 7100, "Door Hardware."

D. Section 26 0526, "Grounding and Bonding for Electrical Systems."

E. Section 26 0533, "Raceways and Boxes for Electrical Systems."

1.3 ABBREVIATIONS AND ACRONYMS, DEFINITIONS, AND REFERENCES

A. Refer to Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

1.4 LANL-FURNISHED MATERIALS FOR SUBCONTRACTOR INSTALLATION

A. None.

1.5 LANL-FURNISHED AND INSTALLED EQUIPMENT

A. LANL will furnish and install badge readers, power supplies, and control equipment.

1.6 LANL PERFORMED WORK

A. LANL will make final wiring connections to administrative access control equipment.

1.7 SUBMITTALS

A. Submit the following in accordance with the requirements of Exhibit I:

1. Catalog Data: Submit manufacturer's data on power, signaling, control cables, electric door strikes, and panic bars.

2. Test Reports: Provide inspection and test report for each power, signaling, and control cable.

3. As-Built Drawings: Provide as-built drawings showing installed administrative access control system raceways, boxes, and cables.

1.8 QUALITY ASSURANCE

A. Conform to requirements of the *National Electrical Code* (NEC) (NFPA 70).

B. Furnish products listed and labeled by a nationally recognized testing laboratory (NRTL) as suitable for purposes specified and shown.

1.9 COORDINATION

A. Coordinate installation of administrative access control system rough-in with the LANL Telecommunications Group.

B. Coordinate electrical requirements for electric strikes with the LANL Telecommunications Group. Refer to Paragraph 2.4B in this section.

C. Complete telecommunications rooms to allow not less than 5 working days for the LANL telecommunications group to install badge reader equipment rack before scheduled start of badge reader system installation. Coordinate schedule with the LANL Project Leader.

1.10 RECEIVING, STORING AND PROTECTING

A. Receive, store, and protect, and handle products and materials according to NECA 1, *Standard Practices for Good Workmanship in Electrical Construction.*

PART 2 PRODUCTS

2.1 PRODUCT OPTIONS AND SUBSTITUTIONS

A. Refer to Section 01 2500, "Substitution Procedures."

2.2 RACEWAYS AND BOXES

A. Provide 4-11/16 square, 2-1/8 inch deep boxes for badge reader outlets. Provide single-gang raised device covers that match the thickness of the wallboard. Provide box supports to prevent movement of the box.

B. Provide flush-mounted 10" X 10" X 4" hinged cover badge reader junction boxes with flush-locking latch and wood mounting panel (Hoffman A-TC1010F).

C. Outside boxes must be weatherproof, R4 or R12, with continuous hinges.

D. Refer to Section 26 0533, "Raceways and Boxes for Electrical Systems."

2.3 CABLES

A. Furnish power, power/switch, and data cables.

B. For power cable use 1-twisted pair, 18 AWG stranded, UL type CMG, Belden 9740.

C. For power/switch cable use 2-twisted pairs, 22 AWG stranded, UL type CMG, Belden 9744.

D. For data cable use 2-individually shielded twisted pairs, 24 AWG, UL Type CMP, Belden 82729.

2.4 ELECTRIC DOOR STRIKES AND PANIC BARS

A. Furnish electric door strike for each access-controlled door or set of doors. Provide electric panic bars for access controlled doors as indicated on the drawings.

B. Provide 24-volt door strikes and panic bars that operate on 0.5 amperes or less, are easily serviceable, and are electrically compatible with the LANL-furnished access control system, functionally compatible with each access-controlled door, and with finish compatible with the other door hardware. (Von Duprin crash bars EL33, EL35, EL98, and EL99 are NOT allowed. Von Duprin E996L and E360L-BE trims are acceptable.)

C. Coordinate with Section 08 7100, "Door Hardware."

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify interior of the building has been protected from weather.

B. Verify that installation of telecommunications rooms is complete.

C. Examine raceways and building finishes for compliance with installation tolerances and other conditions affecting performance of the administrative access control system. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 RACEWAY AND BOX INSTALLATION

A. Install a complete raceway and box system for administrative access control system.

B. Install a flush mounted 4-11/16 square, 2-1/8 inch deep badge reader outlet box on the strike side of each access-controlled door. Flush mount the outlet box with center 44 inches above the finished floor and approximately 12 inches from the doorframe. Provide single-gang raised device covers that match the thickness of the wallboard. Provide box supports to prevent movement of the box. At each exterior location provide a minimum 12 inch x 12 inch surface around the outlet box suitable for mounting the LANL badge reader weather shield.

C. Install a flush-mounted 10" X 10" X 4" hinged cover badge reader junction box on the wall interior to the card reader with center 56 inches above the finished floor and approximately 12 inches from the door frame.

D. Install a 3/4 inch conduit from each badge reader outlet box to the nearby badge reader junction box.

E. Install a 1/2-inch conduit from the badge reader junction box to the access-controlled doorframe for cables to the electronic lock and door contacts.

F. Install a 1-inch conduit from each badge reader junction box to the badge reader wireway in the entrance telecommunications room.

G. Install a 6" X 6" wireway in the telecommunications room and located above the cable tray. Terminate conduits from badge readers into the wireway. Install a 2 inch conduit from the wireway to the LANL badge reader equipment rack; coordinate with the LANL Telecommunication Group.

3.3 CABLE INSTALLATION

A. Clean foreign matter from interior of boxes and conduits before installing cables.

B. Install one power/switch cable from the access controlled doorframe strike location to the badge reader outlet box. Leave 15 inches slack at both ends and 15 inches coiled slack in the badge reader junction box.

C. Install one power/switch cable from the access controlled doorframe contacts location to the badge reader outlet box. Leave 15 inches slack at both ends and 15 inches coiled slack in the badge reader junction box.

D. Install one data cable from the badge reader outlet box to the badge reader equipment rack. Leave 15 inches slack at the badge reader outlet box and enough slack to reach bottom of badge reader equipment rack.

E. Install one power cable from the badge reader outlet box to the badge reader equipment rack. Leave 15 inches slack at the badge reader outlet box and 8 feet slack at the badge reader equipment rack.

F. Uniquely identify each cable at both ends using a numbering scheme that complies with instructions from the LANL Telecommunications Group; use a tag or an indelible marker

3.4 DOOR STRIKE AND PANIC BAR INSTALLATION

A. Install electric door strikes and panic bars in accordance with manufacturer's instructions. Have installation instructions available at the construction site.

B. Adjust electric strikes for proper fit and proper electrical and mechanical operation.

3.5 GROUNDING

A. Ground badge reader raceways and boxes in accordance with Section 26 0526, "Grounding and Bonding for Electrical Systems," secondary grounding using the raceway system as the equipment grounding conductor.

3.6 FIELD QUALITY CONTROL

A. Test power, power/switch, and control cables for continuity, shorts, and unintentional grounds.

B. Verify proper labeling of cables.

C. Submit test and inspection report.

END OF SECTION

FOR LANL USE ONLY

This project specification is based on LANL Master Specification 28 1321, Rev. 2, dated July 22, 2008.

SECTION 28 3100

FIRE DETECTION AND ALARM

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Design, furnish, install, test, certify, and place into service a complete addressable fire alarm system. The system shall be complete with all hardware, software, and memory specifically tailored for this installation.

B. Provide a fire alarm system consisting of, but not limited to the following components:

1. Fire alarm control panel (FACP).
2. Conduit and wiring necessary to connect the FACP to alarm initiating devices, notification appliances and auxiliary equipment.
3. Internal Digital Alarm Communicator Transmitter (DACT).
4. Remote annunciator panel for Operations Center.
5. Addressable manual fire alarm stations.
6. Addressable analog area smoke detectors.
7. Addressable analog duct smoke detectors.
8. Addressable monitor module for connections to sprinkler waterflow alarm switches.
9. Addressable monitor module for connections to sprinkler supervisory switches and tamper switches.
10. Audible and Visual notification appliances.
11. Addressable relay modules for connections to air handling systems shutdown relays and drain solenoid relays.
12. Battery standby.
13. Transient suppression devices for conduit runs to LLW Utility Building.

C. Provide a fire alarm system that conforms to the requirements of NFPA 72 National Fire Alarm Code (current edition), NFPA 70 National Electrical Code (current edition), ASME A17.1 Safety Code for Elevators and Escalators, and NFPA 90A Standard for the Installation of Air-Conditioning and Ventilating Systems (current edition).

1.2 RELATED SECTIONS

A. Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

B. Section 21 1313, "Wet-Pipe Sprinkler Systems."

C. Section 26 0533, "Raceway and Boxes for Electrical Systems."

D. Section 26 0553, "Identification for Electrical Systems."

1.3 ABBREVIATIONS AND ACRONYMS, DEFINITIONS, AND REFERENCES

A. Refer to Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

1.4 SYSTEM FUNCTIONAL DESCRIPTION

A. The system shall identify any off normal condition and log each condition into the system database as an event.

1. The system shall automatically display on the FACP the first event of the highest priority by type. The priorities and types shall include alarm, supervisory, and trouble.

2. The system shall have a queue operation, and shall not require event acknowledgment by the system operator. The system shall have a labeled color-coded indicator for each type of event.

3. The user shall be able to review each event by selecting scrolling keys.

4. New alarm, supervisory, or trouble events shall sound a silenceable audible signal at the FACP.

B. Operation of any alarm-initiating device (except duct smoke detectors) shall automatically:

1. Update the control/display as described above.

2. Audibly and visibly annunciate the alarm condition at the FACP.

3. Audibly and visibly annunciate the alarm condition in the LLW facility Operations Center

4. Sound all alarm signals throughout the building. The fire alarm evacuation tone shall be the three-pulse temporal pattern.

5. Turn on all strobe lights throughout the building (LLW Treatment Building and LLW Utility Building may annunciate independently based on the source of the alarm).

6. Operate the alarm relay and initiate the transmission of an alarm signal to the LANL Central Station over a digital alarm communicator system (DACS).

7. Operate control relay contacts to shut down all HVAC units serving the floor of alarm initiation.

8. Operate control relay contacts to open floor drain valve solenoids when sprinkler system flow is initiated.

C. Activation of a supervisory initiating device shall:

1. Update the control/display as described above.

2. Audibly and visibly annunciate the supervisory condition at the FACP.

3. Audibly and visibly annunciate the supervisory condition in the LLW facility Operations Center

4. Operate the supervisory relay and initiate the transmission of a supervisory signal to the LANL Central Station over a DACS.

5. Duct smoke detectors shall report as supervisory, and upon initiation, operate the HVAC shutdown relay.

D. The entire fire alarm system wiring shall be electrically supervised to automatically detect and report trouble conditions to the FACP. Any opens, grounds or disarrangement of system wiring and shorts across alarm horn/strobe wiring shall automatically:

1. Update the control/display as described above.

2. Operate the trouble relay contacts to initiate the transmission of a trouble signal to the LANL Central Station over a DACS.

3. Visually and audibly annunciate a general trouble condition on the FACP and Operations Center. The visual indication shall remain on until the trouble condition is repaired.

E. The FACP shall have an optional LED Annunciator/Switch Card component installed and programmed for pre-defined disable groups particular to this installation. Disable groups shall consist of the following to facilitate routine inspection, testing and maintenance (ITM):

1. All control relays that initiate/control HVAC shutdown listed in Paragraph 1.4B.7.

2. All control relays that release trench drain valve solenoids in Paragraph 1.4B.8.

3. All notification appliances.

1.5 SYSTEM DESIGN

A. System Design: Provide the services of a qualified factory trained fire alarm designer for the FACP to be installed on this project. The designer shall assure the completeness and correctness of the fire alarm system design by performing the following:

1. Prepare shop drawings of FACP indicating location of components, interconnection of components and connections to alarm initiating, indicating, and auxiliary circuits.

2. Prepare a system input/output matrix to verify that the proper sequences occur for each initiating point or zone.

3. Prepare shop drawings of fire alarm layout, conduit and wiring plans. Show location of all fire alarm appliances, conduit layout, quantity, and type of wires in each conduit, and interface with other systems for functions such as Central Station signaling, fan shutdown, damper operation.

4. Prepare terminal-to-terminal field wiring diagrams for alarm initiating, indicating and auxiliary circuits; detail the interfaces with other systems; indicate labeling of each fire alarm system conductor.

5. Calculate conductor sizes for each alarm initiating, indicating, and auxiliary circuit; limit voltage drops so that they do not exceed the FACP manufacturer's limitations for the most remote device on each circuit.

6. Prepare battery load calculations for the FACP and any remote power supply panels and select proper battery size.

7. Calculate alarm signal in all spaces to comply with ADAAG requirements: minimum 15 dBA above ambient at all locations, but not over 120 dBA at any location.

8. Select alarm initiating, alarm indicating, and auxiliary devices compatible with FACP.

1.6 SUBMITTALS

A. Provide the following submittals according to the requirements of Exhibit I:

1. Calculations: Submit the following calculations at least 30 days prior to scheduled start of fire alarm system installation.

a. System battery capacity calculations to demonstrate that the battery is sized to support the system operating in a "normal" (non-alarm) condition for not less than 24 hours plus a general alarm condition (all alarm notification appliances used for evacuation being activated) for not less than 10 minutes following the completion of the 24 hour period. Battery shall be sized to include an additional 50% safety margin above calculated system demand.

b. Audible signal distribution calculations to demonstrate that the notification appliances are selected and located so fire alarm signal sound intensity levels in all occupied areas will be not less than those required by NFPA 72.

c. Voltage drop calculations to demonstrate that the signal voltage at the most remote notification appliances on each circuit will not be less than the FACP or the notification appliance manufacturer's recommendations.

d. Submit final battery capacity calculations and final voltage drop calculations at least one week prior to final system acceptance test.

2. Catalog Data: Submit catalog data at least 30 days prior to scheduled start of fire alarm system installation for all equipment furnished under this section.

3. Certifications: Submit certifications as follows:

a. Within 30 days after Notice to Proceed, submit certifications of the qualifications of the fire alarm installing firm as described in Paragraph 1.7.

b. Within 30 days after Notice to Proceed, submit certifications of the qualifications of the fire alarm system technician as described in Paragraph 1.7.

c. Provide certification from the fire alarm control manufacturer that proposed alarm-initiating devices, alarm appliances, and auxiliary devices are compatible with the FACP and other auxiliary equipment.

d. Provide "Record of Completion" and associated documentation for the completed system according to NFPA 72 prior to the system acceptance test.

4. Installation Instructions: Submit installation instructions at least 30 days prior to the scheduled start of fire alarm system installation.

5. Materials and Parts List: Submit materials and parts list at least 30 days prior to scheduled start of fire alarm system installation.

6. Shop Drawings: Submit system shop drawings as follows:

   a. Prepare floor plan drawings using a minimum scale of 1/8" - 1'0" for plans and 1/4" = 1'-0" for details.

   b. Hand lettering shall be a minimum of 3/16" and other lettering a minimum of 1/8" to permit microfilm reductions.

   c. Show location of FACP, all fire alarm appliances, conduit layout, quantity and type of wires in each conduit, and interface with other systems for functions such as central station signaling, fan shutdown, damper operation, and elevator recall.

   d. Show layout of the FACP indicating location of components, interconnection of components, and connections to alarm initiating, indicating, and auxiliary circuits.

   e. Submit shop drawings at least 30 days prior to the scheduled start of fire alarm system installation. Installation shall not proceed without design approval by the LANL Fire Protection Group.

   f. Submit final shop drawings at least one week prior to final system acceptance test.

7. FACP Program: Submit FACP program as follows:

   a. Provide the FACP input/output matrix and a copy of the proposed FACP program at least 30 days prior to the anticipated final tie-in/acceptance date of the fire alarm system.

   b. Provide the final FACP input/output matrix and the final FACP program at least two weeks prior to the anticipated final tie-in/acceptance test.

8. Test Reports: Submit test reports as follows:

   a. Submit a report of the pre-final tests indicating system status and corrective actions required before the final acceptance tests.

   b. Submit a test plan for the final acceptance tests at least 30 days prior to scheduled final acceptance tests.

   c. Submit a report of final acceptance tests according to requirements in NFPA 72.

9. Wiring Diagrams: Submit wiring diagrams as follows:

   a. Provide terminal-to-terminal wiring diagrams for alarm circuits, supervisory circuits, remote power supply panels, and interfaces with other systems such as HVAC and elevators.

   b. Submit wiring diagrams at least 30 days prior to scheduled start of fire alarm system installation.

   c. Submit final wiring diagrams at least one week prior to final acceptance testing.

10. O&M Manual: Submit operating and maintenance data.

    a. Submit operating and instruction manuals prior to testing of the system.

    b. Submit five complete sets of project-specific operating and maintenance instruction manuals upon successful completion of testing. Provide complete, step-by-step testing instructions giving recommended and required testing frequency of all equipment, methods for testing each piece of equipment, and a complete trouble shooting manual explaining how to test the primary internal parts of each piece of equipment. Maintenance instructions shall be complete, easy to read, understandable, and shall provide the following information:

        1) Provide instructions for replacing any components of the system, including internal parts.

        2) Provide a list of recommended spare parts.

        3) Provide instructions for periodic cleaning and adjustment of equipment with a schedule of these functions.

        4) Provide a complete list of all equipment and components with information as to the address and telephone number of both the manufacturer and local supplier of each item.

    c. Provide operating instructions prominently displayed on a separate sheet located next to the FACP in accordance with UL 864.

11. Project Record Documents: Submit project record documents as follows:

    a. Provide updated shop drawings reflecting as-built conditions showing the work completed under this section. Include notes on special systems or devices, new and existing, locations of equipment, actual conduit installation, wiring color-coding, wire tag notations, interconnections between all equipment, and internal wiring of the equipment. Include conduit size, conductor size, and number of conductors per conduit.

    b. Provide the updated shop drawings on Mylar reproducible media and on electronic media in AutoCAD "*.dxf" or "*.dwg" format.

12. Warranties: Submit warranties. The subcontractor shall warrant all equipment and wiring free from inherent mechanical and electrical defects for one year (365 days) from the date of final acceptance.

1.7 QUALITY ASSURANCE

A. Qualification of the Installing Firm: The installing firm shall:

1. Be licensed by any state in the United States to engage in the design, fabrication, and installation of fire alarm systems.

2. Have satisfactorily installed at least twenty fire alarm systems of equivalent nature and scope to the system described in this section.

3. Provide the services of a qualified fire alarm system technician to design the fire alarm system and to test the completed system.

4. Be a factory-certified representative of the manufacturer of the FACP that will be used on this Project.

B. Qualifications of the fire alarm system technician: The fire alarm system technician shall:

1. Be factory trained in the theory, operation, installation, and troubleshooting of the FACP that will be used for this project.

2. Have satisfactorily designed at least twenty fire alarm systems of equivalent nature and scope to the system described in this section.

3. Have satisfactorily field-tested at least twenty fire alarm systems of equivalent nature and scope to the system described in this section.

4. Be NICET (National Institute for Certification in Engineering Technologies) Fire Alarm Certified, or certified by an equivalent organization acceptable to the LANL Fire Authority Having Jurisdiction.

1.8 PRODUCT HANDLING

A. Materials and Equipment: Protect materials and equipment from damage during shipping, storage, and installation.

PART 2 PRODUCTS

2.1 GENERAL

A. Provide materials and equipment that are new and unused, free of defects, specifically designed for the use intended, conform to the requirements of the NEC and NFPA 72, and are NRTL listed for the intended use.

B. Provide products suitable for operation at an elevation of 7,500 ft.

2.2 FIRE ALARM CONTROL PANEL

A. The fire alarm control panel (FACP) shall incorporate all control electronics, relays, and necessary modules and components in a flush or semi-flush mounted cabinet (dependent on FACP mounting location). The operating controls and zone/supervisory indicators shall be located behind locked door with viewing window. All control modules shall be labeled, and all zone locations shall be identified. The assembly shall contain a base panel, system power supply and battery charger with additional modules to meet the requirements of these specifications.

B. System circuits shall be configured as follows: Addressable analog loops Class B/Style 4; Initiating Device Circuits (if used) Class B/Style B; Notification Appliance Circuits Class B/Style Y.

C. The system shall store all basic system functionality and job specific data in non-volatile memory. The system shall survive a complete power failure intact.

D. The system shall allow down loading of a job specific custom program created by system application software. It shall support programming of any input point to any output point.

E. The system shall support distributed processor intelligent detectors with the following features: integral multiple differential sensors, environmental compensation, pre-alarm, dirty detector identification, automatic day/night sensitivity adjustment, dual normal/alarm LEDs, relay bases, and isolator bases.

F. The system shall use full digital communications to supervise all addressable loop devices for placement, correct location, and operation. It shall allow swapping of "same type" devices without the need of addressing and impose the "location" parameters on replacement device. It shall initiate and maintain a trouble if a device is added to a loop and clear the trouble when the new device is defined in the system.

G. The system shall have a nationally recognized testing laboratory (NRTL) listed detector sensitivity test feature, which will be a function of the smoke detectors and performed automatically.

H. All panel modules shall be supervised for placement and initiate a trouble signal if damaged or removed.

I. The system shall have a CPU monitoring circuit to initiate a trouble signal should the CPU fail.

J. The system evacuation signal rate shall be suitable to support audio-visual combination-type electronic three pulse temporal pattern sounder and strobe combination units.

K. The system program shall meet the requirements of this project, current codes and standards, and satisfy the LANL Fire Authority Having Jurisdiction.

L. Passwords shall protect any changes to system operations.

M. The power supply shall be a high efficiency switch mode type with line monitoring to automatically switch to batteries for power failure or brown out conditions. The automatic battery charger shall have low battery discharge protection. The power supply shall provide internal power and 24V dc for notification appliance circuits. All outputs shall be power limited. The battery shall be sized to support the system for 24 hours of supervisory and trouble signal current plus general alarm for 10 minutes.

N. The FACP shall have a high contrast, alphanumeric display to show system status, alarm information, and supervisory information. The FACP shall have LED indicators for the following common control functions; AC Power, alarm, supervisory, monitor, trouble, disable, ground fault, CPU fail, and test. There shall be control keys and visual indicators for; reset, alarm silence, trouble silence, and drill.

O. Battery boxes, if required, shall be UL Listed for the purpose.

P. The FACP shall have a digital alarm communicator transmitter (DACT) module to transmit detailed alarm, supervisory and trouble signals to a digital alarm communicator receiver (DACR) at a Central Monitoring Station.

1. The DACT shall support dual telephone lines, "contact ID" communications format, and configured for dual tone multi-frequency (DTMF).

2. The DACT shall be listed for "Central Station Fire Service" and for "Proprietary Station Fire Service" and shall be of the same manufacturer as the control panel.

3. The DACT shall transmit the following information to the DACR:

   a. Fire alarm per point addressable device (e.g., detector or water flow activation, manual pull stations, etc.)

b. Supervisory signal per addressable device (e.g., valve tamper)

c. General System Trouble (alarm panel trouble)

1) Loss of AC Power
2) Communication Line Failure (Primary and Backup)
3) Trouble per zone or point addressable device

4. Restoration of each signal condition identified above shall be transmitted to the LANL Central Station.

5. The secondary telephone line shall only be utilized for signal transmission in the event that attempts to communicate utilizing the primary line are unsuccessful.

6. The secondary telephone line shall have the same account code and communication format as the primary line.

7. A general alarm or supervisory signal shall not be transmitted by the DACT when specific point/zone information is transmitted.

8. Loss of AC power shall be transmitted 6 hours after the detected failure.

9. A test signal shall be sent once every 24 hours.

10. For consistency, telephone wire color configuration shall be as follows:

a. Four pair wire (preferred method):

To DACT				**To Premise Telephone**			
Cable 1		**Cable 2**		**Cable 1**		**Cable 2**	
Tip 1	Ring 1	Tip 2	Ring 2	Tip House 1	Ring House 1	Tip House 2	Ring House 2
White/ Blue	Blue/W hite	White/ Green	Green/ White	White/ Orange	Orange / White	White/ Brown	Brown/ White

b. Two pair wire:

To DACT				**To Premise Telephone**			
Cable 1		**Cable 2**		**Cable 1**		**Cable 2**	
Tip 1	Ring 1	Tip 2	Ring 2	Tip House 1	Ring House 1	Tip House 2	Ring House 2
Green	Red	Green	Red	Black	Yellow	Black	Yellow

Q. Manufacturers: Edwards "Est Quick-Start" Model QS-4 or Notifier "NFS 2-640," no substitutions.

2.3 ANNUNCIATOR PANEL

A. Provide remote annunciator CPU/Display in the Operations Room that annunciates all fire alarm system activity.

B. Manufacturers: EST "MIR-QSC-CPU-1" or Notifier "FDU-80" no substitutions.

2.4 LED ANNUNCIATOR/SWITCH CARD

A. Provide compatible LED annunciator/switch card components programmed per the pre-defined disable groups in Paragraph 1.4E particular to this installation.

B. Manufacturers: EST "SL-30 LED/Switch Card" or Notifier "Annunciator Control Module ACM-24AT," no substitutions.

2.5 ADDRESSABLE PHOTOELECTRIC DETECTORS

A. Provide addressable, analog, intelligent, photoelectric type smoke detectors that are compatible with the FACP.

1. The photoelectric detector shall be rated for ceiling installation at a minimum of 30 ft (9.1m) centers and be suitable for wall mount applications.

B. Manufacturers: "EST SIGA-PS" or NOTIFIER "FSP-851," or equivalent.

2.6 DETECTOR MOUNTING BASES

A. Provide standard detector mounting bases suitable for mounting on 3-1/2" or 4" octagon box and 4" square box. The base shall contain no electronics and support all detector types. Removal of the detector shall not affect communications with other detectors.

B. Manufacturers: EST "SIGA-SB" or Notifier "B710LP Low profile base," or equivalent.

2.7 DUCT SMOKE DETECTOR AND HOUSING

A. Provide addressable photoelectric duct smoke detectors that are compatible with the FACP and listed for the maximum air flow velocity anticipated.

B. Provide smoke detector duct housing assemblies to facilitate mounting an intelligent analog photoelectric detector along with a standard relay or isolator detector mounting base. Provide for variations in duct air velocity between 300 and 4000 feet per minute. Protect the measuring chamber from damage and insects. Provide an air exhaust tube and an air sampling inlet tube that extends into the duct air stream. Provide drilling templates and gaskets to facilitate locating and mounting the housing. Finish the housing in baked red enamel.

C. Where a duct detector is installed in a concealed location more than 10 ft above the finished floor, or in an arrangement where the detector alarm indicator is not readily visible to responding personnel, the detector shall be provided with a remote alarm indicator. Remote alarm indicators shall be installed in a readily accessible location and shall be clearly labeled to indicate its function.

D. Provide duct detector wiring so that detector can be reset at the FACP.

E. Manufacturers: EST "SIGA-SD" or Notifier "FSD-751PL," or equivalent.

2.8 AUTOMATIC SPRINKLER SYSTEM

A. Refer to Section 21 1313, "Wet-Pipe Sprinkler Systems," for pressure switches, flow switches and valve supervisory switches associated with the automatic sprinkler system.

B. Provide intelligent single input or dual input modules as required to connect pressure switches, flow switches, and valve supervisory switches to the addressable analog loop. Each input shall provide a supervised class b input circuit.

C. Manufacturers: EST "SIGA-CT1" single-input, EST "SIGA-CT2" dual-input or Notifier "FlashScan Monitor Module FMM-1" or "FDM-1 FlashScan dual monitor module," or equivalent.

2.9 ADDRESSABLE MANUAL PULL STATIONS

A. Provide addressable double-action, non-coded manual pull stations that are compatible with the FACP.

B. The fire alarm station shall be of Lexan or metal construction with an internal toggle switch. Provide a key locked test feature. Finish the station in red with white "PULL IN CASE OF FIRE" lettering. The manual station shall be suitable for mounting on 2-1/2" deep 1-gang boxes and 1-1/2" deep 4" square boxes with 1-gang covers.

C. Provide the appropriate back boxes and mounting plates for flush-mounting or surface mounting (depending on the building construction).

D. Manufacturers: EST "SIGA 278" or Notifier "NBG-12LX," or equivalent.

2.10 ADDRESSABLE CONTROL RELAY MODULES

A. Provide addressable control relay modules that are compatible with the FACP.

B. The control relay module shall provide one form "C" dry relay contact rated at 2 amps at 24 Vdc to control external appliances or equipment shutdown. The control relay shall be rated for pilot duty and releasing systems. The position of the relay contact shall be confirmed by the system firmware.

C. Manufacturers: EST "SIGA-CR" or Notifier "FRM-1," or equivalent.

D. Provide additional relays with voltage and current ratings as required to perform functions such as air handling system shutdown and elevator recall.

2.11 SOUNDER AND SIGNAL STROBE COMBINATION DEVICES

A. Provide NRTL listed 24 VDC audio-visual combination-type electronic three-pulse temporal pattern sounder and strobe combination units that are compatible with the FACP.

B. Sounders shall include three-pulse temporal pattern generating electronics, audio transducer, and screw terminals housed in a red housing. Acoustical output shall meet requirements of UL 464. The audible signal shall be the "American National Standard Audible Emergency Evacuation Signal" (three-pulse temporal pattern) in accordance with ANSI S3.41, *Audible Emergency Evacuation Signal.*

C. Strobe signal output and flash rate shall meet UL 1971 and ADAAG requirements. Unit shall have a xenon flash tube enclosed in a clear Lexan lens and shall produce a synchronized strobe flash. Provide strobes with flash output levels as required to meet NFPA 72 visual signal requirements for each space.

D. Horn/strobe shall mount to a 4" x 2-1/8" deep electrical box with single device cover. Provide weatherproof wall boxes for outdoor mounting.

E. Manufacturers: EST "GENISIS" series, or Wheelock "AS" series, or equivalent.

F. Voice Alarm Systems shall utilize System Sensor Spectralert series appliances.

2.12 CONDUIT

A. Install fire alarm wiring in conduit. Minimum conduit size 3/4 inch.

B. Refer to Section 26 0533, "Raceway and Boxes for Electrical Systems," for conduit systems.

2.13 JUNCTION BOXES

A. Refer to Section 26 0533, "Raceway and Boxes for Electrical Systems," for junction boxes.

2.14 WIRING

A. Color Code: Use the following color code for the fire alarm system wiring:

1. Black - 120-Volt AC phase wire.
2. White - 120-Volt AC neutral wire.
3. Green - System ground wire.
4. Brown - Negative connection for strobe device (If wired separately from horns).
5. Orange - Positive connection for strobe device (If wired separately from horns).
6. Blue - Negative connection for horn circuit or horn/strobe combination circuit.
7. Yellow - Positive connection for horn circuit or horn/strobe combination circuit.
8. Gray - Negative conventional alarm initiating device connection.
9. Violet - Positive conventional alarm initiating device connection.
10. Black - Negative circuit connection for duct smoke detector reset, HVAC interlock, and other auxiliary connections.
11. Red - Positive circuit connection for duct smoke detector reset, HVAC interlock, and other auxiliary connections.
12. Black/Red Twisted Pair - Addressable device data loop, evacuation speaker circuit.

B. Conductors: Provide alarm and supervisory signaling system conductors that meet the requirements of Article 760 in the NEC and are NRTL listed for the type of service to which they will be subjected. Minimum conductor requirements shall be as follows:

1. Use red-jacketed NEC type FPL cable with No. 16 AWG (minimum) twisted-pair conductors for addressable devices; use shielded twisted-pair cables if required by the FACP manufacturer. Other low voltage conductors shall be type TFN, No. 16 AWG (minimum), thermoplastic insulation, and single solid copper conductor.
2. Power conductors shall be type THHN/THWN, No. 12 AWG, thermoplastic insulation, and single solid copper conductor.

3. Size conductors of the fire alarm system as recommended by the manufacturer, based on the operating ampacity of the circuit and the permissible resistance and voltage drop characteristics that will allow proper operation of the equipment. Provide conductors selected to provide voltages within the manufacturer specification limits for the most remote fire alarm notification appliance or field device.

4. Design each addressable analog loop so device loading will not exceed 80% of loop capacity in order to allow space for future devices.

2.15 TEST EQUIPMENT

A. Provide any special test equipment manufactured by the fire alarm equipment manufacturer for maintenance, testing, or troubleshooting.

2.16 SURGE PROTECTION

A. Provide a UL 1449 listed 120V surge protective device for the main FACP, each sub-FACP, and each booster power supply that has a 120V supply circuit.

1. Device shall be capable of absorbing a maximum single pulse of at least 6,500 ampere.

2. Clamping voltage shall not exceed 330 volts line-to neutral when tested in accordance with ANSI/IEEE C62.31 category C1/B3.

3. Manufacturer: EDCO model "FAS-120AC" or as recommended by the FACP manufacturer.

B. Provide a UL 497B listed surge protective device for each analog initiating device signaling circuit entering/leaving each building that is monitored by the FACP.

1. Device shall be capable of absorbing a peak 8x20 microsecond current of 10,000 amperes at least 10 times.

2. Clamping voltage shall not exceed 30 volts.

3. Capacitance shall not exceed 50pf.

4. Provide matching receptacle for plug-in surge protective devices.

5. Manufacturer: EDCO model "PC642C-030LC" (protects 2 pairs) and "PCB1B" socket, or as recommended by the FACP manufacturer.

C. Provide a UL 497B listed surge protective device for each 24-volt initiating device circuit or control circuit entering/leaving each building that is monitored by the FACP.

1. Device shall be capable of absorbing a peak 8x20 microsecond current of not less than 10,000 amperes at least 10 times.

2. Clamping voltage shall not exceed 30 volts.

3. Provide matching receptacle for plug-in surge protective devices.

4. Manufacturer: EDCO model "PC642C-030" (protects 2 circuits) and "PCB1B" socket, or as recommended by the FACP manufacturer.

D. Provide a UL 497B listed surge protective device for each 24-volt notification appliance circuit entering/leaving each building that is monitored by the FACP.

1. Protective device shall have a series resistance not exceeding 0.2 ohms per pair and shall be capable of carrying a continuous current of 5 amperes.
2. Device shall be capable of absorbing a peak 8/20 microsecond current of 5000 amperes and a 2000-ampere occurrence at least 50 times.
3. Clamping voltage shall not exceed 43 volts.
4. Provide matching receptacle for plug-in surge protective devices.
5. Manufacturer: EDCO model "PHC-043" (protects 2 circuits) and "PCB1B" socket, or recommended by the FACP manufacturer.

E. Provide a single point ground bus for each enclosure containing one or more surge protective devices. Manufacturer: EDCO model "TER-BUS" or as recommended by the FACP manufacturer.

PART 3 EXECUTION

3.1 FIELD CONDITIONS

A. Prior to installation carefully inspect the installed work of other trades, whether pre-existing or part of this project and verify that such work is complete to the point where the installation of the fire alarm system may properly commence.

B. Notify the LANL Subcontract Technical Representative (STR) should conditions exist, not resulting from work of this project, that prohibit the installation from conforming to applicable codes, regulations, standards and the original approved design.

3.2 INSTALLATION

A. General:

1. Install the fire alarm system in accordance with the NEC, NFPA 72, and this specification.
2. Refer to Section 26 0553, "Identification for Electrical Systems," for supporting device requirements for fire alarm cabinets, conduit, and equipment.
3. Verify dimensions in the field. Lay out work in the most direct and expeditious manner to avoid interference.
4. Coordinate necessary shutdowns of existing systems by notifying the LANL STR a minimum of seven working days before rendering such systems inoperative. Do not render inoperative, any system, without the prior approval of the LANL STR. The LANL STR will initiate and submit the LANL Fire Protection Impairment Procedure.
5. Coordinate fire alarm detectors and associated equipment with existing ceiling or roof materials, lighting, ductwork, conduit, piping, suspended equipment, structural and other building components.

6. Coordinate installation of fire alarm system with work of other trades. Protect fire alarm equipment with suitable coverings until completion of Project.

B. Device Mounting Heights:

1. Install manual pull stations with center 48 inches above finished floor.
2. Install combination audible/visual notification appliances with the bottom 80 inches above finished floor or 6 inches below ceiling, whichever is lower. In high bay type areas the devices may be installed at a maximum of 96 inches above the floor.
3. Comply with ADA Accessibility Guidelines (ADAAG) for device mounting heights and locations.

C. FACP Installation

1. Install FACP following manufacturer's written instructions, NFPA 72, and the NEC.
2. Locate the FACP in the main building sprinkler riser room so fire department personnel entering the building can readily access it. Coordinate location of FACP with the LANL Fire Protection Group.
3. Surface mount FACP plumb and rigid without distortion of the box.
4. Train conductors in cabinet gutters neatly in groups; bundle and wrap with cable ties after completion of testing.
5. Tighten electrical connectors and terminals, including grounding connections, according to the manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A.

D. Wiring Installation:

1. Install fire alarm system wiring in conduit raceway.
2. Do not pull wire or cable until the conduit system is complete between pull points.
3. Bundle conductors in panels and boxes into groups by service and destination.
4. Run electronic cable continuous between termination points. No splicing is permitted without prior approval from the LANL STR. Where splicing is approved, use terminal strips that are acceptable to the LANL Fire Protection Group; do not use "wire nuts."
5. Do not install AC current carrying conductors in the same raceway with the DC or digital fire alarm detection and signaling conductors.
6. Circuit each addressable analog loop so device loading shall not exceed 80% of loop capacity in order to allow space for future devices--the loop shall have Class B operation. Where it is necessary to interface conventional devices provide intelligent modules to supervise Class B wiring.
7. Minimize the number of T-taps in fire alarm addressable data circuits and adhere to the manufacturer requirements/limitations. Make no T-Taps in notification appliance circuits. T-taps shall only be made on device

terminals or on terminal strips that are acceptable to the LANL Fire Protection Group, do not use "wire nuts."

8. Make allowances in conductor length at panels and other enclosures to permit forming the conductors neatly within the enclosures. Where wiring troughs are not provided with the enclosures, neatly cable and adequately support the wiring.

9. Ring out and identify power and control conductors before terminal connections are made. Check polarity and phasing and make changes as required before making terminal connections.

10. Test conductors for continuity and for freedom from shorts or unintentional grounds.

E. Junction Box Installation: Refer to Section 26 0533, Raceways and Boxes for Electrical Systems, for installation requirements.

F. Conduit Installation: Refer to Section 26 0533, Raceway and Boxes for Electrical Systems, for conduit installation requirements. Provide minimum 3/4" fire alarm system conduit.

G. Install sounder and signal strobe notification appliances in the following locations to obtain an audible signal level that is at least 15 dB above ambient but does not exceed 120 dB at any location:

1. Corridors
2. Conference Rooms
3. Mechanical Equipment Rooms
4. Computer Rooms
5. Enclosed Offices
6. Common Areas such as Restrooms (strobes only).
7. Use a strobe-only device in the vicinity of the FACP.

H. Surge Protective Device Installation

1. Install a 120V surge protective device for the main FACP, each sub-FACP, and each booster power supply.

2. Install a surge protective device for each initiating device circuit, notification appliance circuit, data, and signaling line circuit entering/leaving each building that is monitored by the FACP.

3. If permitted by the FACP manufacturer, install surge protective devices in the FACP cabinet.

4. If the FACP manufacturer does not allow surge protective devices to be installed within the FACP cabinet, install one or more metal enclosures near the protected fire alarm equipment. Provide separate enclosures for 120V and signal voltage devices, or provide one enclosure with a metal partition to separate the 120V from the signal voltage devices.

5. Install a single point ground bar in the enclosure for the surge protective devices. Bond the ground bar to the enclosure and to the power circuit equipment-grounding conductor. Connect each surge protective device to the ground bar with a separate 12 AWG solid, green-insulated, ground wire. Keep ground wires as short and straight as possible.

6. Install surge protective devices in accordance with manufacturer's instructions, keeping leads and ground conductors as short and straight as possible.

I. Identification

1. Label each conductor at each terminal and junction point. Use wire markers specified in Section 26 0553, Identification for Electrical Systems. On wire markers indicate the type of fire alarm circuit (e.g. Pull Stations, Fan Shutdown, Alarm Strobes, etc.).

2. Mark floor in front of cabinet(s) to show the NEC required working clearances according to Section 26 0553, Identification for Electrical Systems.

3. Label fire alarm junction boxes with 2-1/4" x 1/2" (minimum size) pressure sensitive vinyl markers having "FIRE ALARM" in red letters on a white background.

4. Label all devices with address/zone information. Use self-adhesive vinyl labels with 3/4 inch (minimum) lettering easily visible without a ladder.

3.3 PAINTING

A. Exposed Surfaces: Paint exposed fire alarm conduit, panels, cabinets, pullboxes, supports, and other electrical equipment as follows:

1. Galvanized Surfaces: Paint for repairing galvanized materials shall be zinc-rich type.

2. Refinishing: Thoroughly clean and touchup shop primed or finish painted surfaces damaged in handling or installation with paint supplied with the equipment or an approved matching paint.

3. Interior Conduit: Paint new exposed interior conduit in rooms finished and/or occupied to match the existing background paint color. Paint conduit to be painted with one coat of primer. Paint conduit to match the existing background colors with two coats of paint to provide a minimum thickness of 6 mils.

3.4 EQUIPMENT INSTALLATION

A. Install devices or equipment not specifically covered by these specifications in accordance with manufacturer's instructions.

3.5 CONNECTION TO LANL CENTRAL STATION

A. Install 6 x 6 x 4 enclosure adjacent to the FACP with a conduit to the appropriate factory knockout.

B. Install a 3/4 inch conduit with measuring pull tape from the 6 x 6 x 4 enclosure to the main telecommunications room.

C. Install one GFE Category 5e telecommunications cable in the conduit and label each end of the cable as "emergency."

D. LANL will terminate the telecommunications cable on two 8-pin RJ-31X telephone outlet jacks in a 2-port outlet that is mounted inside the 6 x 6 x 4 enclosure. LANL will label one jack as "primary," and the other as "backup."

E. LANL will terminate the telecommunications cable pairs to two separate lines (numbers) at the telecommunications room, selecting dedicated numbers or low-usage (lobby, conference room, etc), voice-grade, loop-start DTMF numbers that provide timed-release disconnect.

F. LANL will connect the "primary" and "backup" number ports on the DACT to the corresponding telephone outlet jacks.

3.6 CLEANING

A. Blow out junction boxes and fire alarm equipment not hermetically sealed with clear, dry, oil-free (15 psig maximum) air to remove dust and dirt prior to energizing.

3.7 FIELD QUALITY CONTROL

A. Provide the services of a qualified factory trained and certified technician for the FACP installed on this project. The factory technician shall assure the completeness and correctness of the installation by performing the following:

1. Prepare as-built documentation of FACP indicating location of components, interconnection of components, and connections to alarm initiating, indicating and auxiliary circuits.
2. Field verify and mark as-built shop drawings of fire alarm layout, conduit and wiring plans, and point-to-point field wiring diagrams.
3. Verify correct labeling of fire alarm system conductors.
4. Verify that conductor sizes are adequate for each alarm initiating, indicating and auxiliary circuit.
5. Prepare as-built battery load calculations.
6. Measure and adjust audible alarm signal in all spaces to comply with ADAAG requirements: minimum 15 dBA above ambient, but not over 120 dBA at any location.
7. Test all devices for proper supervision and alarm operation.
8. Test all interlocks with HVAC and elevator system for proper operation.
9. Perform pre-final acceptance inspections and tests of the fire alarm system modifications.
10. Prepare final acceptance test plan.

B. After the pre-final test, provide a report to the LANL Project Leader indicating the status of the fire alarm system and any corrective actions required before the acceptance tests.

C. Submit a detailed test plan for the final acceptance test.

1. Submit the test plan not less than 10 working days before the planned final acceptance date.
2. Follow test methods outlined in NFPA 72.

D. Submit FACP program at least two weeks prior to final acceptance test.

E. Submit final drawings, calculations, and manufacturer's data at least one week prior to final acceptance test.

F. Coordinate date of final acceptance test with installer, LANL Project Leader, LANL Fire Protection Group representative, and subtier subcontractors for HVAC, sprinklers, and elevator controls. Make corrective actions before final acceptance test date.

3.8 FINAL ACCEPTANCE TEST

A. Notify LANL STR a minimum of 2 weeks in advance of final acceptance tests. The more advance notice will help minimize scheduling conflicts and delays. Perform final acceptance tests in the presence of an authorized representative of the LANL STR and an authorized representative of the LANL Fire Protection Group.

B. Before the final acceptance test begins, present a preliminary copy of the Record of Completion to the authorized representative of the LANL Fire Protection Group.

1. Preliminary Record of Completion shall be of the form required by NFPA 72.

2. Indicate on the preliminary Record of Completion that the pre-final inspections and tests have been performed and all corrective actions have been completed.

3. The final acceptance test will not proceed before the Record of Completion is presented to the authorized representative of the LANL Fire Protection Group.

C. Perform final acceptance tests on the completed fire alarm system:

1. Follow the approved test plan and comply with NFPA 72 requirements.

2. Test FACP and the connected initiating, alarm, and auxiliary devices.

3. Perform 24-hour discharge test on the FACP batteries.

4. LANL will perform tests on connections made by LANL.

5. LANL Telecommunications Group will perform the acceptance test of the telephone lines from the modular plug connectors, to verify telephone line continuity and switch features before turning lines over to the LANL Fire Protection Group.

D. At the final acceptance test, have marked-up shop drawings and point-to-point wiring diagrams available for review and verification. Final acceptance test will not proceed without these as-built documents. If LANL verification of the as-built documents reveals errors, re-verify the complete fire alarm raceway and wiring system in the presence of a LANL Fire Protection Group representative.

E. Correct deficiencies discovered in the final acceptance test and re-test fire alarm system until satisfactory test results are obtained.

F. Upon successful completion of acceptance tests, submit a final "Record of Completion" and "Inspection and Testing Form" as required by NFPA 72.

G. Submit a "recommended spare parts" list for the installed fire alarm system, along with the Record of Completion.

3.9 SYSTEM IDENTIFICATION PLACARD

A. Furnish and install a permanently mounted placard in or adjacent to the fire alarm control cabinet.

B. Provide the following information typewritten or engraved on the placard:

1. Name, address and telephone number of installing subcontractor.
2. Reference to the standards, including date of issue to which the system conforms (e.g. NFPA 72 (2008) and NFPA 70 (2009)).
3. Circuit number of power supply to FACP and location of the electrical panelboard.
4. Location of fire alarm system Operating and Maintenance Instructions if they are not stored in the FACP cabinet.
5. Location of fire alarm system as-built documents.

END OF SECTION

FOR LANL USE ONLY

This project specification is based on LANL Master Specification 28 3100, Rev. 4, dated May 27, 2010.

SECTION 28 3233.1

RADIATION DETECTION AND ALARM – PERSONNEL CONTAMINATION MONITORS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Personnel Contamination Monitors (PCMs) for measuring surface alpha and beta contamination over an entire human body surface.

1. PCMs will be furnished and tested by the Contractor. Subcontractor shall furnish and install all components associated with the P10 gas distribution system as specified in Section 22 6313, "Gas Piping for Laboratory and Healthcare Facilities."

1.2 RELATED SECTIONS

A. Section 01 4000, "Quality Requirements."

B. Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

C. Section 22 0813, "Testing Piping Systems."

D. Section 22 6313, "Gas Piping for Laboratory and Healthcare Facilities."

1.3 ABBREVIATIONS AND ACRONYMS, DEFINITIONS, AND REFERENCES

A. Refer to Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

1.4 SUBMITTALS

A. Submit the following in accordance with the requirements of Exhibit I:

1. Project record documents:

a. Report of Subcontractor field tests showing compliance with field testing and inspection specified in PART 3 of this section.

b. Certificate of Compliance signed by LANL's Radiation Protection organization, indicating their acceptance of the installation.

c. Certified report of Manufacturer's routine factory tests demonstrating expected detector sensitivity.

2. Provide Operations & Maintenance Manual (Supplied by LANL), with detailed instructions for performance of any required maintenance activities, including as a minimum: lubrication, refurbishment/overhaul, calibration/testing and spare parts list.

1.5 QUALITY ASSURANCE

A. Work Identified in this section shall be done under a Quality Assurance Program in accordance with Section 01 4000, "Quality Requirements."

B. Conform to requirements of the *National Electrical Code* (NEC) (NFPA 70) for power connection to PCMs.

C. Counting gas installation shall conform to requirements of ASME B31.3.

D. Subcontractor shall use listed components unless calculations are provided in accordance with ASME requirements for unlisted components.

1.6 QUALIFICATIONS

A. None.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Manufacturer's standard.

1.8 RECEIVING, STORING AND PROTECTING

A. Receive, store, and protect, and handle PCMs according to manufacturer's instructions.

B. Prior to removing shipment packaging, move PCM to installation location to avoid damage to exterior surfaces during on-site transportation.

C. After unpacking, inspect thoroughly for damage.

D. Use eyebolts provided and appropriately rated equipment for any overhead lifting.

E. Avoid rolling PCMs equipped with casters at rapid rates, over inclines, or along uneven surfaces. When PCM is in place, the casters should be retracted.

PART 2 PRODUCTS

2.1 PRODUCT OPTIONS AND SUBSTITUTIONS

A. No substitutes are acceptable; items must be furnished as specified.

2.2 MANUFACTURERS

A. Personnel Contamination Monitors:

1. Thermo Scientific iPCM-12, with the following options:

a. Voice annunciator, ISA Sound Board and Software: Model PCM2OPT2A.
b. Gas management system, Gas Manager and Tubing: Model PCM2OPT12.
c. Spare detectors, purging.
d. Printer option with 9" dot matrix printer.

2.3 MATERIALS

A. Mechanical:

1. None.

PART 3 EXECUTION

3.1 EXAMINATIONS

A. None.

3.2 PREPARATION

A. None.

3.3 INSTALLATION – GENERAL

A. Install PCM assembly in accordance with manufacturer's instructions. The instructions below are intended to supplement or emphasize manufacturer's instructions only.

3.4 INSTALLATION – PERSONNEL CONTAMINATION MONITORS

A. Location:

1. Locate the PCM assembly in accordance with the design drawings.

B. Electrical Power:

1. Installation shall be in accordance with design drawings and applicable sections of Division 26, "Electrical."

2. Ensure that a dedicated, labeled receptacle is provided for each PCM, and receptacle circuit is free from inductive or other transient-causing loads.

3. Ensure that the slide switch on main computer supply is selected for the correct voltage range (90-132V) prior to energizing PCM.

C. Counting Gas:

1. The P-10 gas distribution system is furnished and installed per Section 22 6313, "Gas Piping for Laboratory and Healthcare Facilities."

2. Connect PCM counting gas inlet in accordance with design drawings.

3. Connect PCM counting gas outlet in accordance with design drawings.

4. Ensure that the gas flow rate does not exceed 1000cc per minute at any time or damage to the Mylar entrance windows may occur.

3.5 SCHEDULES

A. None.

3.6 FIELD INSPECTIONS AND TESTS

A. Electrical:

1. Inspect and test in accordance with applicable sections of Division 26, "Electrical."

2. Prior to energizing, verify that all equipment is installed in accordance with manufacturer's instructions.

3. Verify 120Vac at receptacle designated for PCM.

4. Connect power cord to receptacle and turn PCM Power Switch ON; verify PCM is energized.

B. Counting Gas:

1. Inspect and test in accordance with manufacturer's instructions, Section 22 6313, "Gas Piping for Laboratory and Healthcare Facilities" and Section 22 0813, "Testing Piping Systems."

3.7 FIELD QUALITY CONTROL

A. The Subcontractor Technical Representative shall coordinate with a representative from LANL's Radiation Protection organization during PCM start-up and final calibration.

1. Provide support, as required, to resolve start-up or calibration issues related to Subcontractor's scope of work.

B. Provide Certificate of Compliance signed by LANL's Radiation Protection organization, indicating acceptance of the installation.

END OF SECTION

SECTION 28 3233.2

RADIATION DETECTION AND ALARM – HAND AND FOOT MONITORS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Hand and Foot Monitors (HFMs) for measuring surface contamination on the hands and bottoms of shoes.

B. HFMs will be furnished and tested by the Contractor.

1. Subcontractor shall furnish and install all components associated with the P10 gas distribution system as specified in Section 22 6313, "Gas Piping for Laboratory and Healthcare Facilities."

2. Final installation and startup of the HFMs will be performed by the Contractor (RP-2).

1.2 RELATED SECTIONS

A. Section 01 4000, "Quality Requirements."

B. Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

C. Section 22 0813, "Testing Piping Systems."

D. Section 22 6313, "Gas Piping for Laboratory and Healthcare Facilities."

1.3 ABBREVIATIONS AND ACRONYMS, DEFINITIONS, AND REFERENCES

A. Refer to Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

1.4 SUBMITTALS

A. Submit the following in accordance with the requirements of Exhibit I:

1. Project record documents:

a. Report of Subcontractor field tests showing compliance with field testing and inspection specified in PART 3 of this section.

b. Certificate of Compliance signed by LANL's Radiation Protection organization, indicating their acceptance of the installation.

c. Certified report of Manufacturer's routine factory tests.

2. Provide Operations & Maintenance Manual (Supplied by LANL), with detailed instructions for performance of any required maintenance activities, including as a minimum: lubrication, refurbishment/overhaul, calibration/testing and spare parts list.

1.5 QUALITY ASSURANCE

A. Work Identified in this section shall be done under a Quality Assurance Program in accordance with Section 01 4000, "Quality Requirements."

A. Power connection to HFMs shall conform to requirements of the *National Electrical Code* (NEC) (NFPA 70).

B. Counting gas installation shall conform to requirements of ASME B31.3.

1.6 QUALIFICATIONS

A. None.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Manufacturer's standard.

1.8 RECEIVING, STORING, PROTECTING, AND HANDLING

A. Receive, store, protect, and handle HFMs according to manufacturer's instructions. The instructions that follow are intended to supplement or emphasize manufacturer's instructions:

1. Store HFMs in original packaging material until time of installation in a temperature-controlled environment.

2. Move HFMs using integral pallet and forklift facilities, observing handling instructions. Due to the weight of the equipment, the package may become unstable if lifted improperly, moved over gradients, or lifted with under-rated equipment.

3. No lifting eyes are provided for lifting the HFM from the pallet. A minimum of four people are required to perform this action by hand.

4. If long term storage (more than a few months) is likely, special packaging should be negotiated prior to shipment by the manufacturer. Incorrect storage will invalidate the warranty.

PART 2 PRODUCTS

2.1 PRODUCT OPTIONS AND SUBSTITUTIONS

A. No substitutes are acceptable; where a manufacturer or material has been indicated, items must be furnished as specified.

2.2 PRODUCTS

A. Hand and Foot Monitors:

1. Berthold version LB146 with "LANL upgrade." Subject to change per LANL specification.

2.3 MATERIALS

A. Electrical:

1. Power Cord: Follow manufacturer's instructions for cord replacement if cord supplied with HFM is not compatible with NEMA 5-15R receptacle.

B. Mechanical:

1. None.

PART 3 EXECUTION

3.1 EXAMINATIONS

A. None.

3.2 PREPARATION

A. None.

3.3 INSTALLATION – GENERAL

A. Install HFM assembly in accordance with manufacturer's instructions. The instructions below are intended to supplement or emphasize manufacturer's instructions only.

3.4 INSTALLATION – HAND AND FOOT MONITOR

A. Location:

1. Locate the HFM assembly in accordance with the design drawings.
2. Allow at least 1" between the back of the foot plinth and the wall.
3. Ensure that there is a minimum 14 1/2" clearance above the HFM to open the access door for maintenance.
4. Ensure that the HFM is level; bolt the HFM to the floor in accordance with the manufacturer's instructions.

B. Electrical Power:

1. Ensure that the HFM power switch is OFF before proceeding with electrical installation.
2. Disconnect power cord and replace, if replacement is required (see Paragraph 2.3A.1 of this section).
3. Ensure that power cord grounding conductor is connected to earth ground.
4. Proceed with electrical installation in accordance with manufacturer's instructions.

C. Counting Gas:

1. The P-10 gas distribution system is furnished and installed per Section 22 6313, "Gas Piping for Laboratory and Healthcare Facilities."
2. Connect HFM counting gas inlet and outlet in accordance with design drawings.

3.5 SCHEDULES

A. None.

3.6 FIELD INSPECTIONS AND TESTS

A. Electrical:

1. Perform tests and inspections in accordance with the manufacturer's instructions and applicable sections of Division 26, "Electrical."

B. Counting Gas:

1. Perform tests and inspections in accordance with the manufacturer's instructions, Section 22 6313, "Gas Piping for Laboratory and Healthcare Facilities" and Section 22 0813, "Testing Piping Systems."

3.7 FIELD QUALITY CONTROL

A. The Subcontractor Technical Representative shall coordinate with a representative from LANL's Radiation Protection organization during HFM start-up and final calibration.

1. Provide support, as required, to resolve start-up or calibration issues related to Subcontractor's scope of work.

B. Provide Certificate of Compliance signed by LANL's Radiation Protection organization, indicating acceptance of the installation.

END OF SECTION

SECTION 28 3233.3

RADIATION DETECTION AND ALARM – FIXED AIR SAMPLERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Fixed Air Samplers (FASs) for quantifying airborne contaminants.

1. The following components will be furnished and installed by the Contractor.:

a. Air Sampling Heads,
b. Filters for Paragraph 1.1A.1.a above, and
c.

2. The following components and equipment will be furnished and installed by the Subcontractor:

a. Quick Change Adapters.

b. Ball valves;
c. Flow Indicators;
d. Pipe, tubing, and fittings for the FAS installation; and
e. Critical Flow Venturis.

3. Testing in conformance with project specification 40-1813 and will be performed by the Subcontractor.

4. Operational testing will be performed by the LANL Radiation Protection organization, with assistance from the Subcontractor, as required.

5. The scope of this specification applies only to that portion of the central vacuum system from the Fixed Air Sampling Head to the point of attachment to the central vacuum header.

1.2 RELATED SECTIONS

A. Section 01 4000, "Quality Requirements."

B. Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

C. Section 01 8116, "Facility Environmental Requirements."

D. Section 40 1813, "Low-Vacuum Systems Process Piping."

E. Section 43 1129, "Gas Handling Vacuum Pumps."

1.3 ABBREVIATIONS AND ACRONYMS, DEFINITIONS, AND REFERENCES

A. Refer to Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

1.4 SUBMITTALS

A. Submit the following in accordance with the requirements of Exhibit I:

1. Submittal Data:

a. Vendor data sheets, with complete specifications for rotameters and ball valves.

b. Submittal data as required in other referenced sections of this specification.

2. Project record documents:

a. Report of Subcontractor field tests showing compliance with field testing and inspection specified in PART 3 of this section.

b. Certificate of Compliance signed by LANL's Radiation Protection organization, indicating their acceptance of the installation.

3. Provide Operations & Maintenance Manual (supplied by LANL), with detailed instructions for performance of any required maintenance activities, including as a minimum: lubrication, refurbishment/overhaul, calibration/testing and spare parts list.

1.5 QUALITY ASSURANCE

A. Work Identified in this section shall be done under a Quality Assurance Program in accordance with Section 01 4000, "Quality Requirements."

A. Conform to requirements of the *National Electrical Code* (NEC) (NFPA 70).

B. Furnish products listed and labeled by a nationally recognized testing laboratory (NRTL) as suitable for purposes specified and shown.

C. Conform to ASME B31.3 for vacuum piping.

1.6 QUALIFICATIONS

A. None.

1.7 ENVIRONMENTAL REQUIREMENTS

A. See Section 01 8116, "Facility Environmental Requirements."

1.8 RECEIVING, STORING, PROTECTING, AND HANDLING

A. Receive, store, protect, and handle FAS components and equipment according to manufacturer's instructions and according to the paragraphs referenced within this section.

PART 2 PRODUCTS

2.1 PRODUCT OPTIONS AND SUBSTITUTIONS

A. No substitutes are acceptable; items must be furnished as specified.

2.2 CONTRACTOR-FURNISHED COMPONENTS

A. Air Sampling Head: .

2.3 SUBCONTRACTOR-FURNISHED COMPONENTS

A. Quick Change Adapter: Reference LANL Drawing 26Y79323.

B. Supply vacuum components in conformance with Section 40 1813, "Low-Vacuum Systems Process Piping."

1. Ball Valve: 1/2" FNPT, brass, MSS SP-110.

2. Pipe: Copper, tubing sized per Section 40 1813, "Low-Vacuum Systems Process Piping."

   a. 1/2", with miscellaneous fittings.

3. Gas Tubing: Copper, 1/2", with swaged double-ferrule fittings.

4. Flow Indicators in conformance with Master Equipment List (60239831-LIST-002).

5. Critical Flow Venturi in conformance with Master Equipment List (60239831-LIST-002).

PART 3 EXECUTION

3.1 EXAMINATIONS

A. None.

3.2 PREPARATION

A. None.

3.3 INSTALLATION – GENERAL

A. Connect FAS components and equipment to vacuum header in accordance with design drawings and manufacturer's instructions.

B. If there is a conflict between this specification or the design drawings and the manufacturer's instructions, bring it to the attention of the Subcontract Technical Representative for resolution.

3.4 SCHEDULES

A. Coordinate FAS installation with central vacuum system installation.

3.5 FIELD INSPECTIONS AND TESTS

A. Test FAS installation, in conjunction with central vacuum system, in accordance with Section 40 1813, "Low-Vacuum Systems Process Piping."

3.6 FIELD QUALITY CONTROL

A. The Subcontractor Technical Representative shall coordinate with a representative from LANL's Radiation Protection organization during FAS start-up and vacuum pump adjustment.

   1. Provide support, as required, to resolve start-up or issues related to Subcontractor's scope of work.

B. Provide Certificate of Compliance signed by LANL's Radiation Protection organization, indicating acceptance of the installation.

END OF SECTION

SECTION 28 3233.4

RADIATION DETECTION AND ALARM – ALPHA CONTINUOUS AIR MONITORS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Continuous Air Monitors (CAMs) for detecting airborne alpha contamination.

B. CAM heads and managers will be furnished by the Contractor.

1. Subcontractor shall install all other equipment (alarm sentry managers, network T-boxes, CAM head brackets and backplanes).

2. Final installation and startup of the CAM heads will be performed by the Contractor (RP-2).

1.2 RELATED SECTIONS

A. Section 01 4000, "Quality Requirements."

B. Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

C. Section 40 1813, "Low-Vacuum Systems Process Piping."

1.3 ABBREVIATIONS AND ACRONYMS, DEFINITIONS, AND REFERENCES

A. Refer to Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

1.4 SUBMITTALS

A. Submit the following in accordance with the requirements of Exhibit I:

1. Project record documents:

a. Report of Subcontractor field tests showing compliance with field testing and inspection specified in PART 3 of this section.

b. Certificate of Compliance signed by LANL's Radiation Protection organization, indicating their acceptance of the installation.

c. Certified report of Manufacturer's routine factory tests demonstrating compliance with specifications.

2. Provide Operations & Maintenance Manual (Supplied by LANL), with detailed instructions for performance of any required maintenance activities, including as a minimum: lubrication, refurbishment/overhaul, calibration/testing and spare parts list.

1.5 QUALITY ASSURANCE

A. Work Identified in this section shall be done under a Quality Assurance Program in accordance with Section 01 4000, "Quality Requirements."

B. Conform to requirements of the *National Electrical Code* (NEC) (NFPA 70).

C. Piping shall conform to requirements of project specification 40-1813

D. Subcontractor shall use listed components unless calculations are provided in accordance with ASME requirements for unlisted components.

1.6 QUALIFICATIONS

A. None.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Manufacturer's standard.

1.8 RECEIVING, STORING, PROTECTING, AND HANDLING

A. Receive, store, protect, and handle CAMs according to manufacturer's instructions.

PART 2 PRODUCTS

2.1 PRODUCT OPTIONS AND SUBSTITUTIONS

A. No substitutes are acceptable; items must be furnished as specified.

2.2 CONTINUOUS AIR MONITORS –CONTRACTOR – FURNISHED EQUIPMENT

A. CAMs being considered by the project are either the Canberra Net CAM or the Thermo Alpha-7L CAM. LANL to provide final direction.

1. Alpha Sentry Manager (ASM1000) with Option A,
2. Sensing Heads (AS1700R),

22.3 CONTINUOUS AIR MONITORS – SUBCONTRACTOR – FURNISHED EQUIPMENT

3. Network Tee Box (CA2000),
4. Network Terminator (CA2001),
5. Wall Mounting Bracket (AS050),
6. Power Supply for Sampling Head (AS070), and
7. Alarm Option (AS020).

2.3 VACUUM SYSTEM COMPONENTS -- SUBCONTACTOR-FURNISHED EQUIPMENT

A. Supply vacuum components in conformance with Section 40 1813, "Low-Vacuum Systems Process Piping."

1. Ball Valve: 1/2" FNPT, brass, MSS SP-110.
2. Pipe: Copper, tubing sized per Section 40 1813, "Low-Vacuum Systems Process Piping."
   a. 1/2", with miscellaneous fittings.
3. Gas Tubing: Copper, 1/2", with swaged double-ferrule fittings.
4. Flow Indicators in conformance with Master Equipment List (60239831-LIST-002).
5. Critical Flow Venturi in conformance with Master Equipment List (60239831-LIST-002).

PART 3 EXECUTION

3.1 EXAMINATIONS

A. None.

3.2 PREPARATION

A. None.

3.3 INSTALLATION – GENERAL

A. Install CAMs in accordance with manufacturer's instructions and the design drawings. The instructions below are intended to supplement or emphasize manufacturer's instructions only.

3.4 INSTALLATION – CAMS

A. Electrical Power

1. Install electrical power in accordance with design drawings and applicable sections of Division 26, "Electrical."

2. Each Sampling Head requires a power supply (AS070). Manufacturer's power supply requires a standard NEMA 5-15 duplex receptacle within 4 feet of the location of each sampling head. Install receptacles and conduit per design drawings.

B. CAM Sampling Head/Alarm Option/Network Tee Box:

1. Mount Alarm Option module (AS020) to Sampling Head per manufacturer instructions. Wall-mount in approximate location shown on design drawings. Coordinate final location of all Sampling Heads with LANL RP-1 organization.

2. Mount Network Tee Box in approximate location shown on drawings. Network Tee Box to be mounted within 8 feet of each sampling head and connected using manufacturer's provided 10 foot cable.

C. Signal

1. Provide conduit and cabling from each Alarm Sentry Manager to individual CAM Sampling Head via Network Tee Box per manufacturer instructions and design drawings. Use manufacturers recommended cable or approved equal (Type EIA Industrial RS-485 PLTC/CM).

D. Vacuum

1. Install vacuum components in accordance with design drawings and Section 40 1813, "Low-Vacuum Systems Process Piping."

3.5 SCHEDULES

A. None.

3.6 FIELD INSPECTIONS AND TESTS

A. Vacuum:

1. Perform inspections and tests on vacuum piping and connections in accordance with Section 40 1813, "Low-Vacuum Systems Process Piping."

B. Electrical Power:

1. Prior to energizing, verify that all equipment is installed in accordance with manufacturer's instructions.

2. ASM1000 shall be wall mounted. Power shall be provided by a local 120VAC receptacle and factory installed plug.

3. Perform inspections and tests in accordance with the manufacturer's instructions and applicable sections of Division 26, "Electrical."

C. Signal:

1. Each signal head is installed with an AS020 alarm module. All local visual and audible alarms for each sampling head will be tested. Testing will be conducted under the direction of LANL.

2. Each signal head is networked to an Alarm Sentry Manger (ASM) located in the control room. All ASM visual and audible alarms for each sampling head will be tested. Testing will be conducted under the direction of LANL.

3.7 FIELD QUALITY CONTROL

A. The Subcontractor Technical Representative shall coordinate with a representative from LANL's Radiation Protection organization during CAM start-up and final calibration.

1. Provide support, as required, to resolve start-up or calibration issues related to Subcontractor's scope of work.

B. Provide Certificate of Compliance signed by LANL's Radiation Protection organization, indicating acceptance of the installation.

END OF SECTION

SECTION 31 2000

EARTH MOVING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Potholing.

B. Grading: Clear, excavate topsoil, grade and dispose of materials at site.

C. Excavation: Excavate, place, and compact earth at site.

D. Trenching: Excavate trenches for utilities and install tracer wire/identification tape.

E. Backfilling.

F. Soil compaction and testing.

1.2 RELATED SECTIONS

A. Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

B. Section 01 5705, "Temporary Controls and Compliance Requirements."

1.3 ABBREVIATIONS AND ACRONYMS, DEFINITIONS, AND REFERENCES

A. Refer to Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

1.4 LANL PERFORMED WORK

A. Obtain excavation/soil disturbance permit for Subcontractor.

B. Mark location of known underground utilities.

C. Document new and existing utility locations.

D. Locate utility shut-off points prior to potholing.

E. Perform an electrical continuity test for each run of tracer wire.

1.5 SUBMITTALS

A. Submit the following in accordance with the requirements of Exhibit I:

1. Certifications from an independent testing laboratory that pipe bedding materials meet the specification.
2. Certifications from an independent testing laboratory that base course materials, crushed stone or crushed or screened gravel meet the specification.
3. Test reports of field-testing of material compaction, submitted daily.
4. Test reports of field-testing of tracing wire continuity.
5. Catalog data on identification tape, tracing wire test station, and tracing wire.
6. Project Record Documents: Accurately record GPS-based survey locations of new and existing utilities and infrastructure before backfilling trenches.

1.6 QUALITY ASSURANCE

A. When work or portions of work of this section requires testing, notify LANL Subcontractor Technical Representative (STR) 48 hrs in advance of testing.

B. Ensure compacted fills are tested in accordance with Paragraph 3.11 of this section and in compliance before proceeding with placement of next lift.

C. Do not begin any groundbreaking, fill, or soil disturbance and transfer until known utilities have been marked, and an excavation/soil disturbance permit has been issued to Subcontractor.

D. Comply with OSHA 29 CFR 1926, Subpart P for excavation and trenching operation.

E. Maintain a copy of Excavation/Soil Disturbance Permit package, potholing plan, competent person excavation logs, and test reports on site.

F. Perform pre-job briefing of Permit and associated safety and hazard documentation with workers performing the work.

G. Ensure that engineering controls and required Personnel Protective Equipment (PPE) are used by workers during work activities to maintain safety, especially during jack hammering. Breaking surface blacktop, curbs and gutters with a jackhammer does not require dielectric PPE, provided locates have been performed and the STR is confident no other unexposed utilities are present in the surface concrete, blacktop, curb, gutter or sidewalk to be removed.

H. Review and maintain the work within the established boundaries established by the permit.

1.7 SITE CONDITIONS

A. Do not place and compact backfill material that is frozen or contains ice crystals and that the minimum temperature of any material placed, mixed, or compacted shall be above freezing.

B. Do not place or compact backfill material that is frozen or contains ice crystals that would prevent thorough compaction or increase the risk of settlement after placement.

C. Do not place or compact backfill material on frozen substrate.

PART 2 PRODUCTS

2.1 MATERIALS

A. Topsoil

1. Excavated soil material, graded free of roots, rocks larger than 1-in. subsoils, and debris.

B. Fill and Backfill Material

1. Material consisting of non-plastic granular soils free of organic or other deleterious materials having a maximum particle size of 3 in. and complying with the structural backfill criteria may be used for fill.

2. All borrow and fill material shall be provided by the Subcontractor. The LANL STR in consultation with LANL FOD-Utilities & Infrastructure (U&I) GROUP may approve a borrow/spoils area.

C. Structural Backfill

1. General: Excavated material may be used for fill and/or backfill under sidewalks and site. Use only clean approved materials for structural fill and/or backfill under buildings and structures. Site materials which have the required properties may be used subject to the approval of the LANL STR. If sufficient materials are not available at the site or if the site's materials do not have the specified properties, materials from off-site borrow areas will be used. Off-site materials may be mixed with on-site materials in the proportions necessary to meet the requirements of this section. All arrangements necessary for the use of borrow areas are the sole responsibility of the Subcontractor.

2. Laboratory Testing: Perform appropriate and specified laboratory tests as necessary to insure that soil materials proposed for use on this project meet all specified requirements. Provide a moisture-density curve for each material proposed for use as structural fill.

3. Fill: Structural fill required to raise the building areas and backfill around and above structures shall be clean material, free of vegetation, debris and other deleterious materials and shall meet the following requirements as determined by ASTM D 422 except as otherwise approved by the LANL STR.

Sieve Size	Percent Passing
3 in.	100
No. 4	50 – 100
No. 200	10 – 60

Fill shall have a P.I. of not more than 10. Testing shall be in conformance with ASTM D 4318.

Fill material shall be free from roots, grass, other vegetable matter, clay lumps, rocks larger than 3 in. in diameter, or other deleterious materials.

D. Base Courses

1. Provide base course and aggregate composed of materials consisting of crushed stone, crushed or screened gravel, sand, RAP, or a combination of such materials. Provide base course and aggregate free from vegetable matter and other deleterious materials, including silt and clay balls. Ensure that at least 50 percent of the materials on or above the No.4 sieve have at least two fractured faces. Maximum Liquid Limit of 25 and maximum Plasticity Index of 6, per ASTM D 4318 Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

2. Base course aggregate shall conform to:

Base Course Gradation	
Sieve Size	**Percent Passing**
1 in.	100
3/4 in.	80 – 100
No. 4	30 – 60
No. 10	20 – 45
No. 200	3 – 10

2.2 UTILITY TRENCH BED AND FILL MATERIALS

A. Provide clean sand for pipe bedding material free of any organic or deleterious substance and having 100 percent passing 3/8-in. sieve and 4 percent passing No. 100 sieve.

B. Provide fill and backfill consisting of non-plastic granular soils free of organic or other deleterious materials having a maximum particle size of 2 in.

C. Provide crushed stone and /or crushed or screened gravel free of any organic or deleterious substance and having 100 percent passing 1-in. sieve and 0 percent passing the 1/2-in. sieve.

D. Warning Tape

1. Use non-detectable plastic warning tape consisting of high visibility, color-coded, continuously printed, inert fiber reinforced polyethylene for direct burial service.

2. Provide tape to the following criteria:

a. Minimum overall thickness – 4.0 mils;
b. Minimum tensile strength – 1,500 psi; and
c. Width – 6 in.

3. Refer to trench detail on Drawing for warning tape color.

4. Manufacturer: Bradley, Seton Name Plate Co., etc.

E. Tracer Wire: #10AWG THHN/THWN, yellow, solid copper.

F. Tracer Wire Test Station

1. Manufacturer: C.P. Test Services, Model-Glenn Test Station
2. Test Station: Plastic Pipe, cast iron cover, 2-point terminal box.

PART 3 EXECUTION

3.1 INSPECTION

A. Verify stockpiled fill to be reused is approved by LANL STR.

B. Verify areas to be backfilled are free of debris, snow, ice, or water and surfaces are not frozen.

3.2 PROTECTION

A. Preserve staking, marking, or other designation until the designation is no longer needed for permitted work. If marking is removed or no longer visible, notify LANL STR. The STR will contact LANL's Mapping and Locating Group to revalidate the excavation/soil disturbance permit by locating and marking the utility again.

B. Protect existing structures from equipment and vehicular traffic.

C. Maintain excavation free of standing water.

D. Notify LANL STR of unexpected subsurface conditions and discontinue affected work in area until notified to resume work.

E. Protect bottom of excavations and soil adjacent to and beneath foundations from frost.

F. Grade top perimeter of excavation to prevent subsurface water run-off into excavation.

G. Barricades shall be erected around the excavation area before beginning work activities to prevent accidental entry into the area.

H. Protect disturbed soils, drainage ways and watercourses against soil erosion and sedimentation by employing Best Management Practices (BMPs) as identified in excavation permit review (EX-ID) comments, shown on the drawings or identified in the Storm Water Pollution Prevention (SWPP) Plan and approved by LANL STR. Remove any temporary BMP's at the close of the project.

I. Approved BMPs shall be in place per SWPP plan before soil-disturbing work begins.

J. Stabilize all disturbed areas.

3.3 PREPARATION

A. Identify required contours and data.

B. Notify LANL STR 15 working days prior to startup of construction to have LANL's Mapping and Locating Group identify known underground utilities and stake and flag locations. If a conflict exists between location of such obstacles and proposed work, promptly notify LANL STR and arrange for relocations. Proceed in same manner if a rock layer or any other unforeseen conditions encountered underground make changes advisable.

C. When necessary, compact subgrade surfaces to density requirements for backfill material. Remove unsuitable and unstable subgrade material.

D. In rock cuts, the top of the rock cut elevation shall be considered to be the same as top of subgrade. Base course may be placed directly on top of competent rock without further processing of the rock (i.e. scarify and compaction) provided that pockets in the rock are graded to drain before base course is placed. Any fill placed on top of competent rock needed to bring the top of subgrade to required elevation shall be compacted in accordance with subgrade requirements.

E. Foundations: Remove any soils to provide for 3.0 ft of compacted structural fill below foundations. Structural fill shall extend laterally from all sides of the footing for a minimum distance of 3.0 ft. Where footing bearing elevation is within 12 in. of tuff bedrock; over excavate to provide a minimum thickness of 12 in. of structural fill between footing and tuff bedrock.

F. Floor Slabs: Remove existing surficial soils beneath floor slab areas to provide for 1 ft of compacted structural fill beneath floor slabs.

3.4 WORKING WITHIN 5 FT OF UTILITIES

A. Stop work and notify the LANL STR when an unmarked utility is encountered. The STR shall contact LANL's Mapping and Locating Group so the site can be re-examined by Utility Locators.

B. If an underground utility is damaged or severed during excavation, immediately notify LANL STR. LANL STR will take immediate action to secure the area, notify the agency responsible for the utility so that the damaged section can be isolated, repairs initiated and other notifications made as required.

C. Whenever practical, utilities shall be de-energized, isolated, and tagged-out. The decision not to de-energize shall be made by LANL STR and Facility Operations Manager as appropriate.

D. Do not use mechanical excavating equipment within 5 ft of a marked, non-potholed utility. Mechanical excavation may commence within 5 ft of the underground utility only after the utility has been potholed, exposed, and well-marked and the Subcontractor is confident that there are no unexposed utilities in the excavation area.

1. Exception: Use of mechanical excavating equipment may be used where known utility line depths and/or site conditions exceed limitations of hand or vacuum excavation. For purposes of this exception, excavate pothole perpendicular to surface locate markings for 2 ft on each side of marking to a predetermined depth. Mechanical excavation may proceed to within 18 in. of bottom of potholes under this exception. When deemed necessary, Subcontractor will ask LANL STR to contact LANL's Mapping and Locating Group for consultation, checking of existing locate marks and remarking.

E. Accomplish mechanical excavation at a distance no closer than 18 in. vertically and horizontally to potholed non-fully-exposed utility lines.

F. Fully-exposed underground utilities shall be protected, supported, or removed and reinstalled as necessary to protect employees and the utility.

1. If approved by LANL STR, powered excavation equipment may be used closer than 18 in. to any fully-exposed utilities provided that these are marked and indicated with a prominent, tall flag-on-pole, plank, or other highly visible object so the equipment operator can clearly see their locations and avoid contact. Prior to such excavating, mark and obtain approval using Attachment 1, "Utility Protection Plan" form. Subcontractor shall complete the Utility Protection Plan and clearly indicate the limits of excavation/locates, utilities located, each pothole location, and description of installed marking/flagging measures. More than one form may be required for clarity.

G. Take care while hand excavating adjacent to utility line since hand tools such as shovels, picks, and digging bars can damage the utility line.

H. During machine excavation, have a spotter in place to actively monitor the positioning of the equipment.

I. Hand-excavate obstructions (guy wires, anchors, bollards, fence posts, etc.) to be removed to determine their relationship to existing marked utilities prior to removal.

3.5 POTHOLING

A. Prior to potholing the LANL STR will notify LANL's U&I Group to locate utility shut-off points. U&I Group will ensure the shut-off points are field verified and determined operable.

B. Pothole where existing buried utility lines are inside, or within 5 ft outside of excavation permit boundary limit.

C. Accomplish potholing by hand excavation or through use of vacuum potholing equipment. The use of vacuum potholing equipment is not permitted within the boundary of a Potential Release Site (PRS).

D. Pothole at vertical and horizontal utility angle points, at excavation boundary limit, and as needed. Provide additional pothole where utility depths are unknown or are in sloped work areas where utility depths may vary.

E. When unknown utility lines are marked and hand or vacuum excavation has gone 1 ft deeper than required and 3 ft to the left and right of a locate mark without finding the utility, stop excavating and contact the LANL STR for consultation and remarking.

F. Manholes or valve boxes may be used as a pothole to verify depths and locations of utilities.

G. Parallel Utilities: Pothole at 50-ft intervals where existing utilities parallel excavation and existing lines are located up to 6-ft outside excavation boundary. Hand or vacuum excavate non-conductive direct burial lines within 2 ft of excavation boundary along their entire length adjacent to excavation boundary, or pothole at 5-ft intervals.

H. Backfill potholes to original or better than condition. Refer to Paragraph 2.2B.

3.6 SUBGRADE

A. Foundations

1. Remove any soils to provide for 3.0 ft of compacted structural fill below foundations. Scarify exposed surface a minimum depth of 8 in., water to bring moisture content to within 2 percent of optimum moisture, and compact to 95 percent of maximum ASTM D 1557 dry density. Structural fill shall extend laterally from all sides of the footing for a minimum distance of 3.0 ft. Where footing bearing elevation is within 12 in. of tuff bedrock; over excavate to provide a minimum thickness of 12 in. of structural fill between footing and tuff bedrock.

B. Floor Slabs

1. Remove existing surficial soils beneath floor slab areas to provide for 1 ft of compacted structural fill beneath floor slabs. Scarify exposed surface a minimum depth of 8-in., water to bring moisture content to within 2 percent of optimum moisture, and compact to 95 percent of maximum ASTM D 1557 dry density.

C. Unpaved Areas

1. Subgrade at unpaved areas requiring fill shall be scarified a minimum depth of 8 in., watered to bring moisture content to within 2 percent of optimum moisture and compacted to 90 percent of maximum ASTM D 1557 dry density.

2. At unpaved areas not requiring fill, no compaction is required unless required as part of subgrade treatment for adjacent structures.

3.7 GRADING

A. Excavate topsoil from areas to be further excavated or regraded, and stockpile topsoil on site in area designated by LANL STR. Topsoil may be used on areas to receive landscaping and seeding.

B. Remove vegetation, debris, unsatisfactory soil materials, and obstructions from ground surface prior to grading. Properly dispose of material in accordance with Section 01 5705, "Temporary Controls and Compliance Requirements."

C. Uniformly grade areas within limits of grading under this section, including adjacent transition areas.

D. Match final grade in seeded and unpaved areas to match Drawing finish contours.

E. Construct the subgrade surface elevation to a tolerance of plus or minus 0.1 ft from the specified grade and plus or minus 0.05 ft of the typical cross section, except unlined drainage ditch flow lines shown on Drawing are allowed plus or minus 0.2 ft.

F. Construct the base course to the design depth required and the final surface to a tolerance of plus or minus 0.04 ft within 10 ft.

G. Make changes in grade gradual. Blend slopes into level areas. Prepare finish grade to accept seeding by hand raking or as designated.

H. Remove surplus excavated materials from the site. Movement and proper disposal of materials from the site shall be in accordance with Section 01 5705, "Temporary Controls and Compliance Requirements."

3.8 EXCAVATING AND TRENCHING

A. Excavate and trench subsoil as required for Work.

B. Cut trenches sufficiently wide to enable installation of utilities to allow inspection. Trenches shall be benched, sloped, or shored to meet OSHA 29 CFR 1926 Subpart P, in particular Appendix A for Soil Classification and Appendix B for Sloping and Benching requirements. Refer to trench detail on LANL Standard Drawings for minimum trench widths.

C. Do not interfere with normal 45 degree bearing splay of a structure foundation during excavation work. When excavating near or under a foundation a New Mexico Licensed Professional Engineer shall approve a support system to stabilize the structure or determine that excavation work will not pose a hazard.

D. Hand trim excavation and leave free of loose matter.

E. Remove lumped subsoil, boulders, and rock.

F. Correct errors in excavation.

G. Take proper precaution, such as shoring, sloping, or using a trench box when working in a trench or excavation. Provide a person who is trained and knowledgeable of soil conditions and safety requirements to make safety determinations.

H. Evaluate excavations 4 ft or deeper (or other excavation where employee exposure can be reasonably anticipated) daily and document by a designated competent person before employees are permitted to enter the excavation. Documented inspections on an excavation condition log.

I. When an oxygen deficiency or hazardous atmosphere could be reasonably expected in trenches over 4 ft in depth, such as excavating near roadways, lift stations, sewer/gas lines, etc., the excavation shall be tested with a calibrated intrinsically safe monitoring device before employees are allowed to enter the excavation. If the atmosphere tests hazardous, then do not enter the excavation or if chemical hazards exist or are created within the excavation, stop work immediately and contact the LANL STR.

J. Excavation boundaries shall be adequately marked and barriers installed to avoid inadvertent entry. Excavations that present a possibility of a worker falling to a lower level shall be evaluated by a designated Fall Protection Competent Person for necessary fall protection requirements.

3.9 DOCUMENTING UTILITY LOCATION

A. Do not cover new or exposed existing utilities until LANL's Mapping and Locating Group has verified that utility locations have been documented by the use of GPS in compliance with LANL standard reference system.

B. Subcontractor Responsibility: Notify LANL STR 5 working days in advance that new and exposed utilities will be ready for location verification.

C. LANL STR Responsibility: Notify LANL's Mapping and Locating at 665-1051 immediately after being notified by Subcontractor.

3.10 BACKFILLING EXCAVATIONS/TRENCHES

A. Backfill and fill areas to contour lines and elevations shown on the Drawings.

B. Backfill and fill systematically.

C. Do not place backfill or fill material over frozen, wet, or spongy subgrade surfaces, including surfaces containing frost or ice.

D. Recondition, reshape and recompact areas that are damaged by freezing.

E. Place backfill and fill materials in continuous layers not exceeding 8 in. in loose depth.

F. Before compacting, moisten or aerate each layer as necessary to provide the optimum moisture content.

G. Compact each layer to required percentage of maximum density for the area.

H. Compact layers uniformly before a succeeding layer is placed.

I. Do not disturb or damage adjacent structures during compaction.

J. Backfill against structures as follows:

1. Do not place backfill against structure walls prior to verifying the concrete has been properly cured and is of required strength to resist stresses due to backfill.

2. Take care to prevent wedging action of backfill against structures by carrying the material uniformly around the structures to approximately the same elevation in each lift.

3. When unbalanced pressures are likely to develop on walls:

   a. Continuously monitor for displacements,
   b. Erect shoring to counteract imbalance, if required, and
   c. Leave shoring in place until LANL STR approves its removal.

K. Utility Trenches

1. Support pipe and conduit during placement of concrete or fill.
2. Install tracer wire (no splices) directly above buried non-metallic pipes and conduits, ductile iron, and cast iron pipes and terminate at grade within a test station or valve box. If the tracer wire can be continuous, do not cut the wire in a test station or valve box but leave as a slack, uncut loop. Tracer wire shall not contact underground piping.
3. Visually inspect tracer wire prior to backfilling to ensure wire has not been nicked or cut, and that continuous unspliced wire runs between test station terminals.
4. Prior to utility tie-ins, perform an electrical continuity test for each run of tracer wire after backfill is complete. The STR will notify LANL's Mapping and Locating Group to verify tracer wire continuity and GPS new and existing utility lines.
5. Install non-detectable plastic warning tape 12 in. below finish grade and directly above buried utility pipe or conduit. Visually inspect warning tape prior to backfilling to ensure tape is continuous and not cut.

3.11 SOIL COMPACTION AND TESTING

A. Control soil compaction during construction to provide the minimum percentage of density specified for each area as determined according to ASTM D 1557, Method A or D.

B. Where subgrade or layer of soil material must be moisture-conditioned before compacting, uniformly apply water to surface of subgrade or layer material to prevent free water appearing on surface during or subsequent to compacting operations.

C. Remove and replace, or scarify and air dry, soil material that is too wet to permit compacting to the specified density.

D. The allowable percent variation from optimum moisture is plus or minus 2 percent.

E. The paragraphs below identify location and compaction required as a percentage of maximum density and optimum moisture measured using ASTM D 1557.

1. Compact fill in 8-in. lifts that will be beneath concrete and asphalt structures to 95 percent of maximum density.
2. Compact fill in 8-in. lifts that will be beneath unpaved areas to 90 percent of maximum density.
3. Compact new aggregate base course that will be beneath asphalt structures to 95 percent of maximum density.
4. Compact pipe bedding to 90 percent of maximum density.

F. The Subcontractor shall employ an AMRL-accredited independent testing agency to perform field testing of installed products to include compaction and test samples that shall verify quality control requirements and is responsible for the following:

1. Verify fill material to be placed is within the stated specifications, and laboratory testing is complete.

2. Verify that moisture-density relationship, ASTM D 1557, for each soil type to be placed is completed.

3. Determine field density of in-place material in accordance with any of the following methods:

   a. Nuclear Method, ASTM D 6938;
   b. Rubber-Balloon Method, ASTM D 2167; and
   c. Sand-Cone Method, ASTM D 1556.

4. Determine field moisture content in accordance with either of the following methods:

   a. Nuclear Method, ASTM D 6938 or
   b. Laboratory Determination, ASTM D 2216.

5. Frequency of Tests

   a. One test per 2,000 square feet for each lift of compacted fill material or fraction thereof, but not less than three tests per 8 inches maximum for each lift.

   b. One test per 50 linear feet of trench per 8 inches maximum for each lift.

Utility Protection Plan

Complete and receive approval from LANL STR before mechanically excavating within 18 in. of a fully-exposed underground utility line in accordance with this Specification.

Description of Utility:

_____

_____

_____

Description of Installed Marking/Flagging Measures (e.g., tall flag-on-pole, plank, etc.):

_____

_____

_____

Sketch:

Submitted By: _____ _____

Subcontractor Date

Witnessed/Approved By: _____ _____

LANL STR Date

END OF SECTION

FOR LANL USE ONLY

This project specification is based on LANL Master Specification 31 2000, Rev. 5, dated January 25, 2011.

SECTION 31 2323.33

FLOWABLE FILL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Flowable fill (cement stabilized backfill).

1.2 RELATED SECTIONS

A. Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

1.3 ABBREVIATIONS AND ACRONYMS, DEFINITIONS, AND REFERENCES

A. Refer to Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

1.4 SUBMITTALS

A. Submit the following in accordance with the requirement of Exhibit I:

1. Material certifications. A complete list of materials including type; brand; source and amount of cement, fly ash, pozzolans, silica fume, ground slag, and admixtures; and applicable reference specifications shall be included in the mix design submittal. Provide design mixes and test reports.
2. Batch tickets.
3. Field test reports.

1.5 DESCRIPTION

A. Flowable fill is a self-leveling slurry of cement, fly ash, aggregates, admixtures, and water with low final strength so can be hand dug later.

B. Flowable fill may be used for trenches, pipe structures, fill for abandoned water and sewer lines, and other works where cavities exist and firm support is required.

C. The use of flowable fill around or adjacent to utility lines or structures shall be reviewed and approved by the appropriate LANL Utilities and Infrastructure system representative. Flowable fill shall not be around or adjacent to utility lines that have requirements for movement.

1.6 QUALITY ASSURANCE

A. When work or portions of work of this section are completed and require testing, notify the LANL Subcontract Technical Representative (STR).

B. Ensure all required cast-in-place concrete, embedment items, and utility work has been completed prior to placing flowable fill.

1.7 JOB CONDITIONS

A. Perform concrete washout, trucks and mixers, in a designated and controlled area to prevent the runoff of washout material and the co-mingling of unset concrete with storm water. Properly dispose of all hardened excess concrete.

PART 2 PRODUCTS

2.1 MATERIALS

A. Cement: ASTM C 150, Type I or Type II.

B. Fine and Coarse Aggregates: Conform to ASTM C 33. Provide a uniform mixture of fine aggregate or fine and course aggregate, as determined by ASTM D 422.

Aggregate Mixture Gradation Requirements	
Sieve Size	**Percent Passing**
1 in.	100
3/8 in.	95 – 100
No. 4	80 – 100
No. 8	60 – 95
No. 16	45 – 80
No. 30	25 – 60
No.50	5 – 45
No. 100	5 – 35
No. 200	0 – 30

C. Water: Potable water that is clean and not detrimental to concrete.

D. Fly Ash: Conform to ASTM C 618, Class C or Class F.

E. Air Entrainment: Conform to ASTM C 260. Air entrainment may be between 6 and 25 percent. Air entraining is not required for below grade installation in areas not subject to freeze/thaw cycles.

2.2 PROPORTIONING AND PHYSICAL PROPERTY REQUIREMENTS

A. Provide a flowable fill mix design in accordance with the following limits:

1. Cement, maximum 50 lb/yd^3;
2. Fly ash, from 150 lb/yd^3 to 300 lb/yd^3;
3. Air content, optional;
4. Slump, from 6 to 11 in.;
5. Water/Cement ratio, proportioned by weight to produce a slump within limits;
6. Consistent aggregate throughout the concrete mixture; and
7. Compressive strength will not exceed 150 psi at 28 days.

2.3 FLOWABLE FILL

A. Mix and deliver flowable fill in accordance with ASTM C 94.

B. Use accelerating admixtures in cold weather only when approved by LANL STR. Use of admixtures will not relax cold weather placement requirements.

C. Use set retarding admixtures during hot weather only when approved by LANL STR.

D. Do not use calcium chloride as an admixture.

E. Add air-entraining agent if required to produce a flowable mix.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that all items of cast-in-place concrete, grading, trenching, and all utilities and other embedded items are in place prior to placing flowable fill.

B. Utilities that are subject to required movement (e.g., steam and condensate lines), shall not be embedded in flowable fill or otherwise have restricted movement.

C. Flowable fill shall not be used as a substitute for sand bedding or earth backfill for primary utilities unless approved by the LANL Utilities and Infrastructure system representative.

3.2 PREPARATION

A. Remove all loose material from the uneven tuff and the concrete structures.

B. Set elevation marks or otherwise determine the proper top elevation for the flowable fill.

3.3 PLACEMENT OF FLOWABLE FILL

A. Notify LANL STR a minimum of 48 hours prior to placement of flowable fill.

B. Flowable fill may be placed by direct discharge from the truck, by pumping, or by other approved methods.

C. The flowable fill shall be placed in a uniform manner that will prevent voids or segregation of the bedding and filling material. If required, the flowable fill shall be consolidated with internal vibrators.

D. Pipes, reinforcement, inserts, or other embedded parts shall be placed, supported, and secured in a manner that shall prevent the flowable fill from displacing, sagging, or from floating embedded items.

E. Flowable fill shall be brought up uniformly to the fill line shown on the plans. Formed walls or other bulkheads shall be constructed to withstand the exerted hydrostatic pressure and confine the material within a dedicated space.

F. Placement of flowable fill shall start only when weather conditions are favorable. The temperature shall be at least 35 degrees F and rising. Flowable fill shall not be placed on frozen ground or when it is raining.

3.4 CURING AND PROTECTION

A. Immediately after placement, protect flowable fill from premature drying, excessively hot or cold temperatures and mechanical injury.

B. The flowable fill shall not be subjected to load and shall remain undisturbed by construction activities for at least 24 hours after placement.

3.5 FIELD QUALITY CONTROL

A. Testing of flowable fill is not necessarily required. If testing is required, the Subcontractor shall provide a LANL approved, certified, independent testing agency to perform compressive strength test cylinders.

B. For field testing use a standard (15 lb) T-post driver to drive a #6 reinforcing bar with a flat end into the flowable fill material 24 hours after placement. Lift the

driver until the bottom of the driver is even with a mark located 6 in. below the top of the rebar and then allow it to fall under its own weight. Remove and replace the flowable fill if fewer than 6 blows or more than 25 blows are required to drive the rebar 12 in. into the fill.

C. Provide unobstructed access to work and cooperate with appointed firm.

3.6 DEFECTIVE FLOWABLE FILL

A. Do not accept or place defective flowable fill that is not in conformance with acceptance criteria. Return the fresh flowable fill to the supplier.

B. Defective flowable fill is material having excessive honeycomb, embedded debris, higher than maximum compressive strength, or not conforming to required lines, details, dimensions, tolerances or specified requirements. Repair or replace defective flowable fill as directed by the LANL STR.

C. Replace flowable fill not in conformance with details, tolerances, and other construction requirements at Contractor's expense.

END OF SECTION

FOR LANL USE ONLY

This project specification is based on LANL Master Specification 31 2323.33, Rev. 4, dated December 23, 2009.

SECTION 32 1216

ASPHALT PAVING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Subgrade and Base Course.

B. Plant-Mix Bituminous Pavements.

C. Open graded Friction Course.

D. Tack Coat and Prime Coat.

E. Traffic Control Markings.

1.2 RELATED SECTIONS

A. Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

B. Section 31 2000, "Earth Moving."

1.3 ABBREVIATIONS AND ACRONYMS, DEFINITIONS, AND REFERENCES

A. Refer to Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

1.4 SUBMITTALS

Submit the following in accordance with the requirements of Exhibit I:

A. Material certifications documenting compliance with the New Mexico Department of Transportation (NMDOT) Standard Specifications for Highway and Bridge Construction (SSHBC) 2007 edition including any Supplemental or Interim Specifications (i.e., latest specs). Guidance: Document(s) at http://nmshtd.state.nm.us/main.asp?secid=11183.

B. Proposed design mix of each class of bituminous pavement.

C. Laboratory test reports for design mix for bituminous pavement. The mix design reports shall be less than one year old and be from the same source for the aggregate to be used for the project.

D. Vehicle loadings and structural design.

E. Detailed plan for permanent traffic control markings and traffic informational signs.

1.5 QUALITY ASSURANCE

A. Perform work in accordance with the respective, noted sections of the NMDOT Standard Specifications for Highway and Bridge Construction. Exclude NMDOT Division 100, General Provisions, and any other references to METHOD OF MEASUREMENT, to BASIS OF PAYMENT, and for pay factor determination. *Guidance: Document(s) at* http://nmshtd.state.nm.us/main.asp?secid=11183.

B. Supply the base course and prepare the subgrade in accordance with the NMDOT SSHBC, Section 304, "Base Course" and in accordance with Section 31 2000, "Earth Moving." Obtain materials from same source throughout project, unless approved otherwise by LANL STR.

PART 2 PRODUCTS

2.1 MATERIALS

A. Provide plant mix bituminous pavement conforming to NMDOT Supplemental SSHBC, Section 423, "Hot Mix Ashpalt – Supperpave (QLA and Non-QLA)."

1. Section 423,: Provide aggregates conforming to the requirements for a traffic loading of greater than 500,000 ESALs over 20 years.

2. Provide performance graded asphalt cement conforming to NMDOT Supplemental SSHBC, Section 402, "Asphalt Materials, Hydrated Lime, and Anhydrite Based Material."

B. Provide open-graded friction course conforming to NMDOT Supplemental SSHBC, Section 403, "Open-Graded Friction Course."

1. Open-graded friction course: Provide aggregates conforming to the requirements of Table 403.2.2:1.

2. Provide asphalt cement conforming to NMDOT SSHBC, Section 402.

C. Provide liquid asphalt tack coat conforming to NMDOT SSHBC, Section 407, "Tack Coat."

D. Provide liquid asphalt prime coat conforming to NMDOT SSHBC, Section 408, "Prime Coat."

2.2 TRAFFIC CONTROL MARKING

A. Provide pavement markings and paint conforming to NMDOT SSHBC, Section 704, "Pavement Markings." Comply with the requirements for the application, protection, and limitations of the paint or the inlaid retro-reflective preformed plastic markings.

PART 3 EXECUTION

3.1 INSPECTION

A. Verify the compacted subgrade and base is ready to support paving and imposed loads.

B. Verify grades and elevations of base course are correct.

3.2 PREPARATION

A. Remove loose and deleterious material from compacted base surface immediately before applying prime coat. Surface shall be free of frozen material.

B. Proof roll prepared subgrade surface to check for unstable areas and areas requiring additional compaction.

C. Do not place asphalt when base surface temperature is less than 40 degrees F.

D. Apply prime coat at the rate as recommended by the laboratory mix design and approved by the LANL STR, over compacted base course. Apply material to penetrate and seal, but not flood, surface. Cure and dry as long as necessary to attain penetration and evaporation of volatiles.

E. Apply a tack coat to existing asphalt or new Portland cement concrete surfaces to receive plant-mix bituminous pavement. Apply tack coat to vertical surfaces of

existing or new pavement and concrete surfaces abutting or projecting into new asphalt pavement and construction joints. Apply material at a uniform application rate of 0.10 to 0.15 gal/sy to give a 0.03 to 0.05 gal/sy of residual asphalt on surfaces receiving the tack coat

3.3 PLACING ASPHALT PAVEMENT

A. Place bituminous pavement mixture by means of a paving machine on prepared surface, spread, and strike-off. Thickness of the pavement lifts shall be as recommended by the laboratory mix design and approved by the LANL STR. Place inaccessible and small areas by hand. Place each course to required grade, cross-section, and compacted thickness, as shown on drawings.

B. Target temperature shall be as indicated in the laboratory mix design for bituminous pavement course or between 180 degrees F. and 260 degrees F. for open-graded friction course, unless approved otherwise by LANL STR. Compact pavement by rolling immediately after the bituminous mixture has been spread and struck-off. Hand compact areas inaccessible to rolling equipment. Compact pavement to density and method specified in the respective sections of the NMDOT SSHBC, reference Section 423, Part 423.3.6.1.2, "Contractor Quality Control for Compaction," except a roadway density between 93.0 and 95.99 shall be achieved. Density testing shall be performed by the subcontractor's independent testing agency. If this minimum to maximum density range is not met the section or lot shall be removed and replaced to the satisfaction of LANL STR.

C. Construct joints between old and new pavements, or between successive days' work. Construction joints to have same texture, density, and smoothness as other sections of bituminous pavement course. Clean joint contact surfaces and apply tack coat. The location of cold joints in roadways shall be approved by the LANL STR.

3.4 TOLERANCES

A. Pavement smoothness shall conform to the tolerances required by NMDOT SSHBC, Section 401, "Pavement Smoothness Measurement," if the International Roughness Index for roadways is greater than 75.8, (inch per 0.1 mile) and for ramps, tapers, holding lanes is greater than 67.6 the section or lot shall be removed and replaced to the satisfaction of LANL STR. Reference Section 401, Part 401.3.2, for inclusion as the testing requirements for Pedestrian and Bicycle Paths and Parking Lots.

3.5 CLEANING AND PROTECTION

A. Cleaning

1. After completion of paving operations, clean surfaces of excess or spilled asphalt material to the satisfaction of LANL STR.

B. Protection

1. After final rolling, do not permit vehicular traffic on bituminous pavement until it has properly cooled and hardened.

2. Provide barricades and warning devices as required to protect pavement, employees, and the general public. Temporary traffic control devices

shall meet the requirements of the Manual on Uniform Traffic Control Devices, latest Edition.

3.6 PAVEMENT MARKINGS

A. Sweep and clean surfaces to eliminate loose material, dirt, and debris.

B. Perform detailed layout of the pavement markings as shown on the approved detail plan.

C. Paint-markings and placement of inlaid retro-reflective preformed plastic markings shall be as shown on the Drawings.

D. Apply three (3) coats of paint or one application of inlaid retro-reflective preformed plastic markings. The second and third application of paint shall be placed no sooner the 14 days after the first application.

E. Apply paint with a spray-type self-propelled pavement marking machine to produce uniform straight edges.

F. Provide necessary measures to divert traffic from the installation area during the application and drying time of the permanent traffic control markings.

3.7 FIELD QUALITY CONTROL

A. Submit proposed mix design of each class of bituminous pavement to the LANL STR for review and approval prior to commencement of Work.

B. Provide an independent testing agency approved by LANL to perform testing.

C. Provide unobstructed access to work and cooperate with appointed testing laboratory.

D. Frequency of Asphalt Testing

1. Asphalt Binder Content and Aggregate Gradation; subcontractor shall follow applicable NMDOT section except material shall be sampled and tested at a rate of one test per 300 tons of material produced with at least a minimum of two tests per day's production. Aggregate quality testing shall include Los Angeles Abrasion, fractured faces, and Marshall Stability.

2. Subcontractor Quality Control for Compaction; subcontractor shall follow applicable NMDOT section for PMBP compaction testing.

END OF SECTION

FOR LANL USE ONLY

This project specification is based on LANL Master Specification 32 1216, Rev. 2, dated April 29, 2008.

SECTION 32 3113

CHAIN-LINK FENCES AND GATES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Fence framework, fabric, and accessories.

B. Pedestrian and vehicle gates.

C. Concrete.

D. Electrical grounding.

1.2 RELATED SECTIONS

A. Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

B. Section 03 3053, "Miscellaneous Cast-In-Place Concrete."

C. Section 31 2000, "Earth Moving."

1.3 ABBREVIATIONS AND ACRONYMS, DEFINITIONS, AND REFERENCES

A. Refer to Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

1.4 SUBMITTALS

A. Submit the following in accordance with the requirements of Exhibit I:

1. Catalog data on fabric, posts, accessories, fittings and hardware.

2. Two legible copies of batch tickets for each load of concrete to the Los Alamos National Laboratory (LANL) Subcontract Technical Representative (STR).

1.5 LANL PERFORMED WORK

A. Layout fence lines, gates, and terminal posts with suitable stakes (at intervals not exceeding 500 ft or line of sight).

B. Layout USC&G benchmarks, property monuments, and other underground structures with suitable stakes.

C. Obtain excavation/soil disturbance permit for Subcontractor.

D. Furnish signs for Subcontractor to install on fence. See PART 3 of this section.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle structural steel without damaging finish.

B. Deliver manufactured materials in original unopened packages, containers, or bundles with manufacturer's label intact and legible.

C. Store materials off ground, under cover, and away from damp surfaces.

D. Remove damaged unlabeled or unsatisfactory materials that do not meet this specification from the jobsite.

1.7 QUALITY ASSURANCE

A. Comply with the following unless otherwise noted.

Federal Specification RR-F (http://www.dtic.mil/dtic/search/tr/)	
191K	General Specification
191/1D	Fabric
191/2D	Gates
191/3D	Posts, Rails and Braces
191/4D	Accessories

American Society of Testing and Materials	
ASTM F 552	Definition of Terms
ASTM F 567	Installation
ASTM F 626	Fence Fittings
ASTM F 669	Strength Requirements
ASTM F 900	Gate Construction
ASTM F 1083	Steel Pipe for Fence

PART 2 PRODUCTS

2.1 MATERIALS

A. Fabric: ASTM A 392, Class 1, zinc coated (1.2 oz), steel wire/fabric, 2 in. mesh size, 11-gauge (0.120 in.) coated wire size, galvanized before weaving, with twisted barbed selvages top and bottom.

B. Posts, Rails & Braces: ASTM F 1083 galvanized steel pipe.

C. Galvanizing: ASTM A 123, unless otherwise indicated, provide hot-dipped, zinc-coated accessories of ferrous material with weight of zinc coating not less than 1.2 oz/ft^2.

D. Barbed Wire: ASTM A 121 metallic coated steel, Type Z zinc coating strand wire, 2-1/2 gauge (0.099 inches) steel wire, 4 barb points, 14 gauge (0.080 inches) spaced on 5 inch centers.

E. Fence Fittings: ASTM F 626, Standard Specification for Fence Fittings, type and components as noted.

2.2 BASIC FENCE SYSTEM COMPONENTS

A. Terminal Posts: (Angles, corners, ends, and pull posts) 2-1/2 in. Schedule 40 for fence height up to 8 ft-3 in. Schedule 40 for fence height over 8 ft and equal to or under 16 ft.

B. Line Posts: 2 in. Schedule 40 for fabric height up to 8 ft-2-1/2 in. Schedule 40 for fabric height over 8 ft and equal to or under 16 ft.

C. Braces at Terminal or Gateposts: 1-1/4 in. Schedule 40.

D. Tension Rods: 3/8 in. diameter galvanized steel with turnbuckle end-fitting-type tighteners.

E. Tension Wire: 7-gauge coil spring, hard tempered carbon steel wire.

F. Tension Bars: 3/4-in. by 1/4-in.-thick galvanized steel.

G. Tension Bands: 3/4-in. by 1/10 in. (nominal) galvanized-steel offset bands.

H. Brace Bands: 3/4-in. by 1/10 in. (nominal)-thick galvanized steel.

I. Brace Ends: Cupped fittings of formed steel or cast iron with ears for attaching horizontal braces to brace bands and for connecting diagonal tension rods.

J. Wire Ties: Galvanized, steel with a diameter of at least 0.148 in.

K. Post Caps: Formed steel, malleable cast iron, or aluminum, sized to post diameter, with set screw retainer.

L. Barbed Wire Extension Arms: Galvanized pressed steel, type as specified.

M. Gate Posts:

1. Gate leaf-widths up to 18 ft-6 in. Schedule 40.

N. Gate Frames:

1. Gate leaf-widths greater than 16 ft-2 in. Schedule 80;
2. Diagonal tension rods for leaf-widths over 6 ft; and
3. For gate leaves greater than 8 ft in any direction, provide intermediate braces placed symmetrically so that frame members, including bracing, are spaced not further than 8 ft. Provide braces same size as those called out for fence.

O. Provide non-lift-off type gate hinges sized for gate of adequate strength with large rearing surface for clamping in position so that hinges do not easily twist or turn with gate action.

2.3 FENCE GROUNDING

A. Grounding Cable: No 4/0 AWG bare, stranded, soft temper copper cable conforming to ASTM B 8, Standard Specification for Concentric-Lay stranded Copper Conductors.

B. Flexible Braid: Tinned copper braid with tinned copper ferrules; minimum 250 ampere rating; 12 in. minimum length. O-Z/Gedney Type FB.

C. Cable to Pipe Clamps: NRTL (National Recognized Testing Laboratory) listed copper alloy connectors with silicon bronze hardware for making cable to pipe connections. O-Z/Gedney Type ABG 1-1/2 in. and smaller, Type CG 2 in. and larger pipe diameter.

D. Flexible Braid to Pipe Clamps: NRTL-listed copper alloy connectors with silicon bronze hardware for making braid or copper bar to pipe connections. O-Z/Gedney Type RG.

2.4 CONCRETE

A. Concrete: Furnish concrete for posts and braces in accordance with Section 03 3053, "Miscellaneous Cast-In-Place Concrete."

PART 3 EXECUTION

3.1 PREPARATION

A. Notify LANL STR 10 working days prior to start of construction to identify known utilities and stake and flag locations.

B. Before installing chain-link fence, perform site clearing and grading as noted on drawings.

C. Allow footing to cure minimum 7 days before installing fabric and other materials.

3.2 LATCHES

A. Single gates less than 10 ft wide may use forked type latches.

B. Provide single gates, 10 ft, or more, wide, and inactive leaves of double gates with positive latching devices at top, bottom and center of closing edges such as fork type latches with full gate height plunger bar or rod.

C. At double gates, provide locking devices that retain both gate leaves in same plane when closed.

D. Arrange plunger bars and rods so that they engage gate stops and cannot be raised when locked.

E. Rigidly weld brackets for plunger bars holders to inactivate leaves.

F. Arrange latching mechanisms at double gates so one padlock can lock both gate leaves at center latch integral to gate.

G. Install keepers consisting of a mechanical device for securing free end of gate when in full open position.

3.3 POSTS

A. Space line posts equidistant at intervals not exceeding 10 ft. Measure interval parallel to grade of proposed fence and in line of fence from center to center of post.

B. Set terminal posts (end, corner, and gate) at beginning and end of each continuous length of fence and at abrupt changes in vertical and horizontal alignments.

C. Set fence and gate posts in concrete in holes of diameter and depth as follows:

1. Minimum Diameter: Four times outside diameter of post.
2. Minimum Depth: 36 in. plus an additional 3 in. for each 1 ft increase in fence height over 4 ft.

D. Set posts in a vertical position, plumb and in line. Backfill concrete into excavation and extend 2 in. above grade. An alternative method is to stop footing 2 in. below grade to allow for cover with sod, black top, or other materials. Crown concrete at top to shed water and extend minimum of 2 in. below bottom of post.

E. When solid rock or concrete is encountered, without an overburden of soil, set posts in solid rock or concrete. Depth of hole shall be twelve times the largest cross section of posts. Diameter of hole shall be 6 in. greater than largest cross section of post.

F. The use of sleeves in order to leave voids in new concrete construction is recommended.

G. Half-fill the void with non-shrinkable hydraulic cement and force post to bottom of hole and plumb. Thoroughly work additional grout into hole so as to leave no voids. Crown grout to shed water.

H. Provide tension offset bands fitted around terminal posts at maximum 15-in. intervals to attach tension bars to posts.

I. Provide brace center band to secure brace ends and tension rods to post.

3.4 FABRIC

A. Place chain-link fabric on outside of area enclosed. Locate posts, bracing, and other structural members on inside of secured perimeter.

B. Place fabric by securing one end, applying sufficient tension to remove slack before making attachment elsewhere. Tighten fabric to provide smooth uniform appearance free from sag.

C. Cut fabric by untwisting a picket and attach each span independently at terminal posts. Use stretcher bars with tension bands at maximum 15-in. intervals or any other approved method of attachment.

D. Install fence fabric 2 in. maximum above ground level. Fasten fabric to line posts at intervals not exceeding 15 in. Fasten fabric to rail or tension wire at intervals not exceeding 24 in.

E. Join rolls of wire fabric by weaving a single picket into ends of rolls to form continuous mesh.

F. Provide continuous length tension bars equal to fence height and located wherever chain link fabric end attaches to terminal post. Thread bars through fabric ends for full height, and attach to posts by tension bands.

G. Provide wire ties for attaching chain link fabric to tension wires at maximum 18 in. centers and fence posts at maximum 24 in. centers.

3.5 BARBED WIRE

A. Fencing: Top fencing with three strands of barbed wire on each extension arm. Provide single 45 degree extension arm. Angle single extension arm away from security area.

B. Pull taut to remove sag, firmly install barbed wire in slots of extension arms, and secure to post or terminal arm.

C. Gate: Install barbed wire strands at 6 inches on center between extended gate frame members above gate fabric.

3.6 GATES

A. Install gates true to opening and plumb in closed position.

B. Hang gates so that bottom of gate is as close to ground as practical (2 in. maximum) while allowing sufficient clearance for free operation through at least 90 degree in one direction from closed position.

C. Fasten gate fabric to vertical (end) gate frame members using tension bars and bands as for fence fabric. Fasten fabric to top and bottom gate frame members

and to intermediate braces with 11-gauge wire ties or clips at minimum spacing of 14 in. on center.

D. Extend end frame members 18 in. vertically above top member of gate frame to support barbed wire.

E. Provide tension rods as diagonal braces on gates and secure rods at gate corner only.

3.7 TOP TENSION WIRE AND RAIL

A. Provide top and bottom tension wire and stretch wire from end to end of each stretch of fence at height that will enable it to be fastened to fabric.

B. Stretch tension wire taut (not to exceed 6 in. sideway deflection) between terminal posts for securing fence fabric within 2 in. of top and bottom with hog rings at 18 in. on center, secure with wire ties to every third post minimum.

C. Provide top rail and support at each post so that a continuous brace from end to end of each stretch of fence is formed. Securely fasten top rail to terminal posts and join with sleeves or coupling to allow for expansion and contraction.

3.8 GENERAL REQUIREMENTS

A. Once in place, peen or spot-weld fence hardware to prevent easy removal.

B. Coat damaged galvanized finish with zinc-enriched paint.

C. Leave area of installation neat and free of debris caused by erection of fence.

3.9 ELECTRICAL GROUNDING

A. Bond gateposts on both sides of gate openings using direct buried grounding cable and cable to pipe clamps. Bond gateposts to gates using flexible braid and flexible braid to pipe clamps. Ground posts on both ends of gates; steel posts set in concrete will be considered as adequately grounded.

B. Ground permanent metallic fences crossed by overhead power at every third post for a distance of 50 ft from the crossing; chain link fences with steel post set in concrete will be considered as adequately grounded.

3.10 EXCAVATION, BACKFILL, AND COMPACTION

A. Refer to Section 31 2000, "Earth Moving."

3.11 SIGN INSTALLATION (GFE)

A. Install government furnished property signs or no trespassing signs in areas as indicated by the LANL STR.

B. Signs will generally be 24 in. by 24 in. or smaller and shall be attached to the wire fabric by the use of, as specified, hog rings.

C. General sign locations will be located on all gates, 25 ft each side of gates, trail crossings, and at visible distances along the fence line, not to exceed 300 ft.

END OF SECTION

FOR LANL USE ONLY

This project specification is based on LANL Master Specification 32 3113, Rev. 2, dated August 13, 2009.

SECTION 32 9219

SEEDING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Preparation of seedbed.

B. Seeding.

C. Mulching and erosion control blankets.

D. Watering and maintenance.

1.2 RELATED SECTIONS

A. Section 01 2500, "Substitution Procedures."

B. Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

1.3 ABBREVIATIONS AND ACRONYMS, DEFINITIONS, AND REFERENCES

A. Refer to Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

1.4 SUBMITTALS

A. Submit the following in accordance with the requirements of Exhibit I:

1. Catalog data, including sources of supply for amendments, mulch, tackifier, fertilizer and erosion control blankets.

2. Certification substantiating that material complies with specified requirements. Submit certified seed bag tags and copies of seed invoices identified by project name.

3. Installation instructions, including proposed seeding schedule. Coordinate with specified maintenance periods to provide maintenance from date of final acceptance. Once schedule is accepted, revise dates only with LANL approval after documentation of delays.

1.5 QUALITY ASSURANCE

A. Subcontractor Qualifications:

1. Perform work by a single firm experienced with the type and scale of work required and having equipment and personnel adequate to perform the work satisfactorily.

B. Material Quality Control:

1. Provide seed mixture in containers sealed and labeled by seed dealer. Container label shall show origin of seed and pure live seed (PLS) content, species and percentages in seed mix; lot number; test information including, purity, germination, percentage seed crop, percentage inert, percentage noxious/restricted weeds; net weight; test date; date of packaging; and location of packaging. The seed dealer may premix the seed, documentation shall be provided the same as if the seeds were sold or bagged separately. Seed analysis shall be no older

than five months for seed shipped interstate, and no older than nine months for seed shipped intrastate.

2. Furnish seed labeled in accordance with the requirements of federal seed laws and New Mexico Department of Agriculture seed labeling laws. Such resulting requirements include but are not necessarily limited to: Federal Seed Act and Amendments, rules and regulations established by the United States Department of Agriculture; the New Mexico Seed Law; and all resulting regulations or restrictions established by New Mexico State University or other authorized entity.

3. In addition, ensure seed mix and its application comply with the requirements of all other federal and New Mexico statutes and regulations governing seeds, plants, and weeds. These requirements include but are not necessarily limited to: the Noxious Weed Control Act and all rules, regulations, or control measures by a noxious weed control district embracing Los Alamos County, New Mexico; and the *Harmful Plant Act*.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver packaged materials in original sealed and labeled containers from seed dealer. Protect materials from deterioration during delivery and while stored at site. Opened or wet seed shall be rejected and returned to the responsible party.

B. Temperature of the seed in storage shall not exceed the supplier's recommended maximum temperature.

PART 2 PRODUCTS

2.1 PRODUCT OPTIONS AND SUBSTITUTIONS

A. Comply with Section 01 2500, "Substitution Procedures."

2.2 SEED

A. Obtain native grass seed from sources whose origin would ensure site adaptability at LANL. Plant sources from New Mexico or surrounding states are preferred.

B. Obtain shrub and wildflower seed from sources whose origin would ensure site adaptability at LANL. Plant sources from New Mexico or surrounding states are preferred.

C. Cover crops (annual barley, oats, winter rye, etc.) may be used only as a temporary stabilization measure and shall not be used in conjunction with a perennial seed mix or for final stabilization.

D. Only sterile, non-invasive annual species such as Quickguard sterile triticale hybrid or Regreen shall be used with a perennial seed mix. A minimum 7 lb/acre to a maximum 10 lb/acre shall be applied with the perennial mix. This shall be done when a quick growth establishment is necessary.

E. Develop seed mixture from the following guidelines. Choose a minimum of five grass species from the list. Should wildflowers be included in the mix, use a ratio of 80 to 90 percent grasses and 10 to 20 percent wildflowers. Choose three to five species from the forb and wildflowers list. These species are applicable for both undeveloped and urban-interface areas. All seeding operations must include fertilizer. The seed dealer may premix the seed.

1. Pre-mixed Sources:

   a. Plants of the Southwest, "Dryland Blend;"
   b. Granite Seed, "CGRP Mix;" and
   c. Curtis & Curtis Inc, "Homesteaders Choice Mix" or "Santa Fe Trail Mix."

Native Perennial Mix		
Common Name	**Scientific Name**	**% of Mix**
Grasses		
Blue grama*	*Bouteloua gracilis*	5 to 10
Galleta grass*	*Hilaria jamesii*	5 to 10
Mutton grass	*Poa fendleriana*	10 to15
Sideoats grama*	*Bouteloua curtipendula*	10 to15
Arizona fescue†	*Festuca arizonica*	10 to 15
Prairie junegrass†	*Koeleria macrantha*	5 to 10
Bottlebrush squirreltail*	*Elymus elymoides*	15 to 20
Little bluestem†	*Schizachyrium scoparium*	10 to 15
Indian ricegrass*	*Oryzopsis hymenoides*	10 to 15
Mountain brome†	*Bormus marginatus*	10 to 15
Sand dropseed*	*Sporobolus cryptandrus*	1 to 8
Thickspike wheatgrass	*Agropyron dasystachyum*	20 to 25
Needle and Thread grass*	*Stipa comata*	5 to 10
New Mexico needlegrass*	*Stipa neomexicana*	10 to 15
Sheep fescue	*Festuca ovina*	10 to 15
Smooth Brome	*Bromus inermis*	15 to 20
Stream Bank Wheatgrass	*Elymus lanceolatus ssp. psammophilus*	20 to 25
Forbs/ Wildflowers		
Firewheel	*Gaillardia pulchella*	2
Evening primrose	*Oenothera caespitosa*	1
Gooseberry leaf globemallow	*Sphaeralcea grossulariafolia*	1.5
Scarlet gilia	*Ipomopsis aggregata*	1
Plains aster	*Aster biglovii*	1
Western yarrow	*Achillea millifolium*	1/2
Fringed sage	*Artemisia frigida*	1

Native Perennial Mix		
Common Name	**Scientific Name**	**% of Mix**
Blue flax	*Linum perenne lewisii*	4
Scarlet bulgler	*Penstemon barbatus*	2
Palmer penstemon	*Penstemon palmerii*	2
Prairie coneflower	*Ratibida columnifera*	1
Showy golden-eye	*Heliomerus multiflora*	1
Purple geranium	*Geranium caespitosum*	5
*Species particularly suited for especially dry sites. †Species particularly suited for higher elevations (above 7,000 ft).		

2.3 STRAW MULCH

A. Straw shall be stalks from oats, wheat, rye, barley, or rice that are free from noxious weeds, mold, or other objectionable material. At least 65 percent of the herbage by weight of each bale of straw shall be 10 in. in length or longer. Rotted, brittle or molded straw is not acceptable. Straw from introduced grasses is acceptable if cut prior to seed formation.

2.4 HYDRAULIC MULCH/TACKIFIER

A. Provide mulch material consisting of 100 percent virgin wood fibers manufactured expressly from whole wood chips, such as Eco-Fibre, Conwed, etc. Process chips in such a manner as to contain no growth or germination inhibiting factors. Do not produce fiber from recycled material such as sawdust, paper, cardboard, or residue from pulp and paper plants. Provide materials free from contaminants such as lead paint, varnish or other metal contaminants. Hydraulic mulch shall contain non-toxic dye to assist in visually determining even distribution. Mulch material shall meet the following specifications:

Section Parameter	Value
pH at 3 percent consistency	4.5 +/- 0.5
Ash content	0.8% +/- 0.2%
Moisture holding capacity	1250 (grams water/100 grams oven dry fiber)
Moisture content	12% +/- 3% (Wet weight basis)

B. Combine mulch with an organic plantago based tackifier, such as M-binder, etc., that has no growth or germination inhibiting factors and is nontoxic. Apply the uniform mixture to the seeded area.

C. Bagged mulch/tackifier mix that is homogenous within the unit package may also be used. Tackifier shall adhere to the fibers during manufacturing to prevent separation during shipment and to avoid chemical agglomeration during mixing in the hydraulic mulching equipment.

2.5 BONDED FIBER MATRIX

A. Provide Bonded Fiber Matrix (BFM) composed of natural color, long strand wood fiber, produced by therm-mechanical defribration of wood chips and joined together by a high strength non-toxic adhesive, such as Eco-Ageis, etc. The product shall be composed of 90 percent wood fiber, 9 percent blended

hydrocolloid-based binder, and 1 percent mineral activators, all by total weight. The BFM shall be 100 percent biodegradable and non-toxic to fish and wildlife, and it shall not contain any synthetic fibers.

2.6 FLEXIBLE GROWTH AND FLEXIBLE CONTROL MEDIUMS

A. Provide Flexible Growth Medium (FGM) such as Flexterra™/CocoFlex ET™ or a Flexible Control Medium (FCM) such as EcoFlex™ composed of longstrand, thermally processed wood fibers, crimped, interlocking fibers and performance enhancing additives. The FGM or FCM requires no curing period and upon application forms an intimate bond with the soil surface to create a continuous, porous, absorbent and flexible erosion resistant blanket that allows for rapid germination and accelerated plant growth.

B. The FGM or FCM™ shall be hydraulically applied to the soil as a viscous mixture, creating a continuous 3-dimensional blanket that adheres to the soil surface. Upon drying, the matrix shall form a high-strength, porous and erosion-resistant mat that shall not inhibit the germination and growth of plants in and beneath the layer. The matrix shall retain its form despite re-wetting. T he FCM™ shall be 100 percent biodegradable over time, non-toxic to fish and wildlife, and it shall not contain any non-photo-degradable synthetic fibers.

2.7 ROLLED EROSION CONTROL PRODUCTS

A. For all non-channel applications provide the following:

1. Slopes less than 2:1:

Straw/ coir blend blankets	A machine produced straw /coir fiber erosion control blanket using 70 percent straw /30 percent coir fibers sewn into a heavy weight photo degradable top net and a medium weight photo degradable bottom net. Minimum weight of blanket 0.7 lb/yd^2, such as Greenfix America CFS072R, etc.

2. Slopes 2:1 and greater:

Permanent turf reinforcement mat	A machine-produced mat of 100 percent UV stable polypropylene fiber. The matting shall be of consistent thickness with synthetic fibers evenly distributed over the entire area of the mat. The matting shall be covered on the top with black heavyweight UV stabilized polypropylene netting having ultraviolet additives to prevent breakdown and an approximate 0.50 by 0.50 in. (1.27 by 1.27 cm) mesh size. The bottom net shall also be UV stabilized polypropylene, with a 0.625 by 0.625 in. (1.57 by 1.57 cm) mesh size. The matting shall be sewn together on 1.50 in. (3.81 cm) centers with UV stabilized polypropylene thread, such as North American Green P300 or Greenfix America CFG 2000

B. For all channel applications provide the following:

1. For channels subject to flow producing an unvegetated shear stress of 3 lb/ft^2 or less and a vegetated shear stress of 8 lb/ft^2 or less:

Permanent composite turf reinforcement mat (C-TRM)	A machine-produced composite turf reinforcement mat comprised of a 100 percent UV stabilized polypropylene fiber matrix incorporated into a permanent 3-dimensional turf reinforcement matting. The matting shall be of consistent thickness with synthetic fibers evenly distributed over the entire area of the mat. The matting shall be covered on the top with black heavyweight UV stabilized polypropylene netting having ultraviolet additives to prevent breakdown and an approximate 0.50 by 0.50 in. (1.27 by 1.27 cm) mesh size The bottom net shall also be UV stabilized polypropylene, with a 0.625 by 0.625 in. (1.57 by 1.57 cm) mesh size. The matting shall be sewn together on 1.50 in. (3.81 cm) centers with UV stabilized polypropylene thread to form a permanent 3-dimensional turf reinforcement matting, such as North American Green P300.

2. For channels subject to flow producing an unvegetated shear stress of 4 lb/ft^2 or greater and a vegetated shear stress of 12 lb/ft^2 or less:

Permanent composite turf reinforcement mat (C-TRM)	A machine-produced composite turf reinforcement mat comprised of a 100 percent coconut fiber matrix or a 100 percent polypropylene fiber matrix incorporated into permanent 3-dimensional turf reinforcement matting. The matrix shall be evenly distributed across the entire width of the matting and stitch bonded between a super heavy duty UV stabilized bottom net with 0.50 by 0.50 in. (1.27 by 1.27 cm) openings, an ultra-heavy duty UV stabilized, dramatically corrugated (crimped) intermediate netting with 0.50 by 0.50 in. (1.27 by 1.27 cm) openings, and covered by a super heavy duty UV stabilized top net with 0.50 by 0.50 in. (1.27 by 1.27 cm) openings. The corrugated netting shall form prominent closely spaced ridges across the entire width of the mat. The three nettings shall be stitched together on 1.50 in. (3.81 cm) centers with UV stabilized polypropylene thread to form a permanent 3-dimensional turf reinforcement matting, such as North American Green C350 or P550.

C. Staples: U-shaped, 11 gauge or heavier steel wire, minimum leg length of 6 in. after bending, with a throat approximately 2 in. wide.

2.8 AMENDMENTS / SOIL ADDITIONS

A. Fertilizer: Apply slow-release organic fertilizers such as Biosol Mix, Biosol, Gro-Power, Osmocote, or approved equal to minimize deficiencies of the topsoil. Micronizing fertilizer is acceptable for use in the spring and summer months. All seeding operations must include fertilizer.

B. Water: Clean, fresh, and free of substances or matter that could inhibit vigorous growth.

C. Sand: Clean, washed, and free of toxic materials.

PART 3 EXECUTION

3.1 PREPARATION

A. Preparation of the Seedbed:

1. Prepare seedbed to a maximum depth of 4 in. by tilling with a disc, harrow or chiseling tool. Uproot all competitive vegetation during seedbed preparation and work soil uniformly, leaving surface rough to reduce surface erosion and to retain water runoff. Remove large clods and stones, or other foreign material that would interfere with seeding equipment and erosion control blankets.
2. Perform tillage across slope and along the contour adequately break up soil. Do not till up and down slopes, as this will create excessive surface erosion problems.
3. Do not do work when moisture content of soil is unfavorable or ground is otherwise in a non-tillable condition.
4. To minimize dust problems for adjoining areas, when wind speeds are over 10 mph, dust control measures shall be implemented.
5. The extent of seedbed preparation shall not exceed the area on which the entire seeding operation can be accomplished within a one week period.

B. Soil Amendments/Additions: Uniformly apply slow release organic fertilizer to prepared seedbed in accordance with manufacturer recommended rates.

C. Prepare seedbed again if prior to seeding rain or some other factor has affected the prepared surfaces and will prevent seeding to the proper depth.

D. If cover crop has been established in area to be seeded, mow cover crop early in growing season before cover crop is ready to drop seeds.

3.2 APPLICATION OF SEED

A. General:

1. Avoid seeding between October 1 and April 15. Provide for temporary soil stabilization measures between these dates. Do not seed during windy weather, or when topsoil is dry, saturated or frozen.
2. Equip seed boxes used for drill and broadcast seeding with an agitator.
3. To prevent stratification of seed mix, do not run seed box agitators while seeding is not being performed.
4. If seed mix is transported to site in a seed box or other equipment that subjects mix to shaking or similar movement that has the potential to cause stratification, remix seed prior to application.
5. Seeding equipment shall be calibrated as appropriate to distribute seed at the specified rates.

6. Unless otherwise shown on Drawings, seed areas disturbed by or denuded by construction operations or erosion.

7. Use markers to ensure that no gaps will exist between passes of seeding equipment.

8. If cover crop has been established, mow the crop and drill seed perennial seed mix into the crop stubble.

B. Drill Seeding: When drill seeding, plant seed mix at a rate of 30 to 35 PLS lb/acre. Uniformly apply prescribed mix over area to be seeded as follows:

1. Accomplish seeding operations, where practical, by drilling in a direction across slope and along the contour.

2. Plant seeds approximately 1/4 in. deep.

3. Do not exceed 4 in. distance between drilled furrows. If furrow openers on drill exceed 4 in., drill area twice to obtain a 4-in. distance between furrows.

4. Seed with grass wheels, rate control attachments, seed boxes with agitators, and separate boxes for small seed.

5. Once seed is applied, apply full complement of mulch. This shall allow seed to be in good contact with soil surface and not suspended in mulch matrix.

6. Prohibit vehicles from traveling over the seeded areas.

C. Broadcast Seeding: When broadcast seeding, plant seed mix at a rate of 32 to 37 PLS lb/acre.

1. Where it is not practical to accomplish seeding by drilling, mechanically broadcast seed by use of a hydraulic mulch slurry blower, rotary spreader, or a seeder box with a gear feed mechanism. If seeding is done with a slurry blower, use highest pressure and smallest nozzle opening that will accommodate the seed.

2. Immediately following seeding operation, thoroughly rake seedbed to provide approximately 1/4 in. of soil cover over of the seed.

3. If hydraulically applying mulch as part of the broadcast seeding process, use a 2-step process. Apply seed with a tracer. Once seed is applied, apply full complement of mulch. This shall allow seed to be in good contact with soil surface and not suspended in mulch matrix.

4. Prohibit vehicles from traveling over the seeded areas.

3.3 STRAW MULCH: SLOPES FLATTER THAN 3:1, NON-IRRIGATED PROJECTS

A. Apply straw mulch at a minimum rate of 1.5 tons/acre of air-dry material. Spread straw mulch uniformly over area either by hand or with a mechanical mulch spreader to achieve 80 percent ground cover. When spread by hand, tear bales of straw apart and fluff before spreading. Depth of applied straw mulch shall not exceed 3 in. Do not mulch when wind velocity exceeds 10 mph.

B. Straw mulch shall only be used where use of crimping equipment is practical. Place mulch in manner noted above and anchor the straw into the soil to a minimum depth of 2 in. and not to exceed 3 in. Use a crimper or heavy disc such as a mulch tiller, with flat serrated discs at least 1/4 in. in thickness, having dull

edges, and spaced no more than 9 in. apart. Provide discs of sufficient diameter to prevent frame of equipment from dragging the mulch. Where practical, perform crimping in 2 (opposite) directions. Do not use Sheep's Foot Rollers, heavy equipment tracks, and standard disc cultivators for crimping.

C. If straw mulched areas cannot be anchored by crimping, use hydraulic mulch wood fibers with tackifier. Mix slurry in a tank with an agitation system and spray under pressure uniformly over the soil surface. Keep all materials in uniform suspension throughout the mixing and suspension cycle when using hydraulic mulching equipment. Mix 100 lb. of wood fiber with a minimum 150 to 200 lb of tackifier to anchor straw mulch. Apply mixture at a rate of 250 to 300 lb/acre.

D. Use both horizontal and vertical movements in the applicator to achieve an even application of the slurry material.

3.4 HYDRAULIC MULCHING/TACKIFIER: SLOPES FLATTER THAN 2:1, IRRIGATED PROJECTS

A. Mix slurry in a tank with an agitation system and spray, under pressure, uniformly over soil surface. Apply mulch evenly across landscape at a rate of 2,000 lb/acre.

B. Use both horizontal and vertical movements in applicator to achieve an even application of slurry material. Keep all materials in uniform suspension throughout mixing and suspension cycle when using hydraulic mulching equipment.

C. When using plantago based tackifier as mulch, apply tackifier at a rate of 150 lb/acre.

D. Prohibit foot/vehicle traffic from hydraulically mulched areas.

3.5 BONDED FIBER MATRIX (BFM): SLOPES 2:1 AND STEEPER, IRRIGATED AND NON-IRRIGATED PROJECTS

A. Hydraulically apply BFM over seeded area (or apply seed with a tracer amount, 200 to 300 lb/acre) in accordance with manufacturer's specified procedures. Hydraulically apply BFM as a viscous mixture to form a continuous, porous and erosion resistant mat. Upon drying, matrix shall not inhibit germination and growth of plants in and beneath the layer. Matrix shall retain its form despite re-wetting.

B. Apply matrix uniformly across area and apply in multiple directions to ensure a 100 percent soil surface coverage.

C. Apply at a rate of approximately 3,500 lb/acre in a manner that achieves uniform coverage of all exposed soils.

D. Prohibit vehicle traffic on hydraulic BFM applications.

3.6 FLEXIBLE GROWTH MEDIUM (FGM) AND FLEXIBLE CONTROL MEDIUM (FCM): SLOPES 3:1 AND STEEPER, IRRIGATED AND NON-IRRIGATED PROJECTS

A. For maximum performance, apply FGM or FCM in a two-step process:

1. Step One: Mix and apply seed and soil amendments with small amount of FGM for visual metering.

2. Step Two: Mix and apply FGM at a rate of 50 lb per 125 gallons (23 kg/475 L) of water over freshly seeded surfaces. Confirm loading rates with equipment manufacturer. Do not leave seeded surfaces unprotected, especially if precipitation is imminent.

B. Mixing: A mechanically agitated hydraulic-application machine is recommended:

1. Fill tank to middle of agitator shaft or tank about 1/3 full of water. Turn on pump to wet or purge lines. Begin agitating. Keep adding water slowly while adding the FGM at a steady rate.
2. Consult application and loading charts to determine number of bags to be added. Mix at a rate of 50 lb of FGM per 125 gallons (23 kg/475 L). Contact equipment manufacturer to confirm optimum FGM mixing rates.
3. All FGM should be loaded when the tank is approximately 3/4 full.
4. Fertilizer should be added once the tank is nearly full.
5. Before applying, mix the slurry for at least 10 minutes after adding the last amount of FGM. This is very important to fully activate the bonding additives and to attain proper viscosity.
6. Turn off re-circulation valve to minimize potential for air entrainment within the slurry.

C. Application: Use a fan-type nozzle (50-degree tip) whenever possible for best soil surface coverage. Apply FGM from opposing directions to soil surface, reducing the "shadow effect" and assuring a minimum of 95 percent of soil surface coverage. Slope interruption devices or water diversion techniques are recommended when slope lengths exceed 100 ft (30 m). Install materials at the following minimum application rates:

Condition English Si		
≤ 3H to 1V	3,000 lb/acre	3,400 kg/ha
>3H to 1V and ≤ 2H to 1V	3,500 lb/acre	3,900 kg/ha
>2H to 1V and ≤ 1H to 1V	4,000 lb/acre	4,500 kg/ha
>1H to 1V	4,500 lb/acre	5,100 kg/ha
Below ECB or TRM	1,500 lb/acre	1,700 kg/ha
As infill for TRM	3,500 lb/acre	3,900 kg/ha

Material should not be applied in channels, swales or other areas where concentrated flows are anticipated, unless installed in conjunction with a temporary erosion control blanket or non-degradable turf reinforcement mat. After application, thoroughly flush the tank, pumps and hoses to remove all FGM material. Wash all material from the exterior of the machine and remove any slurry spills. FGM will be more difficult to remove once it dries.

3.7 EROSION CONTROL BLANKET: SLOPES 2:1 AND FLATTER, IRRIGATED AND NON-IRRIGATED PROJECTS

A. Place blankets over native grass seeding immediately following the raking/chaining operation.

B. When using single netted products for 3:1 or flatter slopes, place blanket with netting on top and the wood/ straw fibers in contact with soil over entire seeded area.

C. For slope installations, the following guidelines shall be used:

1. Upslope Anchor – utilize one of the methods detailed below for initial anchoring of Rolled Erosion Control Products (RECP):

   a. Staples: Install the RECP 3 ft (900 mm) beyond the shoulder of the slope onto flat final grade. Secure roll end with a single row of stakes/staples on 1 ft (300-mm) centers.

   b. Anchor Trench: Excavate a 6 in. by 6 in. (150 mm by 150 mm) anchor trench. Extend the upslope terminal end of the RECP 3 ft (900 mm) past the anchor trench. Use stakes or staples to fasten the product into the bottom of the anchor trench on 1 ft (300 mm) centers. Backfill the trench and compact the soil into the anchor trench.

   c. Unroll blanket downslope in direction of water flow.

   d. Overlap edges of adjacent parallel rolls 2 to 4 in. and staple every 3 ft.

   e. When blankets are spliced, place blankets end over end (shingle style) with 6-in. overlap. Staple through overlapped area, approximately 12 in. apart.

   f. Lay blankets loosely and maintain direct contact with soil. Do not place over protruding objects; rocks, grass, etc.

   g. Wire staple blankets sufficiently to anchor blanket and maintain blanket contact with soil per manufacturer's instructions.

2. Seams – utilize one of the methods detailed below for seaming of RECP:

   a. Adjacent Seams: Overlap edges of adjacent RECP by 2 to 4 in. (50 to 100 mm) or by abutting products as defined by manufacturer. Use a sufficient number of stakes or staples to prevent seam or abutted rolls from separating.

   b. Consecutive Rolls: Shingle and overlap consecutive rolls 2 to 6 in. (50 to 150 mm) in the direction of flow. Secure staples through seam at 1 ft (300 mm) intervals.

   c. Check Seam. Construct a stake/staple check seam along the top edge of RECP for slope application and at specified intervals in a channel by installing two staggered rows of stakes/staples 4 in. (100 mm) apart on 4 in. (100 mm) centers.

   d. Slope Interruption Check Slot: Excavate a trench measuring 6 in. wide by 6 in. deep (150 by 150 mm). Secure product to the bottom of the trench. Fold product over upslope material and fill and compact the trench on the downslope side of check slot and seed fill. Continue rolling material downslope over trench.

3. Terminal Ends – utilize one of the methods detailed below for all terminal ends of RECPs:

   a. Staples: Install the RECP 3 ft (900 mm) beyond the end of the channel and secure end with a single row of stakes/staples on 1 ft (300-mm) centers. Stakes/staples for securing RECP to the soil is typically 6 in. (150 mm) long.

b. Anchor Trench: Excavate a 6 in. by 6 in. (150 mm by 150 mm) anchor trench. Extend the terminal end of the RECP 3 ft (900 mm) past the anchor trench. Use stakes or staples to fasten the product into the bottom of the anchor trench on 1 ft (300 mm) centers. Backfill the trench and compact the soil into the anchor trench. Apply seed and any necessary soil amendments to the compacted soil and cover with remaining 1 ft (300 mm) terminal end of the RECP. Secure terminal end of RECP with a single row of stakes or staples on 1 ft (300 mm) centers.

D. Check Slot: Construct a stake/staple check slot along the terminal end of the RECP by installing two rows of staggered stakes/staples 4 in. (100 mm) apart on 4 in. (100 mm) centers.

E. Do not use blankets on undisturbed, natural tuff slopes. Use hydraulic mulching on tuff slopes.

3.8 WATERING

A. Where temporary watering is required for seeded areas, provide temporary water system which may be a sprinkler system, or a water truck with a spray boom or any other method satisfactory to distribute a uniform coverage of clean water (free of oil, acid, salt or other substances harmful to plants) to previously seeded and mulched areas.

B. If a temporary sprinkler system is used, keep all pipe connections tight to avoid leakage and loss of water, and to prevent washing or erosion of growing areas. Maintain sprinklers in proper working order during watering.

C. Do not drive trucks with spray systems on seeded areas and ensure water force does not cause movement of mulch or seed on the ground.

3.9 MAINTENANCE

A. Begin maintenance immediately after planting. Keep re-vegetated areas free of noxious weeds.

B. Maintain seeded areas for not less than 60 days after final acceptance of work and longer as required to achieve final stabilization as described in Paragraph 3.11 of this section.

C. Reseed void areas greater than 6 ft^2 or repetitive voids greater than 2 ft^2 amounting to more than 10 percent of any area that appears the growing season following installation.

3.10 CLEANUP AND PROTECTION

A. After completion of work, clear site of excess soil, waste material, debris and objects that may hinder maintenance and detract from neat appearance of site.

B. Protect seeded areas, work and materials from damage due to vehicles, pedestrians, and operations by other subcontractors. Maintain protection during installation and maintenance periods. Treat, repair or replace damaged work as directed.

C. Upon completion of all seeding operations, clean the portion of the project site used for storing materials and equipment of all debris. Remove all superfluous materials and equipment from the project site. Sweep walks and pavement clean upon completion of work in this section.

3.11 ACCEPTANCE

A. Seeded areas will be reviewed for acceptance by LANL when final stabilization has been achieved. Final stabilization is defined as "All soil disturbing activities at the site have been completed and a uniform (e.g., evenly distributed, without large bare areas) perennial vegetative cover with a density of 70 percent of the native background vegetative cover for the area has been established on all unpaved areas and areas not covered by permanent structures, or equivalent permanent stabilization measures (such as the use of riprap, gabions, or geotextiles) have been employed." Stabilization shall be in conformance with the Storm Water Pollution Prevention Plan (SWPPP), as applicable.

B. In the event that all other work required by the Subcontract is completed before final stabilization is achieved or because seasonal limitations prevent seeding, partial acceptance of the work shall be made with final acceptance delayed until satisfactory vegetative growth has been established.

END OF SECTION

FOR LANL USE ONLY

This project specification is based on LANL Master Specification 32 9219 Rev. 3, dated December 23, 2009.

SECTION 33 0513

MANHOLES AND STRUCTURES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Precast concrete manhole sections and manhole frame and cover castings for use in sanitary sewer and storm water systems.

B. Precast concrete or fiberglass or (HDPE) polyethylene septic and holding tank sections, access frames and covers, and monitoring systems for use in sanitary sewer systems.

1.2 RELATED SECTIONS

A. Section 01 2500, "Substitution Procedures."

B. Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

C. Section 03 3053, "Miscellaneous Cast-In-Place Concrete."

1.3 ABBREVIATIONS AND ACRONYMS, DEFINITIONS, AND REFERENCES

A. Refer to Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

1.4 LANL PERFORMED WORK

A. LANL Utilities and Institutional Group (U&I) will tie into existing systems which include sanitary sewer lines, lift stations, and sewer manholes.

B. LANL Subcontract Technical Representative (STR) will coordinate required inspections and tie-ins.

C. LANL STR will coordinate through LANL Water Quality Group (ENV-RCRA) for inspection of septic tank and holding tank for compliance by New Mexico Environmental Department (NMED).

1.5 SUBMITTALS

A. Submit the following in accordance with the requirements of Exhibit I:

1. Certifications: Furnish copies of materials certificates certifying that each material item complies with, or exceeds, specified requirements.

2. NMED approved septic tank list certification number.

3. Submit manhole exfiltration test results within 5 working days of successful test.

PART 2 PRODUCTS

2.1 SUBSTITUTION LIMITATIONS

A. Alternate products may be accepted; follow Section 01 2500, "Substitution Procedures."

2.2 MATERIALS

A. Provide precast concrete manhole sections (base barrel sections, risers and conical/eccentric tops, flat slab tops, grade rings, etc.) per ASTM C 478. Approved precast concrete septic tanks per ASTM C 1227.

1. Concrete: Compressive strength of 4,000 psi for 28 days.

2. Sanitary Sewer Manhole: Diameter furnished is dependent on depth, pipe size, number of inlet pipes, and if drop manhole.

3. Polyethylene/fiberglass tanks: Tanks shall have side reinforcements specifically designed to withstand the stress, when empty, from soil and surcharge loadings.

B. Manhole Frame and Cover

1. Provide castings true to patterns in form and dimension, and free from pouring faults, sponginess, cracks, blowholes, or other defects in locations affecting their strength and value for the service intended. Provide castings with fillets at angles with sharp and true risers.

2. Provide castings conforming to ASTM A 48, Class 30B.

a. Machine or grind bearing surfaces of the frames and covers to furnish a uniform, flat, non-rocking seat for the cover on the frame.

b. Provide cover with the word "Sewer" cast on the sewer manhole cover.

c. Provide cover with the word "Storm Drain" cast on the storm water manhole cover.

C. Sealing Gasket (precast manhole or tank sections): Mastic Gasket as manufactured by RAM-NEK or Kent Seal.

D. Pipe Waterstop: Provide waterstop grouting ring for watertight connection between manhole wall and pipe, resilient rubber with stainless steel bands. Conform to physical property requirements of ASTM C 923 and ASTM C 1478. Manufacturer: Trelleborg – NPC – Waterstop Grouting Ring with NPC – Corrugated Pipe Adapter as applicable.

PART 3 EXECUTION

3.1 INSTALLATION

A. Compact soil foundations for manhole base or tanks to a density of 95 percent of the maximum density per ASTM D 1557. Compaction shall be minimum 1 ft beyond perimeter of concrete base and shall be a minimum of 1 ft in depth.

B. Invert elevation of pipes entering or exiting manhole or tanks and interior inverts shall not vary more than 0.05 ft from the elevations shown on the drawings.

C. Use concrete per Section 03 3053, "Miscellaneous Cast-In-Place Concrete," for formed-in-place foundations or bases, concrete shelves, and pipe supports.

D. Depending on size of pipe, make connections to existing and new manholes by either core drilling through manhole wall (perform for new precast units), or carefully chipping wall segment. Take care to avoid unnecessary damage to manhole surfaces or walls.

E. Install waterstop grout ring before placing high strength, non-shrink grout around piping in concrete manhole or tank wall. Coat interior surface of concrete manhole or tank to provide watertight seal, exclude storm drain manhole.

F. Piping connecting to a polyethylene/fiberglass tank shall of the same or compatible material as the tank. Connections shall be water proof and per tank manufacturer's instructions.

G. Set the manhole level and plumb.

3.2 MANHOLES

A. The vertical riser sections of manhole may be of different dimensions in order that manholes of various depths can be readily assembled.

B. Install circular precast manhole sections with sealing gasket to seal joints between sections. Clean joints prior to installation. Entire width of joint shall receive a layer of sealing gasket.

C. Fill lifting holes and gaps at joints with a non-shrink grout.

D. Precast concrete manhole bases may be used when approved by a LANL Utilities & Infrastructure Group wastewater system representative. If approved, it is with the understanding that placing the bases at the specified elevation, location, and alignment is the Subcontractor's responsibility.

3.3 GRADE RINGS

A. Use mastic and/or grout to lay grade rings to provide watertight seal and for the prevention of displacement of rings.

B. Grade rings shall remain plumb and vertically aligned during backfilling and paving operations.

3.4 MANHOLE FRAME AND COVER

A. Provide ductile iron castings as shown on the drawings and as specified herein. The castings shall include manhole frames and covers.

B. Seal between grade ring and frame with mastic and/or grout to provide watertight seal and for the prevention of displacement of rings and frame.

3.5 TESTING OF SEWER MANHOLES

A. Test sanitary sewer manholes for leakage by a water exfiltration test. Submit test reports to the LANL STR. Perform test prior to backfilling around manhole and prior to placement of manhole frame and cover. Properly plug inlet and outlet lines and fill and seal lift holes and barrel joints as specified. In lieu of water exfiltration testing the manhole interior can be coated with a two part, high build epoxy lining with 100% solids by volume. Material shall have chemical resistance and be designed as a structural lining for manholes and vessels in wastewater facilities. Preparation of surface and application of product shall be per the manufacturer's instructions. If manhole(s) fail two exfiltration tests, the manhole(s) shall be spraylined to specifications.

1. Manufacturer: Raven Lining Systems.

B. Furnish all materials and equipment necessary to perform test and conduct test in the presence of the LANL Inspector. Allow a stabilization period of 1 hour for absorption, after which, refill manhole as necessary before starting test. Perform

test for a period of 2 hours, after which refill manhole, measuring necessary quantity of water. The difference in water surface elevation from original to final level shall be measured and converted to gallons per hour lost through manhole leakage. An allowable leakage is allowed and is represented by the following formula:

$$V = 0.20\ DHT$$

where,

V = Allowable loss in gallons;
D = Manhole diameter in feet;
H = Initial depth of water to invert in feet; and
T = Duration of test in hours.

END OF SECTION

FOR LANL USE ONLY

This project specification is based on LANL Master Specification 33 0513, Rev. 5, dated February 24, 2011.

SECTION 33 1000

WATER UTILITIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Site water distribution piping system (potable and fire water) beyond the building wall.

1.2 RELATED SECTIONS

A. Section 01 2500, "Substitution Procedures."

B. Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

C. Section 01 4444, "Offsite Welding & Joining Requirements."

D. Section 01 4455, "Onsite Welding & Joining Requirements."

E. Section 22 0813, "Testing Piping Systems."

F. Section 22 0816, "Disinfection of Potable Water Piping."

G. Section 22 0554, "Identification for Plumbing, HVAC, and Fire Piping and Equipment."

H. Section 31 2000, "Earth Moving."

1.3 ABBREVIATIONS AND ACRONYMS, DEFINITIONS, AND REFERENCES

A. Refer to Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

1.4 LANL PERFORMED WORK

A. LANL Utilities and Institutional Group (U&I) will perform final tie-in into existing water piping systems.

1.5 LANL-FURNISHED AND INSTALLED EQUIPMENT

A. LANL will furnish and install post indicator valve padlocks.

1.6 SUBMITTALS

A. Submit the following in accordance with the requirements of Exhibit I:

1. Catalog data on pipe materials, pipe fittings, valves, and accessories and directional drilling pull (weak link) device and casing seals.
2. Installation instructions for valves and accessories.
3. Existing system pressure calculations to support new water pipe design and selection.
4. Certification of welders and qualified welding procedure per LANL's Welding Program *Engineering Standards Manual* (ESM) (ISD 341-2 and PD342, Chapter 13, "Welding, Joining, & NDE").
5. Submittals for the Horizontal Direction Drilling.
6. Tracing wire continuity test report.
7. Catalog data on identification tape and tracing wire.

1.7 QUALITY ASSURANCE

A. Welders Certifications and Qualified Procedure Standards

1. On-site welding and joining shall comply with LANL's ESM Chapter 13 and Section 01 4455, "Onsite Welding & Joining Requirements."

a. Use LANL Welding Procedures.

b. Welders shall be qualified at LANL by LANL.

2. Off-site welding and joining shall comply with LANL's ESM Chapter 13 and Section 01 4444, "Offsite Welding & Joining Requirements."

3. Plastic Pipe: ASTM D 2657 and ASTM D 3261 and pipe manufacturer's heat fusion qualification guide. Training in the making of heat fusion joints shall be per the manufacturers recommended procedure.

4. Weld Inspection: Comply with LANL's ESM Chapter 13 for PE pipe.

B. LANL STR shall submit the material and accessory catalog data, certified material inspection report for steel pipe, and certification of welders and qualified welding procedure to the LANL U&I gas system engineer and the LANL construction inspector for verification of construction items and certifications during field quality assurance.

PART 2 PRODUCTS

2.1 PRODUCT OPTIONS AND SUBSTITUTIONS

A. Alternate products may be accepted; follow Section 01 2500, "Substitution Procedures."

2.2 WATER BEYOND BUILDING WALL

A. Ductile Iron Pipe: AWWA C151.

1. Joints: Bell and spigot, AWWA C111 rubber gaskets.

2. Fittings: AWWA C110, Ductile-Iron or Gray-Iron, Class 350 or AWWA C153, Ductile-Iron Compact Fittings, Class 350.

3. Pipe and Fittings: Cement mortar lined with bituminous outside coating.

B. Copper Tubing: ASTM B 88, Type K, hard drawn or annealed.

1. Joints: AWS A5.8, BCuP silver braze.

2. Fittings: ANSI/ASME B16.22, wrought copper and copper alloy solder-joint.

C. PVC Pipe: AWWA C900, DR18, pressure rating 150.

1. Joints: Bell and spigot joint ASTM D 3139 rubber gaskets ASTM F 477.

2. Fittings: AWWA C110, Ductile-Iron or Gray-Iron, Class 350 or AWWA C153, Ductile-Iron Compact Fittings, Class 350.

D. Polyethylene Pipe and Fittings: AWWA C901 (3 in. or less) and AWWA C906 and ASTM F 714 (4 to 63 in.), Class 150, pressure rating 150.

1. Manufacturer: CP Chem Performance Pipe - Driscoplex 4100 FM, Ductile Iron Pipe Size.

2. Pipe: Polyethylene, high density, AWWA (C901), (C906), PPI-PE4710, cell classification number PE 445574C per ASTM D 3350. Certifications by Factory Mutual Approvals (FMA) Class Number 1613 and National Sanitation Foundation (NSF).

3. Fittings: Polyethylene, high density, AWWA (C901), (C906), ASTM D 3261, PPI-PE4710, cell classification number PE 445574C per ASTM D 3350. Certifications by Factory Mutual System approvals (FM) and National Sanitation Foundation (NSF). The pipe manufacturer shall supply fittings and adapters.

4. Joints: Heat fusion per ASTM D 2657 and manufacturer's written instruction.

2.3 FLANGES, UNIONS, AND COUPLINGS

A. Copper Tubing:

1. Class 150 bronze unions with soldered joints.

B. Mechanical or Push-On Type Pipe, and Fittings Below Grade.

1. UL-listed or FM-approved.

2. Ductile Iron Pipe: Megalug Series 1100, malleable/ductile iron joint retainer/restraint gland with polymer, epoxy or bituminous outside coating and 1/2 in. minimum diameter asphalt coated tie rods.

3. PVC Pipe: for ductile iron joint use a compression connection and restraint system or retainer/restraint gland, Mueller AquaGrip System, Megalug Series 2000PV.

4. HDPE Pipe: for ductile iron joint use restraint devices designed to resist pull out forces. Internal pipe wall stiffeners must be used when restraining HDPE. Megalug Series 2000PV.

C. High Density Polyethylene

1. Flanges: Flanged joints shall be standard manufacturers flange adaptor that is butt fused to the pipe. Backup ring shall be ductile iron. Flange gaskets shall be installed.

2. Transitions: MJ Adaptors shall be standard manufacturers adaptor that is butt fused to the pipe for connecting to mechanical joint pipe, fittings, and appurtenances. Manufacturers' complete assembly shall be supplied; including stainless steel stiffener, extended gland bolts and nuts, gland and gasket.

2.4 VALVES, ABOVE GRADE

A. Ball Valves up to 2 in.:

1. Manufacturer: NIBCO, Series 585-70.

2. MSS SP-110, 600 psi CWP, bronze, two piece body, chrome plated brass ball, full port, Teflon seats and stuffing box ring, blowout proof stem, lever handle, solder or threaded ends.

B. Butterfly Valves over 2 in.:

1. Manufacturer: NIBCO, Series LD 2000.

2. MSS SP-67, 200 psi CWP, ductile iron body, aluminum bronze disc, resilient replaceable EPDM seat, lug style, extended neck, lever handle, for use between ANSI Class 125/150 flanges.

C. Globe Valves up to 2 in.:

1. Manufacturer: NIBCO, Series 211.

2. MSS SP-80, Class 125 bronze body, bronze trim, hand wheel, bronze disc, solder or threaded ends.

D. Gate Valves up to 2 in.:

1. Manufacturer: NIBCO, Series 111.

2. MSS SP-80, Class 125 bronze body, bronze trim, rising stem, hand wheel, inside screw, solid wedge disc, solders or threaded ends.

2.5 VALVES, BELOW GRADE

A. Gate Valves less than 2 in.:

1. Manufacturer: NIBCO, Series T-176-A.

2. MSS SP-80, Class 300 bronze body, bronze trim, non-rising stem, hand wheel, inside screw, solid wedge disc, and threaded ends.

B. Gate Valves 2 in. and over:

1. Manufacturer: Mueller, No. A-2360-8, 2 through 3-in. threaded, 2-in. square wrench nut or No. A-2360-20 or A-2361-77 AquaGrip, 4 in. and larger, 2 in. square wrench nut.

2. AWWA C509, UL listed or FM approved, Class 250, non-rising stem, open left, threaded inlet and threaded outlet or mechanical joint inlet and outlet with mechanical joint unassembled accessories or Mueller AquaGrip System.

C. Tapping Valves:

1. Manufacturer: Mueller, No. T-2360-16, No substitution.

2. AWWA C509, UL listed or FM approved, Class 250, resilient wedge, non-rising stem, open left, ANSI Class 125/150 inlet flange, mechanical joint outlet with mechanical joint accessories, 4 in. and larger, 2 in. square wrench nut.

D. Gate Valve (Post Indicator):

1. Manufacturer: Mueller, No. P-2360-20 or P-2361-77 AquaGrip, No Substitution.

2. AWWA C509, UL listed or FM approved, Class 250, non-rising stem with post indicator flange, open left, mechanical joint inlet and outlet with mechanical joint accessories or Mueller AquaGrip System.

2.6 FIRE HYDRANTS

A. Manufacturer: Mueller, Super Centurion 250, Style A423. No Substitution.

B. UL listed or FM approved, dry barrel, 5-1/4-in. main valve opening, 3-way with 4-1/2-in. pumper nozzle and two 2-1/2-in. hose nozzles, ground level break flange, and mechanical joint inlet connection or Mueller AquaGrip System. Hydrant factory painted yellow.

2.7 POST INDICATORS

A. Manufacturer: Mueller, No. A20806. No Substitution.

B. UL listed or FM approved, adjustable type, open left, complete with lower barrel sized for appropriate bury depth.

2.8 SERVICE SADDLE

A. Manufacturer: Mueller, DR1A & S Series and DR2A & S Series for A-C and plastic.

B. Ductile iron, stainless steel strap, iron pipe outlet thread, and o-ring gasket.

C. Strap shape to be per manufacture recommendation for the existing pipe material.

2.9 TAPPING SLEEVE

A. Manufacturer: Romac Industries, No. FTS 419, No Substitution.

B. Fabricated steel, ANSI Class 150 outlet flange, suitable for PVC, steel, ductile iron, and cast iron pipe, outlet flange size and sleeve O.D. to suit piping system, 4 in. and larger.

2.10 COUPLING

A. Manufacturer: Dresser, Style 38 for steel pipe, and style 138 for cast iron pipe.

B. Steel, size suitable for pipeline material and diameter.

2.11 VALVE BOX

A. Manufacturer: Tyler, Series 6860.

B. Cast iron, 5-1/4-in. shaft, screw-type, lid marked "water".

PART 3 EXECUTION

3.1 EXAMINATION

A. Do not install underground piping when bedding is wet or frozen.

B. Verify that excavations are to required grade.

3.2 PREPARATION

A. Ream pipe and tube ends. Remove burrs.

B. Remove scale and dirt on inside and outside of piping before assembly.

C. Keep open ends of pipe free from scale and dirt. Whenever work is suspended during construction, or at the end of each workday, protect open ends with temporary plugs or caps.

3.3 PIPING TIE-IN

A. Tie-in to existing piping systems will be performed by LANL U&I group. Excavation, backfill, and materials required for tie-in shall be provided by Subcontractor. The tie-in will be inspected by the LANL Subcontract Technical Representative (STR) and the LANL U&I Group water system representative.

B. New tie-ins shall be a minimum size of 2 in. when tying into existing piping systems that are 4 in. and larger. If required, a pipe size reduction shall be made after the valve.

C. New tie-ins to existing piping systems 4 in. and larger shall be made by using a tee cut into the existing pipe and a valve on the new service line. If the existing line cannot be removed from service a tapping tee and tapping valve can be used.

D. Notify LANL STR at least 15 working days in advance to schedule tie-in. The LANL STR will notify LANL U&I group and, prior to doing so, the LANL STR will ensure materials required for tie-in are on site, service lines have been tested, material submittals and all test reports have been approved by LANL U&I Group, and bell hole is dug.

3.4 BURIED PIPING

A. Refer to drawings and Section 31 2000, "Earth Moving," for earth cover, bedding, tracer wire, wire continuity test, warning tape, documenting new or exposed existing utility location, etc., requirements.

B. Minimum cover over pipe shall be 48 inches measured from finish grade to top of pipe.

3.5 INSTALLATION

A. Comply with Uniform Plumbing Code (IAMPO) and applicable AWWA publications.

B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.

C. Route piping in a straight line, in an orderly manner, and maintain gradient.

D. Set hydrants plumb and locate pumper nozzle perpendicular to and facing roadway.

E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

F. Sleeve and caulk pipes penetrating exterior walls below grade to provide a waterproof installation.

G. Disinfect water distribution system per Section 22 0816, "Disinfection of Potable Water Piping."

H. Pressure test piping system per Section 22 0813, "Testing Piping Systems."

I. Fire hydrants tied into a non-potable dedicated fire loop shall have the hydrant bonnet painted black, and labeled "Non-Potable Water, Do Not Drink" per Section 22 0554, "Identification for Plumbing, HVAC, and Fire Piping and Equipment." Refer to drawings for hydrant location.

J. Comply with AWWA M23, PVC Pipe Design Installation, for installation of PVC piping under roads.

3.6 POLYETHYLENE PIPING INSTALLATION

A. Lay coiled and small diameter piping on trench bottom in such a manner as to snake piping ("S" curves) in trench along the piping run. This will insure that sufficient piping material is available for expansion and contraction. Lay piping in trench and allow for temperature stabilization to minimize thermal expansion and contraction.

B. Cold (field) bending allowable bend radius is determined by pipe diameter and dimension ratio. Minimum bend radius shall be per manufacturers written instructions. Bends shall not be made where fittings are in the bend.

C. Provide minimum of 5 ft of cover over piping installed under any roadways and vehicle parking areas.

D. Perform butt heat-fusion joining in accordance with ASTM D 2657 and the manufacturer's written instructions. See PART 1, Quality Assurance.

E. Make connections to PE-to-DI or PVC pipe and mechanical connections, valves, and appurtenances with transition fittings that are butt fused onto the PE pipe. Provide complete assemblies and install per manufacturers written instruction.

F. Thrust blocks and restraint shall be installed at tees and change in direction per the manufacturer's written instructions.

3.7 HORIZONTAL DIRECTIONAL DRILLING

A. Crossing of paved streets or roadways or other areas, if approved by LANL U&I group representative, may be accomplished by horizontal directional drilling (HDD), whenever practical. The HDD bore shall be kept to a maximum of 2 in. larger than the pipe. Care shall be exercised to ensure the paved surface is not damaged during the drilling operation.

B. Top of HDD shall have a minimum below grade bury depth of 48 in. and a minimum bury depth of 60 in. below any paved surface. Depth shall not exceed excavation by standard, conventional means and shall be approved by LANL U&I group representative.

C. When pulling in pipe the pulling force shall be monitored and kept below the Allowable Tensile Load (ATL) value of the pipe size and material per manufacturer's recommendation. Both pipe ends shall be monitored for continuous, smooth movement. Pulling load from the equipment shall be monitored and the pipe lead end shall be equipped with a weak link device to disengage at the ATL or below. Manufacturer's procedures and design parameters shall be followed, in addition to ASTM F 1962.

D. Polyethylene pipe shall extend 3-5 percent of the pulled-in length past the termination points to allow for contraction. Polyethylene pipe shall be allowed 24 hours to recover from the pulling stress and contract to original pre-pull length and allowed to stabilize to buried soil temperature before final tie-ins are accomplished. A minimum of 5 ft of pipe shall extend beyond the drilling entrance/exit hole to allow for pipe damage assessment. Tracing wire shall be pulled in with the polyethylene pipe.

END OF SECTION

FOR LANL USE ONLY

This project specification is based on LANL Master Specification 33 1000, Rev. 4, dated February 24, 2011.

SECTION 33 3000

SANITARY SEWERAGE UTILITIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Site piping, fittings, manholes, and accessories beyond 5 ft of building wall.

1.2 RELATED SECTIONS

A. Section 01 2500, "Substitution Procedures."

B. Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

C. Section 01 4444, "Offsite Welding & Joining Requirements."

D. Section 01 4455, "Onsite Welding & Joining Requirements."

E. Section 03 3053, "Miscellaneous Cast-In-Place Concrete."

F. Section 22 0813, "Testing Piping Systems."

G. Section 31 2000, "Earth Moving."

H. Section 33 0513, 'Manholes and Structures."

1.3 ABBREVIATIONS AND ACRONYMS, DEFINITIONS, AND REFERENCES

A. Refer to Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

1.4 LANL PERFORMED WORK

A. Coordinate with the LANL Subcontractor Technical Representative (STR) for tie into existing systems which include sanitary sewer lines, septic tanks, treatment plants, lift stations, and manholes. Ties into existing systems shall be performed by LANL Utilities and Institutional Group (U&I).

B. LANL STR will coordinate for inspection of the interior of new and existing sanitary sewer lines (accessible by camera) with video camera for piping integrity and proper installation both before tie-in and at turnover.

C. Subcontractor Technical Representative (STR) will ensure that an approved WPF (Waste Profile Form) for all anticipated wastewater from all drains or buildings connected to the sanitary wastewater system has been completed by LANL Projects Manager and on file before scheduling tie-ins. Documentation shall be submitted to the LANL Utility & Infrastructure Group wastewater representative prior to utility tie-in. http://enterprise.lanl.gov/forms/1346.pdf

D. STR will coordinate all required inspections and tie-ins.

1.5 SUBMITTALS

A. Submit the following in accordance with the requirements of Exhibit I:

1. Catalog data on pipe materials, fittings and accessories, and casing seals.

2. Certifications of welders qualified for heat fusion polyethylene joints.

3. Tracing wire continuity test report.

1.6 QUALITY ASSURANCE

A. Welders Certifications and Qualified Procedure Standards per Section 01 4455, "Onsite Welding & Joining Requirements."

1. Plastic Pipe: Comply with LANL's *Engineering Standards Manual* (ESM) (ISD 341-2 and PD342, Chapter 13, "Welding, Joining, and NDE"), 49 CFR 192.283, and 49 CFR 192.285.

a. On-site and joining welding shall comply with LANL's ESM Chapter 13 and Section 01 4455, "Onsite Welding & Joining Requirements."

1) Use LANL Welding Procedures.

2) Welders shall be qualified at LANL by LANL.

b. Off-site welding and joining shall comply with LANL's ESM Chapter 13 and Section 01 4444, "Offsite Welding & Joining Requirements."

c. Weld Inspection: Comply with LANL's ESM Chapter 13 for PE pipe.

B. LANL STR shall submit the material and accessory catalog data, certified material inspection report for steel pipe, and certification of welders and qualified welding procedure to the LANL U&I gas system engineer and the LANL construction inspector for verification of construction items and certifications during field quality assurance.

PART 2 PRODUCTS

2.1 PRODUCT OPTIONS AND SUBSTITUTIONS

A. Alternate products may be accepted; follow Section 01 2500, "Substitution Procedures."

2.2 SANITARY SEWER PIPING, BURIED BEYOND 5 FT OF BUILDING

A. Ductile Iron Pipe: AWWA C151, Class 150.

1. Joints: Bell and spigot, AWWA C111 rubber gaskets.

2. Fittings: AWWA C110, Ductile-Iron or Gray-Iron, Class 350 or AWWA C153, Ductile-Iron Compact Fittings, Class 350.

B. PVC Pipe and Fittings: ASTM D 3034, SDR 35.

1. Joints: Bell and spigot, ASTM D 3212 rubber gaskets.

2. Not for use in force mains.

C. PVC Pipe: AWWA C900, Class 150 (DR 18).

1. Joints: Bell and spigot joint ASTM D 3139, rubber gaskets ASTM F 477.

2. Fittings: AWWA C110, Ductile-Iron or Gray-Iron, Class 350 or AWWA C153, Ductile-Iron Compact Fittings, Class 350.

D. Polyethylene Pipe and Fittings.

1. Manufacturer: CP Chem Performance Pipe, Driscoplex 4100, Iron Pipe Size or Driscoplex 4000, Ductile Iron Pipe Size. Use of IPS or DIPS shall be appropriate for new system or interface with existing system.

2. Pipe: Polyethylene, high-density, ASTM D 3035, ASTM F 714, PPI-PE4710, [SDR11] pipe size, ASTM D 3350 cell classification number 445574C..

3. Joints: Heat fusion per manufacturer's instruction.

4. Fittings: Polyethylene, high-density, butt heat fusion-type, ASTM D 3261, PE4710, [SDR 11], ASTM D 3350 cell classification number 445574C.

2.3 FLANGES, UNIONS, AND COUPLINGS (SEWER FORCE MAINS)

A. Mechanical or Push-On Type Pipe, and Fittings Below Grade.

1. Ductile Iron Pipe: Megalug Series 1100, malleable/ductile iron joint retainer/restraint gland with polymer, epoxy or bituminous outside coating and 1/2-in. minimum diameter asphalt coated tie rods.

2. PVC Pipe: use a compression connection and restraint system or retainer/restraint gland, Mueller AquaGrip System, Megalug Series 2000PV.

B. High-Density Polyethylene

1. Transitions: MJ Adaptors shall be standard manufacturers adaptor that is butt fused to the pipe for connecting to mechanical joint pipe, fittings, and appurtenances. Manufacturers' complete assembly shall be supplied; including stainless steel stiffener, extended gland bolts and nuts, gland and gasket.

2.4 CLEANOUTS

A. Cleanout

1. Manufacturer: General Engineering Company, GENECO.

2. Ferrous metal top with gasketed bell to accept PVC schedule 40 or cast iron riser pipe.

3. Screw plug to be standard brass countersunk plug.

B. Riser Pipe

1. Pipe: 4-in. minimum PVC schedule 40 or heavier or cast iron.

C. Wye

1. Preformed single-wye or double-wye per design requirement.

2.5 MANHOLE

A. Provide precast concrete manhole, concrete grade rings, and ductile iron cover per drawings and Section 33 0513, 'Manholes and Structures."

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify excavations are to required grade. Do not over excavate.

3.2 PREPARATION

A. Ream pipe ends and remove burrs.

B. Remove scale and dirt on inside and outside of piping before assembly. Pipe interior shall be thoroughly cleaned of foreign material before lowering into the trench.

C. Keep open ends of pipe free from scale and dirt. Whenever work is suspended during construction, or at the end of each workday, protect open ends with temporary plugs or caps.

3.3 PIPING TIE-IN

A. Tie-ins to existing piping, lift stations, manholes, and equipment will be performed by LANL U&I group. Excavation, backfill, and materials required for tie-in shall be provided by Subcontractor. The tie-in will be inspected by the LANL Construction Inspector and the LANL U&I Group sanitary sewer systems representative.

B. Notify LANL STR at least 10 working days in advance to schedule tie-in of piping system and pre-tie-in video inspection described in Paragraph3.6.

C. Before tie-ins are scheduled, the LANL STR will ensure materials required for tie-in are on site, service lines have been tested, material submittals and all test reports have been approved by LANL U&I, and the excavation meets access and OSHA requirements.

D. Install pipe at manhole tie-ins at the same invert elevation without sags or low points. Chip manhole wall only to allow for insertion of new pipe. Install waterstop grout ring around the pipe before repairing the manhole wall. Caulk/seal around new pipe to provide watertight installation in manhole wall. Seal shall be per pipe manufacturer's instructions, in addition to ASTM F 585.

E. Sleeve and caulk pipes penetrating exterior walls below grade to provide a waterproof installation.

F. Set concrete manholes level and plumb and test manholes for leakage per Section 33 0513, 'Manholes and Structures."

3.4 BURIED PIPING

A. Refer to drawings and Section 31 2000, "Earth Moving," for cover, bedding, tracer wire, wire continuity test, warning tape, documenting new or exposed existing utility location, and other requirements.

B. Slope of service lateral from building to main shall be continuous and uniform without fittings or angled pipe joints. Slope shall be a minimum slope of 1/4 in./ft and a maximum slope of 1/2 in/ft. Minimum depth of cover shall be 4 ft.

C. Comply with New Mexico Plumbing Code (IAPMO UPC and amendments).

D. Route piping in orderly manner and maintain gradient.

E. Install bell and spigot pipe with bell end upstream.

F. Thrust blocks and restraint shall be installed on sanitary sewer force mains at tees, elbows, and change in direction, per the manufacturer's written instructions and Section 03 3053, "Miscellaneous Cast-In-Place Concrete."

G. Pressure test piping system with water or air in accordance with Section 22 0813, "Testing Piping Systems."

3.5 SEWER CLEANOUT

A. Cleanouts shall consist of single or double preformed wye, riser pipe, and access top.

B. Double cleanout shall be placed at 5 ft from building wall. A cleanout shall be placed at a change in direction in service laterals. The distance between cleanouts in service laterals shall not exceed 100 ft.

C. Riser pipes shall be one piece extended to grade with top adapter for a countersunk threaded plug.

D. Sand bedding or fine graded backfill material shall be compacted around riser pipe.

E. Cleanouts at grade shall have concrete collars 18 square by 6 in. thick with 6X6X10 gauge (W1.4) wire fabric reinforcement. Concrete shall be continuous at double cleanouts. Collar shall be flush with finish grade or pavement.

3.6 LANL ACCEPTANCE INSPECTION AND TESTING

A. Notify STR at least 10 working days before tie-in to schedule video inspection of piping system. Inspection will verify that new and existing lines are clean and acceptable for tie-in to commence.

B. Notify STR at least 7 working days before system turnover to schedule second and final video inspection of piping system. The re-inspection is to assure no debris from construction activity has entered the new or existing system.

END OF SECTION

FOR LANL USE ONLY

This project specification is based on LANL Master Specification 33 3000, Rev. 5, February 24, 2011.

SECTION 33 3200

WASTEWATER UTILITY PUMPING STATIONS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Submersible pumps and equipment for sanitary sewer lift station.

1.2 RELATED SECTIONS

A. Section 01 2500, "Substitution Procedures."

B. Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

C. Section 26 0553, "Identification for Electrical Systems."

D. Section 33 0513, "Manholes and Structures."

1.3 ABBREVIATIONS AND ACRONYMS, DEFINITIONS, AND REFERENCES

A. Refer to Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

1.4 LANL PERFORMED WORK

A. LANL Utilities and Institutional Group (U&I) will perform acceptance inspection, testing, adjusting and tie-in of lift station. See PART 3 of this section.

1.5 SUBMITTALS

A. Submit the following in accordance with the requirements of Exhibit I:

1. Catalog data on each item of equipment to be incorporated into the lift station.
2. Power and Control Cables.
3. Pump curves.
4. Operation and maintenance data.
    a. Theory of operation.
    b. Test procedure.
5. Warranties.

1.6 WARRANTY

A. Manufacturer's printed warranties shall apply to pumps.

B. Provide five years or 10,000 elapsed-time hours warranty after installation, including parts and labor.

C. Provide for repairs to be performed at the manufacturer's authorized warranty repair station located within a 200 mile radius of this Project.

1.7 QUALITY ASSURANCE

A. Provide nationally recognized testing laboratory (NRTL)-listed material and equipment for the application and environment in which installed.

B. Install electrical motors, equipment, and wiring in accordance with the *National Electrical Code* (NEC) (NFPA 70).

PART 2 PRODUCTS

2.1 PRODUCT OPTIONS AND SUBSTITUTIONS

A. Alternate products may be accepted; follow Section 01 2500, "Substitution Procedures."

2.2 ACCEPTABLE MANUFACTURER

A. Flygt – No Substitutions.

B. Pumps shall be readily removable and replaceable without de-watering wet well or disconnecting any piping in wet well.

2.3 PERFORMANCE AND DESIGN REQUIREMENTS

A. See Paragraph 3.6, "Equipment Schedule."

2.4 PUMP MATERIALS

A. Provide pumps that are NRTL listed to UL 778, *Motor Operated Water Pumps*.

B. Volute, impeller, motor housing, discharge elbow, and other components: Gray cast iron, ANSI Class 30.

C. Shaft: Stainless steel or carbon steel.

D. Motor:

1. Rotor bars and short circuit rings: Aluminum.
2. Windings: Copper.
3. Stator winding and lead insulation: NEMA Class F.

E. Mechanical Seals:

1. Lower: Tungsten carbide/tungsten carbide.
2. Upper: Tungsten carbide/carbon.

F. Wear Ring:

1. Case wear ring: Steel with molded nitrile rubber.
2. Impeller wear ring: ANSI 304 stainless steel. Provide on pump greater than 15 HP.

G. Exposed Nuts and Bolts: ANSI 304 stainless steel.

2.5 PUMP CONSTRUCTION

A. Water Tight Sealings: Nitrile rubber O-rings against machined surfaces.

B. Cable Entry Design:

1. Seal: Torque-free mechanical compression type with strain relief. Do not use epoxies, silicones, or other secondary sealing. Submersible cable entry shall be field replaceable without replacing cable.
2. Seal junction chamber from motor by terminal board and an elastomer compression seal.

C. Pump Motor:

1. Squirrel cage induction type, housed in air-filled watertight chamber.
2. Dip and bake stator three times in NEMA Class F varnish and heat shrink fit into the stator housing. Do not use designs requiring penetration of stator housing.
3. Motor cooling system:
   a. Thermal radiators integrally cast into stator housing, up to 10.5 HP.
   b. Circulation of pumped media through a cooling jacket for 15 HP and larger.

D. Pump Shaft Bearings:

1. Permanently lubricated ball bearings.
   a. Upper Bearing: Single row deep groove.
   b. Lower Bearing: Two-row angular contact.
2. Sealed completely from pump liquid.

E. Minimum B10 Bearing Life: 20,000 elapsed-time hours at any point on head-capacity curve.

F. Mechanical Seals: Tandem independent and run in a standard motor oil reservoir.

G. Impeller: Dynamically balanced, double shrouded, non-clog, single vane capable of handling 3 inch diameter solids, unless otherwise scheduled.

H. Equip each pump with stainless steel lifting chain and submersible pump cable.

I. Provide sliding guide bar bracket unit to guide on at least two rails which is an integral part of pump unit. Do not permit any portion of the pump or guidance system to bear on sump floor. Do not use guide cables.

J. Provide metal-to-metal discharge pump/elbow connection seal. Do not use diaphragm or O-ring type seals.

2.6 PERFORMANCE

A. Pump motor:

1. 3 phase motor.
2. Non-overloading throughout pump curve.
3. Capable of 15 evenly spaced starts per hour.
4. Capable of running dry indefinitely without damage.
5. Motor shall be rated for the site elevation.

2.7 PROTECTIVE COATING

A. Pump Exterior: PVC epoxy primer and chloric rubber paint finish.

B. Impeller: PVC epoxy or Rislan.

2.8 ACCESSORIES

A. Pump accessories supplied by pump manufacturer.

B. Provide pump accessories required for proper installation and/or as recommended by manufacturer, including the following.

1. Upper and intermediate guide bar brackets with stainless steel nuts and bolts.
2. Stainless steel guide rails and brackets with stainless steel nuts and bolts.
3. Stainless steel lift-chain system with shackles.
4. Safety chain hook.
5. Cable holder for pump cable and float cable.
6. Cable support grip.
7. Anchorage.
8. Cable rack for liquid level float system.
9. Self-weighted float switch, Flygt Model ENM-10. Provide complete back-up operating four part float system.
10. Check valve, flanged ends, line size, Flygt Model HDL 5087.
11. Plug valve, eccentric, flanged ends, line size, BUNA packing, neoprene plug facings, lever handle, DeZuric series 100, Fig. No. 118.
12. Standard discharge connection.
13. Wet Well: Aluminum access frame and cover, single door with spring assist, 48 inches x 36 inches, with stainless steel hinges and accessories, locking mechanism to accept a Best brand government padlock, and hinged safety grating built-in. Hinges shall be alongside of door opening.
14. Dry Well: Aluminum access frame and cover, single door, 36 inches x 36 inches, with stainless steel hinges and accessories, and locking mechanism to accept a Best brand government padlock, and hinged safety grating built-in. Hinges shall be alongside of door opening.
15. Transducer Containment Fittings:
    a. 8 x 6 inch PVC Schedule 40 reducer coupling.
    b. 8 inch PVC Schedule 40 cap.
    c. 8 inch Schedule 40 pipe.
16. Flygt Mix Flush Valve Model 4901, mounted on one pump in wet well.

C. Controls:

1. RACO Verbatim – No substitute, including the following.
    a. Enclosure – NEMA 4X.
    b. Environmental – Heater.
    c. Local alarm relay output.
2. Milltronics Hydro-Ranger 200, Part No. 7ML1034 - 1AA1 with Echomax XPS-10 transducer, Part No. 7ML1115 - 0CA31.

3. NEMA 4X enclosure box for mounting of RACO Verbatim outside of, but attached to, motor control center. Provide connections in motor control center for RACO Verbatim unit.

4. Telephone line grounding/terminator box, Hoffman No. A-1086CHQRFG, with 1/2 inch plywood backing plate mounted inside. Mount box beside and connect to the RACO Verbatim box with 3/4 inch conduit nipple.

5. RACO Verbatim enclosure and backplate, Hoffman No. A-201608LP and No. A-20P16.

D. Portable Pump Quick Disconnect

1. Furnish means to connect a portable, fuel powered sewage pump to bypass the normal lift station pumps. The outlet hose will be connected via a quick disconnect installed in the dry well down stream of the flanged plug valve.

a. Fittings: AWWA C153, Ductile-Iron Compact Fittings, Class 350. Size 4inch MJ x FLG with 4" flanged outlet. MJ joints restrained with Megalug Series 1100, malleable/ductile iron joint retainer/restraint gland with polymer, epoxy or bituminous outside coating.

b. Valve: Mueller, No. A-2360-6, 4 inch FL x FL, AWWA C509, non-rising stem, open left, handwheel.

c. Riser: 4 inch stainless steel nipple 12 inch length.

d. Hose Coupling: Dixon Bayco cam and groove coupling connector male 4 inch, aluminum, Type D female coupler x female NPT with dust plug.

2.9 MOTOR CONTROL CENTER

A. Provide motor control panel that is NRTL listed to UL 508 Industrial Control Equipment.

B. Duplex pump control panel supplied by pump supplier.

1. Manufacturer: E.G. Pumps Controls.

C. Provide duplex pump controls required for proper installation and/or as recommended by manufacturer including the following:

1. If MCC is required provide it with separate cubicle to accommodate Milltronics unit with glass view port on door.

2. Two pump Circuit Breakers: UL interrupting rating not less than 14,000 amperes RMS symmetrical at 480 volts or 22,000 amperes RMS symmetrical at 240 volts.

3. Two NEMA rated, full voltage non-reversing motor starters.

4. Duplex Logic Chassis (an anodized aluminum sub-assembly) with Logic Panel Including:

a. Two Hand-Off-Auto selector switches.
b. Two run pilot lights (red).
c. Two off pilot lights (green).
d. Level alarm pilot light.

e. Alarm silence pushbutton.
f. Motor over temperature sensor – shut pump down.
g. LED status indication pilot lights for each relay function.
h. GFCI 120 Volt duplex convenance receptacle. Mount inside on front plate.

5. Space heater to prevent condensation within the enclosure.
6. Ground lugs for pump and service connections.
7. Enclosure NEMA 3R gasketed outer door with lockable latches, dead front panel.
8. Additional control breaker - 15 amp, 1 pole.
9. Control power transformer - 2 KVA, 16.7 amps.
10. Phase Monitor Relay, 440-480 volt, 3-phase; capable of detecting loss of a single phase, under-voltage, over voltage, and voltage unbalance. Alarm will be sent to the RACO Verbatim unit.
11. Lightning surge arrestor.
12. Elapsed time meter for each pump.
13. Lag pump time delay relay.
14. Seal failure relay, Flygt, with pilot light.
15. Audible Alarm horn, 93 dB at 20 feet.
16. Alarm beacon with flasher.
17. Alarm memory circuit to maintain alarm beacon until manually reset.
18. Alarm and control enclosure.
19. Additional isolated dry contacts.
    a. Motor over-temperature (2) - contact type form "C".
    b. Motor overload trip (2) - contact type normally open.
    c. Seal failure (2) - contact type form "C".
    d. Power failure - contact type form "C".
20. High-level float status light.
21. High-level float test switch.
22. Local control panel disconnect. Mount beside, but exterior to, the control panel.
23. Main breaker.
24. Operating voltage sign and station name.

2.10 POWER AND CONTROL CABLES

A. Provide for all cables to connect between motor control center, motors, control devices, and electrical devices. Cables shall be based on the pump manufacturer's products and requirements.

PART 3 EXECUTION

3.1 INSTALLATION

A. Wet well and dry well shall be fabricated and installed by the LANL Standard Exterior Lift Station Drawings ST-G3020-2 and per Section 33 0513, "Manholes and Structures."

1. Wet well bottom and walls shall be coated with a two-part, high build epoxy or polyurethane lining. Material shall have chemical resistance and designed as a structural lining for manholes and vessels in wastewater facilities.

2. Verify that surfaces and substrate conditions are ready to receive work as instructed by the product manufacturer before applying lining.

3. Apply products in accordance with manufacturer's instructions.

4. Material will be 100% solids by volume.

5. Manufacturer: Raven Lining Systems, Zebron Corporation.

B. Install pumps and equipment in accordance with manufacturer's instructions, Subcontract Drawings and LANL Standard Drawings ST-G3020-2.

C. Install pumps level, plumb, accurately aligned, with leak-proof pump connection, and easily removed without entering wet well.

D. Provide vehicle accessible, level, all-weather surface adjacent to control panel that is suitable for positioning a trailer-mounted engine-generator. Install bollards per ST-G30GEN-1 to protect the lift station and prevent vehicles from inadvertently traversing the access doors for the wet and dry wells.

E. Install all electrical equipment and electrical boxes outside of lift station pit except for the transducer that is installed by LANL U&I Group.

1. Install Millitronics Hydro-Ranger in electrical motor control panel.
2. Adjust settings as directed by LANL U&I Group .

F. Make no splices in cable.

G. Furnish and install all power connections to and from the control box in accordance with provisions of Division 26.

H. Provide communications link between the lift station monitoring/controls and the TA-46 Wastewater Plant PLC system. System shall be installed and available for testing during the Acceptance Inspection.

3.2 HIGH-LEVEL FLOAT AND BACKUP FLOAT SYSTEM

A. Suspend on bracket as shown on Drawings.

B. Make no splices in cable.

C. Adjust float level as directed by LANL U&I Group.

3.3 MANUFACTURER'S ON-SITE SERVICE

A. Arrange for a factory trained service engineer to be present to check installation and operation.

B. Arrange for a factory trained service engineer to provide a minimum of 4 hours per pump station of training to operating personnel on operation and maintenance of pumping equipment.

C. Provide a report by the service engineer certifying that equipment has been installed and is operating correctly.

3.4 LANL ACCEPTANCE INSPECTION, TESTING, ADJUSTING, AND TIE-IN

A. LANL Subcontract Technical Representative (STR) will contact LANL's U&I Group Wastewater Representative at least 15 working days in advance to have LANL's U&I Group perform the following:

1. Video inspection of gravity and force main sewer lines.
2. Inspection, testing, and adjusting of alarms and controls on lift station.
3. Inspection of lift station for compliance with drawings and specifications.
4. Tie-ins to existing sanitary sewer system.

B. LANL STR will ensure that an approved WPF (Waste Profile Form) for all anticipated wastewater from all drains or buildings connected to the sanitary wastewater system has been completed by LANL STR and on file before scheduling tie-ins. Documentation shall be submitted to the LANL U&I Group wastewater representative prior to utility tie-in. http://enterprise.lanl.gov/forms/1346.pdf

C. Schedule electrical inspection by the LANL Electrical Authority Having Jurisdiction (AHJ). Do not connect equipment to electrical service until the work has been inspected and approved by the AHJ.

3.5 IDENTIFICATION

A. Install component identification, voltage warning labels, and arc-flash warning labels on motor control center and manual transfer switch.

B. Refer to Section 26 0553, "Identification for Electrical Systems."

3.6 EQUIPMENT SCHEDULE

A. Flygt Model N3085 with Impeller.

1. GPM/TDH (feet): 250 GPM/75 feet
2. HP: 6.5
3. Discharge Pipe (inches): 3 inches
4. RPM: 3,480
5. Volts/Phase: 480V/3 phase
6. Max system Input at design point (KW): 4.85

B. Site elevation: 7,500 feet.

END OF SECTION

FOR LANL USE ONLY

This project specification is based on LANL Master Specification 33 3200, Rev. 6, dated February 24, 2011.

SECTION 33 4000

STORM DRAINAGE UTILITIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Site storm drainage piping, fittings, and accessories beyond building wall.

1.2 RELATED SECTIONS

A. Section 01 2500, "Substitution Procedures."

B. Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

C. Section 22 0813, "Testing Piping Systems."

D. Section 31 2000, "Earth Moving."

1.3 ABBREVIATIONS AND ACRONYMS, DEFINITIONS, AND REFERENCES

A. Refer to Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

1.4 LANL PERFORMED WORK

A. LANL Utilities and Institutional Group (U&I) will inspect interior of storm drainage lines beyond the building wall with video camera for piping integrity and proper construction.

1.5 SUBMITTALS

A. Submit the following in accordance with the requirements of Exhibit I:

1. Catalog data on pipe materials, fittings and accessories.
2. Installation instructions for accessories.
3. Certifications of welders qualified for heat fusion polyethylene pipe joints.

1.6 QUALITY ASSURANCE

A. Welders Certifications and Qualified Procedure Standards

1. On-site welding shall comply with ESM, Chapter 13 – Welding and Master Specification 01 4455, Onsite Welding & Joining Requirements

2. Plastic Pipe: 49 CFR 192.283 and 192.285, and Driscopipe heat fusion qualification guide.

PART 2 PRODUCTS

2.1 PRODUCT OPTIONS AND SUBSTITUTIONS

A. Alternate products may be accepted; follow Section 01 2500, "Substitution Procedures."

2.2 STORM DRAINAGE PIPING

A. Ductile Iron Pipe: AWWA C151:

1. Joints: Bell and spigot, AWWA C111 rubber gaskets.

2. Fittings: AWWA C110, Ductile-Iron or Gray-Iron, Class 350 or AWWA C153, Ductile-Iron Compact Fittings, Class 350.

B. PVC Pipe and Fittings: AASHTO M304 and ASTM D 1784.

1. Joints: Bell and spigot, ASTM D 3212, rubber gaskets.

C. Polyethylene Pipe and Fittings:

1. Manufacturer: CP Chem Performance Pipe, Driscoplex 4100, Iron Pipe Size or Driscoplex 4000, Ductile Iron Pipe Size.

2. Pipe: Polyethylene, high-density, ASTM D 3035, ASTM F 714, PPI-PE4710, [SDR11] pipe size, ASTM D3350 cell classification number 445574C.

3. Joints: Heat fusion per manufacturer's instructions.

4. Fittings: Polyethylene, high-density, butt heat fusion type, ASTM D 3261, PE4710, [SDR 11], ASTM D 3350 cell classification number 445574C.

2.3 CORRUGATED METAL PIPE

A. Material: Steel base metal with 2 oz. per square foot zinc coating per AASHTO M-218 and ASTM A 444 or polymeric coating AASHTO M246 and ASTM A 742.

B. Fabrication: Fabrication by corrugating continuous coils into helical form with lock-seam or by rolling annular corrugated mill sheet per AASHTO M36 and ASTM A 760; polymeric pipe per AASHTO M245.

C. Gaskets and Sealants: ASTM D 1056 sponge neoprene sleeve gaskets and mastic sealant.

2.4 CORRUGATED POLYETHYLENE PIPE AND FITTINGS

A. Material: High-density polyethylene, ASTM F 405 and AASHTO M252 pipe and fittings size small, ASTM F 667 and AASHTO M252 pipe and fitting size medium, and AASHTO M294 pipe and fitting size large, 12 in. and larger. Pipe shall have corrugated exterior with smooth interior.

B. Gaskets and Sealants: ASTM D 3212, flexible elastomeric seals.

C. Installation: Per manufactures requirements and recommendations of ASTM D 2321.

2.5 CLEANOUTS

A. Manufacturer: J.R. Smith Mfg. Co.

2.6 MANHOLES

A. Provide concrete catch basins and pre-cast concrete manhole per details shown on the drawings.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify excavations are to required grade. Do not over excavate.

3.2 PREPARATION

A. Ream pipe ends, remove burrs, and regalvanize damaged surfaces.

3.3 BURIED PIPING

A. Refer to Drawings and Section 31 2000, "Earth Moving," for earth cover, bedding, tracer wire, wire continuity test, warning tape, documenting new or exposed existing utility location, etc requirements.

B. Bedding material for corrugated metal pipes shall confirm to Drawings and Section 31 2000, "Earth Moving." Place bedding material under the pipe and around a minimum of 1/3 the diameter of the pipe. Place bedding material to provide uniform support for the entire length of pipe.

C. Backfill material for corrugated metal pipes shall consist of a well graded mixture of stone fragments, gravel, and sand. Backfill material shall have a maximum particle size less than 1.5 in. and be free of organic material, frozen clump, or stones.

3.4 INSTALLATION

A. Encase exterior cleanouts in concrete, flush with gradient as shown on drawings.

B. Route piping in orderly manner and maintain gradient as shown on drawings.

C. Install bell and spigot pipe with bell end upstream.

D. Sleeve and caulk pipes penetrating exterior walls below grade to provide a waterproof installation, "excluding corrugated type pipes."

E. Pressure test piping system with water in accordance with Section 22 0813, "Testing Piping Systems." excluding corrugated type pipes.

3.5 LANL ACCEPTANCE INSPECTION AND TESTING

A. Notify LANL Subcontract Technical Representative (STR) at least 10 working days in advance to schedule inspection of piping system.

B. LANL STR will contact LANL U&I Group representative to arrange for video inspection of interior of piping system beyond building wall. LANL's U&I Group will perform inspection.

C. Before tie-ins are scheduled the LANL STR will ensure materials required for tie-in are on site, service lines have been tested, material submittals and all test reports have been approved by LANL U&I.

END OF SECTION

FOR LANL USE ONLY

This project specification is based on LANL Master Specification 33 4000, Rev. 2, dated September 8, 2009.

SECTION 33 5100

NATURAL GAS DISTRIBUTION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Site distribution gas piping system including above grade piping and appurtenances upstream of and including the low pressure regulator station.

1.2 RELATED SECTIONS

A. Section 01 2500, "Substitution Procedures."

B. Section 01 4000, "Quality Requirements."

C. Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

D. Section 01 4444, "Offsite Welding &d Joining Requirements."

E. Section 01 4455, "Onsite Welding % Joining Requirements."

F. Section 09 9100, "Painting."

G. Section 22 0529, "Hangers and Supports for Plumbing Piping and Equipment."

H. Section 22 0813, "Testing Piping Systems."

I. Section 31 2000, "Earth Moving."

1.3 ABBREVIATIONS AND ACRONYMS, DEFINITIONS, AND REFERENCES

A. Refer to Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

1.4 LANL FURNISHED AND INSTALLED EQUIPMENT

A. LANL Utilities and Institutional Group (U&I) will install regulator station and adjust outlet pressure of gas regulators.

1.5 LANL PERFORMED WORK

A. LANL U&I will tie into existing gas piping system.

1.6 SUBMITTALS

A. Submit the following in accordance with the requirements of Exhibit I:

1. Catalog data on pipe materials, pipe fittings, valves, pipe coating, pipe pig, and accessories, and directional drilling pull (weak link) device and casing seals.

2. Certified material inspection report for steel pipe.

3. Certification of welders and qualified welding procedure.

4. Certified Welding Inspector (CWI) inspection report

5. Submittals for the Horizontal Directional Drilling.

6. Pipe pigging inspection report.

7. Tracing wire continuity test report.

8. Catalog data on identification tape and tracing wire.

9. Total connected natural gas load in BTU's per hour, heat input requirement for each connected device in BTU's per hour, and pressure (psig) requirement at building wall.

1.7 QUALITY ASSURANCE

A. Work identified in this section shall be in accordance with Section 01 4000, "Quality Requirements."

B. Welders Certification, Qualified Procedure Standard, and Weld Inspection/Testing.

1. Exterior Steel Pipe: API Standard 1104

a. On-site and joining welding shall comply with LANL's *Engineering Standards Manual* (ESM) (ISD 341-2 and PD342, Chapter 13, "Welding, Joining, and NDE") and Section 01 4455, "Onsite Welding & Joining Requirements."

1) Use LANL Welding Procedures.

2) Welders shall be qualified at LANL by LANL

3) Consumables in accordance with LANL's ESM (Chapter 13, Volume 1, General Welding Standards, GWS 1-03 – Welding and Brazing Material Procurement & Control.)

b. Off-site welding and joining shall comply with LANL's ESM Chapter 13 and Section 01 4444, "Offsite Welding & Joining Requirements."

c. Weld Inspection: Weld inspection acceptance shall be in accordance with API Standard 1104, Section 9, for steel pipe and LANL's ESM Chapter 13. Certified Weld Inspector (CWI) shall visually inspect 100% of the completed welds. Inspector should make an effort to visually inspect weld fit up, root and second pass when on-site.

2. Plastic Pipe: Comply with LANL's ESM Chapter 13, 49 CFR 192.283 and 49 CFR 192.285.

3. Weld Inspection: Comply with LANL's ESM Chapter 13 and 49 CFR 192.287 for PE pipe.

C. Clean and pig piping 4 inch diameter and larger, and all piping sizes with lengths greater than 500 feet.

D. LANL STR shall submit the material and accessory catalog data, certified material inspection report for steel pipe, and certification of welders and qualified welding procedure to the LANL U&I gas system engineer and the LANL construction inspector for verification of construction items and certifications during field quality assurance.

E. Materials and Installation: Conform to ASME B31.8, UPC, UMC, and NFPA 54.

PART 2 PRODUCTS

2.1 PRODUCT OPTIONS AND SUBSTITUTIONS

A. Alternate products may be accepted; follow Section 01 2500, "Substitution Procedures."

2.2 POLYETHYLENE PIPING, BELOW GRADE

A. Manufacturer: C. P. Chem Performance Pipe (Driscopipe 8100 or Yellowstripe 8300), no substitution.

B. Pipe: Polyethylene, high density, ASTM D 2513, PPI-PE4710, SDR11 iron pipe size, cell classification number 445574C per ASTM D 3350. Provide and install SDR-9 polyethylene pipe when performing horizontal directional drilling or other pipe pulling operation.

C. Fittings: Polyethylene, high density, butt heat fusion type, ASTM D 2513, PE4710, SDR 11, cell classification number 445574C per ASTM D 3350.

2.3 STEEL PIPING, BELOW GRADE

A. Pipe: Standard wall, black steel, ASTM A 53, Type E, Grade B or API 5L EW, Grade B or ASTM A 106, Grade B.

B. Fittings: Standard wall, black steel, butt-welding type, ANSI B16.9 or MSS SP-75.

C. Coating: Factory applied fused system consisting of; an adhesive primer layer, with minimum 10 mil thermoplastic elastomer layer and minimum 40 mil polyolefin top layer containing UV protection; or alternate of an epoxy primer layer with minimum 50 mil high density polyethylene top layer; or an approved equal by the LANL U&I Group gas system representative.

D. Manufacturers:

1. Tyco Adhesives, Synergy Plant Coating System
2. Tyco Adhesives, VANGUARD Plant Coating System

E. Product marking shall be in accordance with ASTM A 53, Section 21. Product marking shall be transferred to and stenciled to the outside of the pipe coating. Minimum transferred information shall include; pipe specification, grade, size, type, and heat number in accordance with the certified material test report and the product marking.

2.4 STEEL PIPING, ABOVE GRADE

A. Pipe: Standard wall, black steel, ASTM A 53, Type E, Grade B or API 5L EW, Grade B or ASTM A 106, Grade B. Welded for pipe sizes above 2 inches, threaded for pipe sizes 2 inches or less.

B. Fittings: Malleable iron, threaded type, ANSI B16.3, Class 150 or standard wall, black steel, butt welding type, ANSI B16.9 or MSS SP-75.

C. Flanges: Forged steel, ASTM A 105, ANSI Class 150, weld neck, raised face, dimensions per ANSI B16.5.

D. Gasket Material: Neoprene, durometer hardness 50-65.

2.5 PRESSURE REGULATOR STATION

A. LANL Utilities and Institutional Group (U&I) will install regulator station and adjust outlet pressure of gas regulators.

2.6 SHUT-OFF VALVE, ABOVE GRADE, THREADED ENDS

A. Manufacturer: Balon Series S. No Substitution.

B. Valve: Ductile iron body, threaded ends, non-lubricated full port opening ball valve, lever-operated, 1000 psig working pressure, size as indicated on drawing.

2.7 SEISMIC SHUT-OFF VALVE, ABOVE GRADE, THREADED ENDS

A. Manufacturer: Pacific Seismic Products, Model 314. No Substitution.

B. Valve: 60 psig maximum working pressure, 2 inch, UL listed.

2.8 SHUT-OFF VALVE, ABOVE AND BELOW GRADE, WELDED ENDS

A. Manufacturer: Balon US Series Weld X Weld, No Substitution.

B. Valve: Steel body, butt welded ends, non-lubricated full port opening ball valve, wrench operated, Class 150, size as indicated on drawings.

2.9 SHUT-OFF VALVE, BELOW GRADE, POLYETHYLENE

A. Manufacturer: Nordstrom Poly-Gas.

B. Ball Valve for natural gas service ASME B16.40, material PPI- PE 4710, C.P.Chem Performance Pipe (Driscopipe 8100 or 8300 designation), SDR11, iron pipe size 100 psig service pressure, butt fusion end connections. Full bore when available.

1. Valve Size: as indicated on drawing.

2.10 ANODELESS RISER

A. Manufacturer: R.W. Lyall and Company, Inc.

B. Prebent, for use with C.P.Chem Performance Pipe (Driscopipe 8100 or Yellowstripe 8300) polyethylene piping ASTM D 2513, PPI-PE 4710, SDR11, iron pipe size NPT steel end by PE butt fusion, size to match piping system. Steel pipe shall be standard wall, black steel, API 5L EW, Grade A or ASTM A 53, Type E, Grade A for 1-1/2 inch and less, Grade B for 2 inch and larger. The mechanical joint shall be provided with a tamper-proof, gas-tight connection and seal per ASTM D 2513, Category 1.

2.11 TRANSITION FITTING

A. Manufacturer: R.W. Lyall and Company, Inc.

B. Preformed steel pipe to PE pipe, for use with C.P. Chem Performance Pipe (Drisopipe 8100 or Yellowstripe 8300) polyethylene piping ASTM D 2513, PPI-PE 4710, SDR11, iron pipe size beveled steel end for welding by PE butt fusion, size to match piping system. Steel pipe shall be standard wall, black steel, API 5L EW, Grade A or ASTM A 53, Type E, Grade A for 1-1/2 inch and less, Grade B for 2 inch and larger. The mechanical joint shall be provided with a tamper-proof, gas-tight connection and seal per ASTM D 2513, Category 1.

2.12 VALVE BOX

A. Manufacturer: Tyler, Series 6860.

B. Valve Box: Cast iron, 5-1/4-inch-shaft screw-type, with lid marked gas, length to suit burial depth.

2.13 TEST PLUG (PETE'S PLUG)

A. 1/4-inch NPT, brass body, neoprene core, rated for 1,000 psig, complete with sealing cap and gasket, to receive 1/8-inch O.D. probe.

PART 3 EXECUTION

3.1 PREPARATION

A. Ream pipe ends and remove burrs.

B. Remove scale and dirt on inside and outside of piping before assembly.

C. Keep open ends of pipe free from scale and dirt. Whenever work is suspended during construction, or at the end of each workday, protect open ends with temporary plugs or caps.

3.2 GENERAL INSTALLATION

A. Furnish and install gas piping in accordance with *Uniform Plumbing Code*, *Uniform Mechanical Code*, ASME B31.8 *Gas Transmission and Distribution Piping Systems*, and 49 CFR 192 *Code of Federal Regulations*.

B. Do not run gas piping below buildings, structures, or in crawl spaces.

C. Do not run gas piping under walks and equipment pads adjacent to building. If unavoidable, sleeve line with non-metallic piping.

D. Pressure test piping in accordance with Section 22 0813, "Testing Piping Systems."

E. Paint outside gas regulator piping, valves, and appurtenances above ground to match building exterior. Refer to Section 09 9100, "Painting."

F. Support piping in accordance with Section 22 0529, "Hangers and Supports for Plumbing Piping and Equipment."

G. Test steel pipe coating in accordance with Section 22 0813, "Testing Piping Systems."

H. Minimum cover over pipe shall be measured from finish grade to top of pipe.

3.3 NON-DESTRUCTIVE RADIOGRAPHIC EXAMINATION

A. Test the natural gas steel piping for weld integrity.

1. Pipeline 4 inches and larger shall be examined as required by American Petroleum Institute Standard 1104.

B. Perform non-destructive radiographic examination.

1. Prior to the start of radiography, the subcontractor shall notify LANL HSR-12 of the scope of work and the time and exact location of work.

2. At the end of each shift, a copy of the inspection reports, diagrams, and radiographs for that shift will be left with designated LANL personnel.

3. Rejected welds or material shall be brought to the attention of designated LANL Construction Inspector within 4 hours of rejection.

3.4 CLEANING OF NATURAL GAS PIPING INTERIOR

A. Use a pipeline pig to clean the interior of natural gas piping. The pipeline pig used shall be of a type and configuration to provide optimum cleaning of scale, debris, and moisture from the pipeline interior.

1. Soft pigs shall be used with polyethylene pipe to avoid damage to the pipe.

B. A pressuring system shall be used to provide sufficient energy to drive the pig but to not overpressure the pipeline, the pressure to drive the pig shall not exceed the final test pressure.

C. A pig catcher of a design to provide a safe and effective means to receive the pig as it discharges from the line shall be used.

3.5 POLYETHYLENE PIPING INSTALLATION

A. Lay piping on trench bottom in such a manner as to snake piping from one side of trench to the other with one cycle approximately every 40 feet. This will insure that sufficient piping material is available for expansion and contraction.

B. Provide minimum of 5 feet of cover over piping installed under any roadways and vehicle parking areas.

C. Perform butt heat-fusion joining in accordance with ASTM D 2513 and manufacturer's written instructions.

D. Refer to Drawings and Section 31 2000, "Earth Moving," for earth cover, bedding, tracer wire, wire continuity test, warning tape, documenting new or exposed existing utility location, etc., requirements.

E. Make plastic-to-steel connection with transition fitting that is butt fused on plastic end and welded on steel end.

3.6 STEEL PIPING INSTALLATION

A. Butt weld underground steel piping. See Paragraph 1.7.

B. Use threaded joints for above grade piping 2 inches and smaller and butt-welded joints for piping above 2 inches.

C. Apply Polyken primer 1019 or 1027 to underground joints, fittings, and valves, and spiral wrap with a double layer, half lapped, 35 mil tape, Polyken 934 system. Follow manufacturer's instructions.

D. Refer to drawings and Section 31 2000, "Earth Moving", for earth cover, bedding, tracer wire, wire continuity test, warning tape, documenting new or exposed existing utility location, etc., requirements.

3.7 PIPING TIE-IN

A. Tie-in to existing system will be performed by LANL U&I. Excavation, backfill, and materials required for tie-in shall be provided by Subcontractor. Tie-in will be inspected by LANL STR and the LANL U&I Group gas system representative.

B. Notify LANL STR at least 10 working days in advance to schedule tie-in. The LANL STR will notify LANL U&I group.

C. Prior to notifying LANL U&I, the LANL STR will ensure materials required for tie-in are on site, service lines have been tested, material submittals and all test reports have been approved by LANL U&I Group and bell hole is dug.

END OF SECTION

FOR LANL USE ONLY

This project specification is based on LANL Master Specification 33 5100, Rev. 5, dated November 8, 2011.

SECTION 33 7119

ELECTRICAL UNDERGROUND DUCTS AND MANHOLES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Underground ductbanks for medium-voltage power utility systems.

B. Underground ductbanks for low-voltage service and feeder systems.

C. Underground ductbanks for open telecommunications utility systems.

D. Manholes for medium-voltage power utility systems.

E. Manholes for open telecommunications utility systems.

1.2 RELATED SECTIONS

A. Section 01 2500, "Substitution Procedures."

B. Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

C. Section 03 3001, "Reinforced Concrete."

D. Section 31 2000, "Earth Moving."

1.3 ABBREVIATIONS AND ACRONYMS, DEFINITIONS, AND REFERENCES

A. Refer to Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

1.4 LANL PERFORMED WORK

A. LANL Utilities & Infrastructure will furnish, install, and test medium-voltage power cables. At electrical manholes containing energized cables, LANL Utilities & Infrastructure will make penetrations into manholes and will install the last 5 ft of duct into the manhole using materials furnished by the construction subcontractor.

B. LANL Telephony Services will furnish, install, and test open telecommunications cables.

1.5 SUBMITTALS

A. Submit the following in accordance with the requirements of Exhibit I:

1. Catalog Data: Submit catalog data describing pre-cast manhole(s), manhole frame(s) and lid(s), ladders, and cable racks. Include data substantiating that materials comply with specified requirements.

2. Test Reports: Submit report of duct blockage tests.

3. Project Record Documents: Accurately record GPS-based survey locations of ductbanks, new and existing manholes, and places where ductbanks cross other underground systems.

1.6 QUALITY ASSURANCE

A. Comply with the *National Electrical Code* (NEC) (NFPA 70) and IEEE Std C2, *National Electrical Safety Code*, for components and installation.

B. Furnish products that are listed and labeled by a nationally recognized testing laboratory (NRTL) for the application, installation condition, and the environment in which installed.

1.7 RECEIVING, STORING AND PROTECTING

A. Receive, store, and protect, and handle products according to NECA 1 – Standard Practices for Good Workmanship in Electrical Construction and NECA/NEMA 605 – Recommended Practice for Installing Underground Nonmetallic Utility Duct.

1.8 SEQUENCING AND SCHEDULING

A. Notify LANL Subcontract Technical Representative (STR) to schedule inspection of each ductbank or ductbank segment before concrete is placed.

B. Notify LANL STR 10 days before duct tests.

PART 2 PRODUCTS

2.1 PRODUCT OPTIONS AND SUBSTITUTIONS

A. Alternate products may be accepted; follow Section 01 2500, "Substitution Procedures."

2.2 INTERMEDIATE METAL CONDUIT AND FITTINGS

A. IMC: UL1242 – Intermediate Metal Conduit and ANSI C80.6 – Intermediate Metal Conduit.

B. Fittings and conduit bodies: Zinc-plated, threaded, malleable iron, meeting UL514B – Fittings for Conduit and Outlet Boxes, and ANSI/NEMA FB1 – Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.

2.3 RIGID METAL CONDUIT AND FITTINGS

A. Conduit per UL6 – Rigid Metal Electrical Conduit and ANSI C80.1 – Rigid Steel Conduit, Zinc Coated.

B. Fittings and conduit bodies: Zinc-plated, threaded, malleable iron, meeting UL514B and ANSI/NEMA FB1.

2.4 PLASTIC-COATED STEEL CONDUIT AND FITTINGS

A. Conduit or IMC: PVC exterior coated, urethane interior coated, galvanized rigid steel shall meet the requirements of NEMA RN 1 – *PVC Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.*

B. Use factory-fabricated elbows.

C. Fittings and conduit bodies: 40 mil PVC exterior coated, urethane interior coated, zinc-plated, threaded, malleable iron meeting UL514B – *Fittings for Conduit and Outlet Boxes* and NEMA RN 1 – *PVC Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.*

2.5 RIGID NON-METALLIC CONDUIT AND FITTINGS

A. Conduit: PVC per UL651 – Schedule 40 and 80 Rigid PVC Conduit and NEMA TC 2 – Electrical Plastic Tubing and Conduit, ANSI C80.3.

B. Fittings: Solvent-welded socket fittings meeting UL514C – Non-Metallic Fittings for Conduit and Outlet Boxes, and NEMA TC 3 – PVC Fittings for Use with Rigid PVC Conduit and Tubing.

2.6 UTILITIES DUCT AND FITTINGS

A. PVC type EB, 90 degree C rated, utilities duct for concrete encasement per NEMA TC 6 – Plastic Utilities Duct for Underground Installation, ANSI C130.2, ASTM F-512 – Standard Specification for Smooth-Wall PVC Conduit and Fittings for Underground Installation, and UL-651A – Type EB and A Rigid PVC Conduit and HDPE Conduit.

B. PVC fittings per NEMA TC 9 – Fittings for Plastic Utilities Duct for Underground Installation and ASTM F-512 – Standard Specification for Smooth-Wall PVC Conduit and Fittings for Underground Installation.

2.7 DUCT SPACERS

A. Duct spacers must provide 3-inch separations between ducts and minimum 3 inch concrete coverage on bottom sides and top.

B. Manufacturers: Underground Devices "Wunpeece".

2.8 GROUND CABLE

A. Use 4/0 AWG bare stranded, soft temper copper cable per ASTM B 8, Standard Specification for Concentric-Lay Stranded Copper Conductors.

2.9 CORROSION PROTECTION TAPE

A. Pressure-sensitive, 10 mil thick, PVC based tape for corrosion protection of metal conduit and fittings.

B. Manufacturer: 3M "Scotchwrap 50."

2.10 UNDERGROUND WARNING TAPE

A. Furnish non-detectable underground warning tape for underground duct banks.

B. Use 6 inch wide, minimum 4.0 mils thick, high visibility, continuously printed, inert fiber reinforced polyethylene for direct burial service underground warning tape with the following background colors:

1. Electric: Red.
2. Telephone/Communications: Orange.

C. Lettering shall be black and indicate the type service buried below.

1. Electric: "CAUTION BURIED ELECTRIC LINE BELOW."
2. Telephone/Communications: "CAUTION BURIED COMMUNICATION LINE BELOW."

D. Manufacturer: 3M, Seton, Presco.

2.11 RACEWAY MEASURING/PULLING TAPE

A. Raceway measuring/pulling tape shall have permanently printed measurements in one-foot increments and minimum 1200 lb average breaking strength.

B. Manufacturer: Greenlee "39243."

2.12 INSULATING BUSHINGS

A. NRTL-listed insulating bushings with 105 ºC rated insulation.

B. Manufacturer: O-Z/Gedney, Type IB.

2.13 GROUNDING BUSHINGS

A. NRTL-listed, galvanized malleable iron, 150ºC rated insulated throat grounding bushings with lay-in type ground cable lugs.

B. Manufacturer: O-Z/Gedney, Type BLG.

2.14 DUCT PLUGS

A. Soft, expansible gasket material compressed with non-metallic plates and bolts to produce a positive seal against water and gas in unused ducts.

B. Manufacturer: Condux, Jackmoon USA, Inc.

2.15 DUCT SEALANT

A. Expandable foam duct sealant kits to prevent water and gas from entering manholes, vaults, or structures.

B. Manufacturer: 3M "Scotchcast 4416 Duct Sealing Kit."

2.16 PRE-CAST MANHOLES

A. Per ASTM C858 – Standard Specification for Underground Precast Concrete Utility Structures.

1. Electrical manholes shall have dimensions as shown on the drawings. Coordinate with LANL Utilities & Infrastructure through the LANL Subcontract Technical Representative (STR).

2. Telecommunications manholes shall have the following minimum inside dimensions: 8'-0" long, 6'-0" wide, 7'-0" high. Coordinate requirements with LANL Telephony Group through the LANL Subcontract Technical Representative (STR).

B. Minimum thickness of floor, walls and roof shall be 6 inches.

C. Minimum design loading shall be in accordance with ASTM C857 – Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures

1. Design live loading for manholes not subject to vehicle traffic shall be not less than 300 lb/sq ft.

2. Design live loading shall be AASHTO HS-20 per AASHTO HB-17 where manhole is installed in a street or paved parking area.

D. Manhole floor shall be cast integral with walls to form the bottom ring.

E. Furnish a keyed joint between the bottom ring and top ring.

F. Position six 30 inches X 30 inches knockout panels, one in each end wall and two in each side wall of each power manhole. Coordinate locations of knockout panels in telecommunications manholes with LANL Telephony Group through the LANL Subcontract Technical Representative (STR).

G. Position a 12-inch diameter sump hole with cast iron cover in the floor near a corner.

H. Locate a 36-inch diameter access opening centered in the roof of the manhole.

I. Furnish pre-cast concrete grade rings as required to place top of manhole flush with paving or 2 to 4 inches above finished grade. Grade rings shall have a minimum inside diameter of 36 inches. Furnish cast iron manhole steps at 16 inches on-centers.

J. Furnish lifting inserts in each manhole section for unloading and positioning.

K. Position one hot dip galvanized steel pulling iron under each knockout panel, two along each side wall and one under the manhole access opening (total of seven). Pulling iron shall have a capacity of 8000 lb. with a safety factor of 2.

L. Embed 1-5/8 inches X 1-5/8 inches hot dip galvanized steel continuous pre-set inserts in each side wall of manhole.

1. Orient inserts horizontally and space 20 inches apart with bottom insert 12 inches above the floor.

2. Extend inserts to within 6 inches of end walls.

3. Manufacturer: Unistrut, P3200 series.

M. Manufacturers: ARCO Concrete, Inc; AMCOR Pre-cast; Pre-Cast Manufacturing, Co.; 4-Corners Pre-Cast; Vaughn Concrete Products, Inc.

2.17 PREMOLDED JOINT FILLER

A. Closed cell expanded neoprene joint filler conforming to ASTM D1056 – Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber.

B. Manufacturer: Williams Products, Inc., Type NN-1.

2.18 MANHOLE ACCESSORIES

A. Heavy duty cast iron manhole frame with solid lid.

1. Material shall conform to ASTM A48 – *Standard Specification for Gray Iron Castings*, Class 35B.

2. Frame and lid shall be suitable for AASHTO HS-20 wheel loads.

3. Minimum clear opening through the frame will be 30 inches.

4. Furnish lid lettering "ELECTRIC" for power manhole and "TELEPHONE" for communications manhole.

5. For open telecommunications manholes furnish inner lid with rubber gasket seal suitable for water-resistant construction. Furnish locking bar with tightening screw that can be locked in place to prevent removal by unauthorized personnel.

6. Manufacturer: Neenah Foundry Company, Model R-1640-C1 (power), Model R-1751-C (telecommunications).

B. Furnish hooked manhole ladder that complies with OSHA 29 CFR 1910.27 and ANSI A14.3 – *Safety Code for Fixed Ladders.*

1. Ladder shall be fabricated from steel conforming to ASTM A36 – *Standard Specification for Structural Steel.*

2. Paint manhole ladder as follows: One coat of rust inhibiting primer, 2 to 3 mil minimum wet thickness. Two finish coats of water based alkyd enamel, 3 mil minimum wet thickness, and safety yellow color.

3. Manufacturer: Condux, Inwesco.

C. Furnish hot dip galvanized steel telescoping ladder safety post in manholes with two or more grade ring steps. Manufacturer: Bilco LU-2.

D. Furnish heavy duty non-metallic cable racks and arms for manholes.

1. Each member shall be molded in one piece from UL listed glass reinforced nylon that can be field cut to length.

2. Furnish 14-inch long and 3-inch long saddle arms. Coordinate quantity and types with the LANL Subcontract Technical Representative (STR).

3. Manufacturer: Underground Devices, Inc., #CR36-B 36-inch rack, #RA14 arm, and 3HDS arm (saddle arm).

E. Use hot dip galvanized, electro-galvanized or stainless steel fasteners and hardware in manholes.

2.19 PRE-CAST HANDHOLES

A. Telecommunications handholes will be 30" x 48" x 36" deep precast concrete structures with a 28 day compressive strength of 4000 psi.

B. Provide concrete enclosures with knockouts located and sized for the telecommunications conduits as shown on the drawings.

C. Furnish lid lettering "TELEPHONE" for communications manhole.

D. Frame and lid shall be suitable for AASHTO H-20 loading.

PART 3 EXECUTION

3.1 PREPARATION

A. Install underground ductbank systems according to the NEC, the NESC, NECA/NEMA 605 – *Recommended Practice for installing Underground Nonmetallic Utility Duct*, and the requirements in this section.

B. Duct bank system routing shown on Drawings is in approximate locations unless dimensioned. Route as required to complete the system.

1. Coordinate underground ductbank system work to avoid interference with other trades and existing utilities.

2. Verify routing and termination locations of duct banks before excavation for rough-in.

3. Verify that field measurements are as shown on drawings.

C. Position trench so concrete envelope of ductbanks will have the following minimum horizontal and vertical separations from parallel or perpendicular runs other utility pipes or conduits.

Utility Type	Parallel Lines	Perpendicular Crossings
Water	36 inches horizontal separation	24 inches
Gravity Sewer	36 inches horizontal separation	24 inches
Force Main Sewer	36 inches horizontal separation	24 inches
Storm Drain	36 inches horizontal separation	24 inches
Natural Gas	60 inches horizontal separation	24 inches
Steam or Hot Water	60 inches horizontal separation	24 inches
Open Communications	24 inches horizontal separation of tamped soil or 3 inches of concrete	12 inches vertical separation of tamped soil or 3 inches of concrete
Secure Communications	36 inches horizontal separation of tamped soil or 6 inches of concrete; verify case-by-case with LANL Security Division-PTS Team	24 inches vertical separation of tamped soil or 6 inches of concrete; verify case-by-case with LANL Security Division-PTS Team
Electrical	12 inches horizontal separation of tamped soil or 3 inches of concrete	12 inches vertical separation of tamped soil or 3 inches of concrete

3.2 EXCAVATION AND BACKFILL

A. Make excavation for manholes and underground ductbanks to depth required and to provide solid bearing.

1. Set excavation so top of power ductbank concrete encasement will be not less than 24 inches below finished grade or paving.

2. Set excavation so top of telephone ductbank concrete encasement will be not less than 24 inches below finished grade or paving.

B. Grade trenches for underground ductbanks to a minimum of 4 inches per 100 ft. toward manholes.

C. Keep excavation dry during installation of work.

D. Make trenches of sufficient width to receive work to be installed and provide specified concrete coverage on sides.

E. Backfill excavations for ductbanks and manholes in 6 inch layers; use soil excavated; remove roots, rocks and sharp objects. Furnish coarse sand as required for additional backfill material.

F. Moisture condition backfill soil and compact in accordance with ASTM D 1557 to 95% of maximum density under paved areas and 90% of maximum density under unpaved areas.

G. Overfill excavations to allow for settlement.

H. Refer to Section 31 2000, "Earth Moving," for additional requirements.

3.3 UNDERGROUND DUCTBANK INSTALLATION

A. Install the number and size of ducts as indicated on the Drawings.

B. Use the following duct materials:

1. Use Schedule 40 rigid non-metallic conduit, Type EB utility duct, galvanized intermediate metal conduit, or rigid galvanized steel conduit for low voltage lighting, power or control wiring.

2. Use Schedule 40 rigid non-metallic conduit, Type EB utility duct, galvanized intermediate metal conduit, or rigid galvanized steel conduit for communications ducts.

3. Use Schedule 40 rigid non-metallic conduit, Type EB utility duct, galvanized intermediate metal conduit, or rigid galvanized steel conduit for utility level medium voltage power ducts.

4. Use plastic-coated galvanized rigid steel conduit, tape-wrapped galvanized intermediate metal conduit, or tape-wrapped rigid galvanized steel conduit for elbow and riser where ducts turn up to the surface.

C. Grade ducts to drain to manholes; do not trap ducts.

D. Use the smooth earth walls of trenches as forms for concrete encasement of ducts.

E. If a manhole is not indicated, make horizontal changes in direction of duct runs using long sweep bends with a minimum radius of 35 feet unless otherwise noted on the Drawings.

F. Where ducts turn up into the surface, use RGS, IMC or PVC coated rigid steel elbows with minimum 36 inches radius; terminate in a coupling 4 inches above the surface or equipment pad. Install zinc-plated malleable iron pipe plug in each unused duct stub-up.

G. Support ducts with duct spacers placed at intervals not exceeding 5 ft.

H. Anchor ducts to bottom of trench using reinforcing steel and wire at intervals not exceeding 10 ft.

I. Terminate power and telecommunications ducts in manholes, vaults and building walls using bell end fittings.

1. At each existing electrical manhole that contains energized cables, terminate ducts 5 ft from the manhole wall. LANL Utilities & Infrastructure will make penetrations into the manhole and will install the last 5 ft of duct into the manhole. Furnish all ductbank materials required for this work.

2. For ducts installed through holes cut by the subcontractor in existing building, vault or manhole walls, pack opening with non-shrink grout. Feather the edge of the grout around each bell and conform to the curvature of the bell end. Remove sharp edges and projections and fill voids within 6 inches of bell ends.

3. For concrete-encased ducts installed in new manholes through a knockout panel, after removing forms from the end of the ductbank, rub the exposed concrete surface smooth. Feather the edge of the concrete around each bell and conform to the curvature of the bell end. Remove sharp edges and projections and fill voids within 6 inches of bell ends.

J. Ground metallic conduit exposed to contact according to the requirements of NFPA 70. Use exothermic welded connections for concealed grounding connections.

K. Install a 4/0 AWG bare copper ground cable centered within each power ductbank.

1. Connect to ground cable in manholes and at riser poles using exothermic welds or IEEE 837 certified compression connectors.

2. Connect to ground point in switchgear and transformers using IEEE 837 certified compression connectors.

L. Install a 4/0 AWG bare copper ground cable centered within each telecommunications ductbank.

1. Connect to ground cable in manholes using exothermic welds or IEEE 837 certified compression connectors.

2. Connect to ground bar in telecommunications room using IEEE 837 certified compression connectors.

M. Make-up joints in underground ducts to be tight, driven home on both sides and thoroughly waterproof. On non-metallic ducts use manufacturer's recommended solvent-cement. On metallic conduits, coat male threads with red colored, alkyd base, tank and structural primer that is suitable for galvanized steel; make up fittings wrench-tight.

N. Where metallic conduits exit concrete encasement, use plastic coated rigid steel conduit or tape wrap with corrosion protection tape, half-lapped. Wrap IMC or RGS conduit 12 inches on each side of exit point and wrap all metal conduits in contact with earth.

O. Schedule inspection of each ductbank or ductbank segment before concrete is placed.

P. Test each duct for blockage or deformation after concrete has cured for 24 hours.

1. Use a flexible mandrel/scraper not less than 12 inches long with a diameter approximately 1/4 inch less than the inside diameter of the duct.

2. Pull a mandrel behind a brush with stiff bristles.

3. Replace any duct section found blocked.

4. Notify LANL STR 10 days before duct tests; submit written reports of tests to STR.

Q. After ducts have been successfully tested:

1. Backfill the trench as described in the EXCAVATION AND BACKFILL paragraph above, and

2. Place underground warning tape in backfill 12 inches below the surface.

R. Install measuring and pulling tape in each duct. Leave not less than 12 inches of slack at each end of the tape. Secure each end of tape.

S. Stub-Up Connections:

1. Use rigid steel conduit or IMC for outdoor stub-up connections. Non-metallic conduit may be used for indoor stub-up connections that are not subject to physical damage.

2. Extend conduits through concrete pad or floor for connection to freestanding equipment with an adjustable top or coupling threaded inside for plugs, and set flush with the finished floor or equipment pad.

3. Where equipment connections are not made under this Subcontract, install threaded insert plugs set flush with the floor.

T. Install corrosion protection tape on metal conduits and fittings in contact with soil using half-lapped wrappings.

3.4 CONCRETE ENCASEMENT

A. Concrete-encase underground ductbanks to provide not less than 3 inches of coverage on all sides.

B. Refer to Section 03 3001, "Reinforced Concrete," for basic material and installation requirements. Neither concrete reinforcing nor concrete testing is required for this application.

1. Use a pre-approved concrete mix design that is suitable for exterior use exposed to freezing and thawing.

2. Use un-colored concrete to encase ductbanks for low-voltage (less than 1000 V) power, communications, and alarm circuits.

3. Use red-colored concrete to encase ductbanks for medium voltage cables.

a. Use 2.0 lb. of pigment per 94 lb. sack of cement.
b. Manufacturer: Rockwood Industries/Davis Colors, No. 1117.

4. Place concrete using deflecting trough directing concrete through the duct assembly.

5. Place concrete envelope as one monolithic pour where possible; taper any joints with a 10: 1 slope.

6. Allow for expansion/contraction of ducts; place concrete starting at one end of ductbank allowing the free end to move.

3.5 MANHOLE INSTALLATION

A. Install manholes at locations indicated on the Drawings.

B. Install manholes in accordance with ASTM C891 – *Standard Practice for Installation of Underground Precast Concrete Utility Structures.*

C. Make excavation of suitable dimensions so ducts enter manhole at proper elevation. Refer to Section 31 2000, "Earth Moving," for additional requirements.

D. Install at least 6 inches sand bedding under manholes; level and compact to 95% maximum density accordance with ASTM D 1557.

E. Install a 2 ft. X 2 ft. X 2 ft. sump of 3/4 inch gravel below the drain sump opening in the bottom ring of the manhole.

F. Place pre-molded joint filler in joints between bottom ring, top ring, grade rings and manhole frame. Install following manufacturer's instructions.

G. Install a continuous loop of 4/0 AWG bare copper ground cable around inside walls of manholes at floor level.

1. Attach to walls using copper or cast bronze cable holders and masonry anchors.

2. Connect to duct bank ground cable using exothermic welds or approved non-reversible compression fittings.

3. Ground metallic conduits or duct bell ends to ground cable loop using exothermic welds or approved non-reversible compression fittings.

4. Ground metal cable racks and permanent ladders using exothermic welds or approved non-reversible compression fittings.

H. Install cable racks as required to support cables at intervals not exceeding 3 ft. Coordinate quantity and types of racks and arms with the LANL Utilities electrical distribution engineer and the LANL Telecommunications Group.

I. For manholes in unpaved areas install an 8 ft by 8 ft by 6 inch concrete apron around manhole frame and cover. Taper the concrete one inch away from the frame to the edge of the apron for drainage.

J. Stamp manhole structure number on north edge of manhole ring. Use steel dies with 3/8 inch or larger characters.

3.6 DUCT PLUGGING AND SEALING

A. Install duct plugs in both ends of all unused ducts that cross any natural gas line.

B. Install duct sealant in both ends of all ducts containing cables that cross any natural gas line.

3.7 FIELD QUALITY CONTROL

A. Provide final protection and maintain conditions to ensure that coatings and finishes are without damage or deterioration at final inspection.

B. Inspection Points: Provide not less than 2 working days advance notice to the LANL STR for the following LANS inspection points. In the notice identify the particular areas of the Project for which LANS inspection is requested. Correct deficiencies identified during inspections. If the requested LANS inspection does not occur within 1 working day of the LANS inspection point, work may proceed.

1. Underground ducts: After ducts have been installed but before concrete-encasement or trench backfilling commences. Inspections may be scheduled for one or more segments. LANS inspection may include, but is not limited to:

a. Correct duct material, quantity, and size,
b. Proper duct spacing and supports,
c. Proper anchoring of support spacers,
d. Proper depth and grading of ducts,
e. Correct duct stub-up locations,

f. Duct connection and coupling integrity,
g. Ground cable material and size, and
h. Ground cable connection integrity.

2. Mandrel testing of underground ducts: After concrete-encasement has cured for 24 hours but before trench backfilling commences. LANL witnessing of subcontractor-performed tests may be scheduled for one or more segments.

3. Manholes: After manholes have been installed but before concrete-backfilling commences. Inspections may be scheduled for one or more manholes. LANS inspection may include, but is not limited to:

   a. Correct manhole material and size;
   b. Proper manhole location, orientation, leveling, and depth; and
   c. Proper installation of premolded joint filler between sections.

END OF SECTION

FOR LANL USE ONLY

This project specification is based on LANL Master Specification 33 7119, Rev. 3, dated January 5, 2012.

SECTION 33 7311

PAD-MOUNTED TRANSFORMER ROUGH-IN

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Furnish and install rough-in for pad-mounted utility transformer including the following:

1. Reinforced concrete transformer pad.
2. Underground ductbank for medium-voltage cables.
3. Underground secondary service.
4. Grounding provisions.

1.2 RELATED SECTIONS

A. Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

B. Section 03 3001, "Reinforced Concrete."

C. Section 26 0519, "Low-Voltage Electrical Power Conductors and Cables."

D. Section 26 0526, "Grounding and Bonding for Electrical Systems."

E. Section 26 0533, "Raceways and Boxes for Electrical Systems."

F. Section 26 0553, "Identification for Electrical Systems."

G. Section 31 2000, "Earth Moving."

H. Section 33 7119, "Electrical Underground Ducts and Manholes."

1.3 ABBREVIATIONS AND ACRONYMS, DEFINITIONS, AND REFERENCES

A. Refer to Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

1.4 LANL PERFORMED WORK

A. LANL Utilities & Infrastructure will furnish, install, and test the pad-mounted transformer and associated medium-voltage cables.

1.5 SUBMITTALS

A. Construction Submittals: None.

1.6 QUALITY ASSURANCE

A. Comply with the requirements of the *National Electrical Code* (NEC) (NFPA 70) and IEEE Std C2, *National Electrical Safety Code*.

1.7 SEQUENCING AND SCHEDULING

A. Coordinate rough-in for pad-mounted transformer with LANL Utilities & Infrastructure through the LANL Subcontract Technical Representative (STR).

B. After transformer pad is formed, and conduits, reinforcing bars, and ground rod are installed, but before concrete is placed, schedule an inspection through the LANL STR.

C. Contact the LANL STR to schedule an inspection of the secondary service conductor installation.

PART 2 PRODUCTS

2.1 PAD-MOUNTED TRANSFORMER (GFE)

A. LANL Utilities & Infrastructure will furnish a compartment type, self-cooled, tamperproof and weatherproof pad-mounted transformer that will comply with the following ANSI/IEEE standards:

1. ANSI/IEEE C57.12.22, American National Standard for Transformers—Pad-Mounted, Compartmental-Type, Self-Cooled Three-Phase Distribution Transformers with High-Voltage Bushings, 2500 kVA and Smaller: High Voltage, 34500 GrdY/19920 Volts and Below; Low Voltage, 480 Volts and Below.
2. ANSI C57.12.00, IEEE Standard for Standard General Requirements for Liquid Immersed Distribution, Power, and Regulating Transformers.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine surfaces and conditions, with Installer present, for compliance with installation tolerances and other conditions affecting rough-in for pad-mounted transformer. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 CONDUIT AND DUCT INSTALLATION

A. Terminate medium-voltage ducts in the primary compartment area of the transformer pad. Refer to Section 33 7119, "Electrical Underground Ducts and Manholes," for material and installation requirements.

B. Terminate low-voltage conduits in the secondary compartment of the transformer. Refer to Section 26 0533, "Raceways and Boxes for Electrical Systems."

C. Terminate each primary and secondary conduit with a bell end fitting set 2 inches above the top of the concrete pad.

3.3 CONCRETE PAD INSTALLATION

A. Prepare level, compacted pad site per Section 31 2000, "Earth Moving." Compact to 95% per ASTM D1557.

B. Install reinforced concrete pad for pad-mounted transformer as shown on the Drawings. Refer to Section 03 3001, "Reinforced Concrete," for materials and installation requirements.

1. Form concrete transformer pad using framing lumber with form release compounds.
2. Use a Section 03 3001 pre-approved design mix for exterior, 4000 psi concrete.
3. Wood float finish top of pad to be level within 1/4" in 5 ft and to have no depressions.
4. Chamfer top edges and corners.
5. Cure concrete not less than seven days before installing equipment.

C. Install equipment protection barrier pipes around the transformer pad as indicated on the Drawings.

3.4 GROUNDING

A. Install a 10 ft driven ground rod below the secondary compartment area of the transformer pad. Provide 4/0 AWG ground cable and compression ground lug to connect ground rod to transformer ground pad in the secondary compartment.

B. Terminate medium-voltage duct bank ground cable in primary compartment area of the transformer pad. Provide compression ground lug to connect duct bank ground cable to transformer ground pad in the primary compartment.

C. Refer to Section 26 0526, "Grounding and Bonding for Electrical Systems," for material and installation requirements.

3.5 FIELD QUALITY CONTROL

A. After transformer pad is formed, and conduits, reinforcing bars, and ground rod are installed, but before concrete is placed, schedule an inspection through the LANL STR.

B. Allow 3 working days in schedule for LANL inspection.

C. Correct deficiencies noted before placing concrete.

3.6 TRANSFORMER INSTALLATION

A. LANL Utilities and Infrastructure will install the pad-mounted transformer on the concrete pad.

1. The transformer will be anchored to the pad with post-installed concrete anchors.

2. Ground cables will be connected to the ground pads in the primary and secondary compartments.

B. LANL Utilities and Infrastructure will install, test, and terminate the medium-voltage cables in the primary compartment.

C. Install the secondary service conductors from the building service-entrance equipment to the pad-mounted transformer secondary compartment.

1. Connect secondary service conductors to the low voltage lugs in the secondary compartment.

2. Use materials and installation methods specified in Section 26 0519, "Low-Voltage Electrical Power Conductors and Cables."

3. Identify secondary service conductors per Section 26 0553, "Identification for Electrical Systems."

4. Contact the LANL STR to schedule an inspection of the secondary service conductor installation.

END OF SECTION

FOR LANL USE ONLY

This project specification is based on LANL Master Specification 33 7311, Rev. 2, dated September 1, 2009.

SECTION 33 7711

PAD-MOUNTED SWITCH ROUGH-IN

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Furnish and install rough-in for pad-mounted medium-voltage switch including the following:

1. Underground ductbank for medium-voltage cables.
2. Grounding provisions.

1.2 RELATED SECTIONS

A. Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

B. Section 26 0526, "Grounding and Bonding for Electrical Systems,"

C. Section 33 7119, "Electrical Underground Ducts and Manholes."

1.3 ABBREVIATIONS AND ACRONYMS, DEFINITIONS, AND REFERENCES

A. Refer to Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

1.4 LANL PERFORMED WORK

A. LANL Utilities & Infrastructure will furnish, install, and test the pad mounted medium-voltage switch and associated medium voltage cables.

B. At electrical manholes containing energized electrical cables, LANL Utilities & Infrastructure make penetrations into the manholes and will install the last 5 ft of duct into the manhole using materials furnished by the construction subcontractor.

1.5 SUBMITTALS

A. Construction Submittals: None.

1.6 QUALITY ASSURANCE

A. Comply with the *National Electrical Code* (NEC) (NFPA 70) and the *National Electrical Safety Code* (IEEE Std C2).

1.7 SEQUENCING AND SCHEDULING

A. Coordinate rough-in for medium-voltage pad-mounted switch with LANL Utilities & Infrastructure through the LANL Subcontract Technical Representative (STR).

PART 2 PRODUCTS

2.1 PAD-MOUNTED MEDIUM-VOLTAGE SWITCH (GFE)

A. LANL Utilities & Infrastructure will furnish tamperproof and weatherproof pad-mounted medium-voltage switch that will comply with IEEE C37.74, *IEEE Standard Requirements for Subsurface, Vault, and Pad-Mounted Load-Interrupter Switchgear and Fused Load-Interrupter Switchgear for Alternating Current Systems Up to 38 kV*.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine surfaces and conditions, with Installer present, for compliance with installation tolerances and other conditions affecting rough-in for pad-mounted medium-voltage switch. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 MANHOLE

A. Existing manhole with cover is designed for mounting one medium-voltage pad mounted switch unit. Refer to Section 33 7119, "Electrical Underground Ducts and Manholes."

3.3 DUCT INSTALLATION

A. Install 6-inch concrete-encased duct from below each switch compartment at the switch pad to within 5 ft of existing manhole. LANL Utilities & Infrastructure will extend ducts into existing manhole. Furnish all ductbank materials required for this work.

B. Refer to Section 33 7119, "Electrical Underground Ducts and Manholes," for materials and installation requirements.

3.4 GROUNDING

A. Terminate medium-voltage duct bank ground cables in switch compartment area of the medium-voltage switch pad. Provide compression ground lug to connect ground cable to medium-voltage switch ground pad in the switch compartment.

B. Refer to Section 26 0526, "Grounding and Bonding for Electrical Systems," for material and installation requirements.

3.5 MEDIUM-VOLTAGE SWITCH INSTALLATION

A. LANL Utilities & Infrastructure will install the pad-mounted medium-voltage switch on the concrete pad.

1. The switch will be anchored to the pad with post-installed concrete anchors.

2. Ground cables will be connected to the ground pads in switch compartments and to the ground ring in the electrical manhole or to the duct bank ground cable.

B. LANL Utilities & Infrastructure will install, test, and terminate the medium-voltage cables.

END OF SECTION

FOR LANL USE ONLY

This project specification is based on LANL Master Specification 33 7711, Rev. 2, dated September 1, 2009.

SECTION 40 0511

COMPRESSION FITTINGS ON COPPER AND STAINLESS-STEEL TUBING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. The purpose of this specification is to provide a safe and correct method for installation and remake of Swagelok fittings on stainless steel and copper instrument and process tubing up to a maximum OD of 1 inch.

B. Swagelok brand compression fittings are the available fittings through the LANL Just-In-Time contract.

Note: Other manufacturers of compression fittings will follow these general requirements. Specific makeup and installation instructions shall follow manufacturer's written instructions. Use of compression fittings outside the scope of this specification shall be at the written direction of a technical person familiar with their application.

1.2 RELATED SECTIONS

A. Section 01 4000, "Quality Requirements."

B. Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

C. Section 22 0529, "Hangers and Support for Plumbing Piping and Equipment."

D. Section 22 0554, "Identification for Plumbing, HVAC, and Fire Piping and Equipment."

E. Section 22 0813, "Testing Piping Systems."

1.3 ABBREVIATIONS AND ACRONYMS, DEFINITIONS, AND REFERENCES

A. Refer to Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

1.4 QUALITY ASSURANCE AND TESTING

A. Work identified in this section shall be in accordance with Section 01 4000, "Quality Requirements."

1.5 STORAGE AND HANDLING

A. Deliver tubing material and fittings to site in clean, degreased, and dry condition.

B. Maintain end seals and covers to physically protect parts and preserve cleanliness.

C. Remove end seals and covers only for cleaning, fabrication, erection, or inspection.

D. Exercise care in the handling and storage of materials and pre-fabrications to ensure that contamination by foreign material does not occur.

E. Do not drag tubing off trucks or rack (causes longitudinal scratches).

1.6 PREREQUISITES

A. Installers of compression fittings shall be one-time trained on their assembly by the manufacturer or an authorized distributor, or through a formal LANL course for the following applications:

1. Nuclear/radiological (glove boxes, wash downs, CAMs, etc.);
2. Toxic systems, such as those contributing to a high or moderate facility categorization (e.g., beryllium);
3. Intermediate and high pressure systems (defined here as 150 psi gas/1500 psi liquid and 3000 psi gas/5000 psi liquid max allowable operating pressures, respectively).
4. Acceptable Courses:
   a. Course 30831, Compression Fitting Assembly (future; *approx 90 minutes at White Rock).*
   b. Course 19676, (*approx 90 minutes at TA-60, taught through and largely for the SSS (KSL) by Albuquerque Valve and Fitting Co as needed; contact: Ronnie Tupin*),
   c. Swagelok Safety Seminar (*approx 4 hours, taught by Albuquerque Valve and Fitting at their facility near the airport, (505) 842-0213 or info@albuquerque.swagelok.com*),
5. Submit copies of training certification for each assembler.

B. Review drawings, details, manuals, and other material required for instrument or process tubing and fitting installation.

C. Use the following guidelines during the performance of this specification:

1. Fitting Removal
   a. If applicable, verify piping system has been properly isolated, drained, and tagged.
   b. Tube caps and fittings should not be used to bleed or vent any instrument/process lines at normal system pressures. This is an unsafe act that may result in serious injury or contamination.

D. When working with potentially contaminated systems, ensure catch bags, filters, or other mechanisms are used to contain any contaminants.

PART 2 PRODUCTS

2.1 EQUIPMENT REQUIRED

A. Swagelok Tube Fitting Gap Inspection Gauges for initial installation (see Attachment 4, Table 4-1).

B. Special Tools:

1. Tube benders (with bend radius as required by Attachment 2, Table 2-1);
2. Tube cutter (see Attachment 1).
3. Tube deburring tool or equivalent.

C. Additional Equipment/Tools

1. Applicable personal protective equipment
2. 6-inch ruler
3. Scribe (for marking fittings) or equivalent (indelible pen or felt tip marker – low chloride if on stainless steel)
4. Open end wrenches (as required for application)
5. Tubing, as applicable for work to be done
6. Fittings and fitting components, as applicable for work to be done

2.2 TUBING MATERIAL

A. Standards for Seamless Ferritic and Austentic Tubing and Piping: ASTM A 213.

B. Stainless Steel Tubing: ASTM A 269, annealed, Type 316.

C. Seamless Copper Water Tube: ASTM B 88, soft annealed (temper 060), Type L.

D. Seamless Carbon Steel Tubing: ASTM A 179, maximum hardness 72 HRb.

E. Seamless Copper Tube: ASTM B 75, soft annealed (temper 060).

PART 3 EXECUTION

3.1 INSTALLATION

A. Follow Attachments 1 through 8 for proper installation, remake, and maintenance of Swagelok compression fittings.

3.2 PARTS REPLACEMENT

A. Do not connect, mix, or interchange parts (caps, plugs, ferrules, bodies, etc.) of tube fittings made by different manufacturers (such as Parker to Swagelok). Improper fitting seal, DAMAGE, or INJURIES may result.

B. Use all SS fittings and ferrules on SS tubing.

C. Use all brass fittings and ferrules on copper tubing.

3.3 POST INSTALLATION INSPECTION AND TESTING

A. Inspection

1. Ensure lines are terminated correctly by performing visual continuity checks on each tubing run.
2. Ensure tubing and fittings are of the type and size specified.
3. Ensure tubing is free of wrinkles, flats, axial scratches, gouges, and humps.
4. Ensure tubing is properly supported and protected from damage.
5. Ensure threads are mostly or fully covered by fitting nut.
6. Check for proper pull up of the fitting with appropriate size no-go gauge.

Note: Some fittings (e.g., bulkhead fittings) are not gaugeable.

B. Leak Test

1. Test to determine the integrity of the component and related equipment to perform their intended functions. Pressure test all new piping and overall system, and any pressure system that has been modified or repaired, shall be pressure-tested before operating. Pressure test existing pressure systems (even if they have been previously tested) that, due to changes in mission or use, present significant hazards such as stored energy, toxicity, flammability, corrosiveness, or oxygen depletion, before operation. Testing must conform to the conditions of the relevant codes and standards (e.g., B&PV, B31, or DOT).

   Note: Pressure and leak testing on systems in radiological service or containing hazardous materials require hazard control plans or activity hazard analysis. Systems greater than 15 PSIG require adherence to LANL ESM, Chapter 17.

2. On pressure systems, perform a pressure test in accordance with Section 22 0813, "Testing Piping Systems." And the appropriate ASME B&PV Code, or appropriate volume of the ASME B31 piping codes (see LANL ESM, Chapter 17).

3. Systems under 15 PSIG may be pressure tested in accordance with the appropriate volume of the ASME B31 piping codes or using LANL ESM, Chapter 17 as guidance.

PART 4 ATTACHMENTS

A. Attachment 1 Tube Cutting.

B. Attachment 2 Tube Bending.

C. Attachment 3 Tubing Installation.

D. Attachment 4 Swagelok Fitting Initial Installation.

E. Attachment 5 Tube Fitting Tightening Due to Leaking Fitting.

F. Attachment 6 Tube Fitting Removal and Reconnection.

G. Attachment 7 Tube Cap Installation.

H. Attachment 8 Tube Cap Reinstallation.

Tube Cutting

CAUTION:
- When cutting, ensure tubing does not get hot. Heat hardening of tubing may cause fitting failure.
- Tube cutters used for SS up to 1" OD must be specially designed to avoid work hardening.
- Due to the possibility of introducing foreign particles internal to tubing, ensure tubing is clean and deburred after cuts (hacksaw use is highly discouraged).

NOTE: Tubing shall be cut using tools designed and maintained (sharp cutting surfaces) specifically for that purpose.

1.1 Tube Cutters

A. Using tube cutters, cut tubing squarely with gradually applied force. Use 1/8 turn of cutter knob for every two revolutions on steel or stainless steel. Use 1/8 turn of cutter knob for each revolution when cutting copper tubing.

B. Deburr ID of tubing.

C. Clean as necessary.

1.2 Hacksaw (Hacksaw Use Is Highly Discouraged)

A. When using a hacksaw to cut tubing, use tube sawing guide instead of a vise to ensure a square cut and to keep tubing from flattening out.

B. Hacksaw blade should have 24 teeth per inch minimum.

C. For proper entry into fitting and to prevent system contamination and/or restricted flow, deburr both ID and OD of tubing.

D. Clean as necessary.

Tube Bending

NOTES:
1. Tubing minimum bending radius shall be based on the applicable tubing OD (tube fittings shall be used whenever smaller bending radii are required).
2. Tube bending will result in wall thinning and the need to derate the tubing design pressure per ASME (e.g., ANSI/ASME B31.9, Section 102.4.5).

2.1 Tubing Bend Radius

A. Use Table 2-1 to determine minimum tubing bend radius.

Table 2-1. Minimum Bending Radius for Tubing (requires derating).

	For Tube Bend 180^0		
Tubing OD (inch)	**Minimum Bend Radius (inch)**	**Calculated Bend Radius (diameter)**	**Resulting Wall Thinning (%)**
1/8	3/8	3	22
1/4	9/16	2.25	31
1/4	3/4	3	22
3/8	15/16	2.5	27
1/2	1-1/2	3	22
5/8	2-1/4	3.6	19
3/4	3	4	17
1	4	4	17

NOTES:
1. All tube bends shall be made using tools designed specifically for that purpose. Caution shall be exercised to ensure a smooth, even bend with minimal flattening, wrinkles, humps, or other damage to tubing.
2. Tube benders vary, but requirements for minimum bend radius shall be met.
3. Actual bend radius can be greater than required minimum.

2.2 Select tube bender that meets the minimum bend radius requirements from Table 2-1.

2.3 Bend tubing as follows:

A. Ensure even bends with no flattening or other damage to tubing.

B. Bend tubing so that deformed section at bend does not enter fitting. See dimension L on Figure 2-1 and Table 2-2.

Figure 2-1. Guidance for Determining Length Between Tube Bend and Fitting.

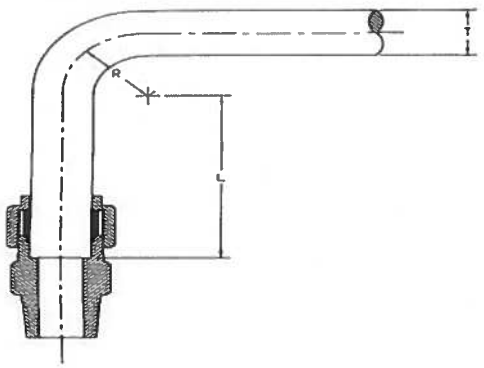


Table 2-2. Determining Length Between Tube Bend and Fitting.

T (inch)	Tubing OD	1/8	1/4	3/8	1/2	5/8	3/4	1
L (inch)	Recommended	3/4	13/16	15/16	1-3/16	1-1/4	1-1/4	1-1/2
Length of Straight Tube	Absolute Minimum	5/8	11/16	3/4	1	1-1/6	1-1/16	1-5/16

CAUTION: Do not spring tubing into position in fitting as this can result in excessive stress on tubing and connections leading to leakage.

C. Tube line fabrication (bend angles and measured lengths) must be accurate so that the tube end easily enters the fitting in proper alignment.

D. When a section of bent tubing is being connected, ensure that tubing is in proper alignment with fitting before tightening.

E. Use bends where practical instead of fittings.

2.4 Verify and document based on applicable Project Quality Management Plan.

Tubing Installation

3.1 Flush or blow down tubing and fitting(s), where practical.

3.2 Ensure that visible internal surfaces of tubing are clean of any foreign matter. Remove all filings, chips, and grit before attachment of fittings. Cover ends until final installation.

3.3 Use related attachments with this one as necessary.

A. Tube Cutting (Attachment 1).

B. Tube Bending (Attachment 2).

C. Swagelok Fitting Installation (Attachment 4).

3.4 Plan tubing layout to ensure:

A. Tubing does not block access to doors, bolts and equipment that needs to be accessed for maintenance.

B. When attaching tubing to an item that may occasionally be removed for repair or maintenance, ensure method of connecting and running tubing allows easy removal.

C. Ensure tubing is kept clear of controls and does not impede operator's access to controls.

D. If tubing is run in an area that will expose it to damage, e.g., being stepped on or used as a hand hold, review with supervisor or technical support for need/method to protect tubing.

E. Ensure tubing is appropriately supported. Refer to Section 22 0529, "Hangers and Supports for Plumbing Piping and Equipment."

F. Ensure valves or other devices that require torque to be executed in their operation are mounted so that a twisting movement is not applied to tubing. Normally this would require valves or other devices to be mounted using a bracket to hold it in place.

G. If possible, gang tubing vertically rather than horizontally to avoid collection of dirt, corrosives, and contaminants.

H. Ensure fittings are staggered and offset when making multiple runs to provide easier installation and conserve space.

I. Verify slope requirements are met per appropriate design standards.

> **NOTE:** Straight runs between two fixed fittings should be avoided. This does not allow for expansion and or for tubing to be properly bottomed in fitting when being made up.

J. If necessary, use expansion loops in tubing to allow for thermal growth.

K. If necessary, make layout sketch of tubing runs by measuring distances with a flexible steel rule. Some suggestions to consider:

1. Consult fitting vendor catalog to determine distance to end point of tubing. (See Attachment 2 on bending tubing)

2. Measure all dimensions to and from centerline of tubing.

3. For clearances, it is necessary to allow for one-half tubing OD to clear obstructions to prevent rubbing.

4. Tube bends can be measured square and excess tubing trimmed from end after bending. For more accurate tube length measurement, length of tubing in a bend can be calculated using Table 3-1 and the equation below:

Table 3-1. Bend Angle Cross Reference to Bend Factor.

Degrees of Bend	30	45	60	90	180
Bend Factor	0.52	0.78	1.04	1.57	3.14

Required Tub Length = (Bend Factor) (Bend Radius)

NOTE: Example: For a 90° bend with a bend radius of 2 inches, required Tube Length = (1.57) x (2 inches) = 3.14 inches.

3.5 Label piping system. Refer to Section 22 0554, "Identification for Plumbing, HVAC, and Fire Piping and Equipment."

3.6 Verify and document based on applicable Project Quality Management Plan.

Swagelok Fitting Initial Installation

NOTE: When using compression fittings other than Swagelok, the manufacturer's installation instructions shall be furnished by the fitting supplier.

4.1 Refer to the following for:

A. Tube Cutting (Attachment 1).

B. Tube Bending (Attachment 2).

4.2 Flush or blow down tubing / fitting(s), where practical.

4.3 Ensure that visible internal and external surfaces of tubing and fitting(s) are clean of any foreign matter.

NOTE: Tubing surface finish is very important to proper sealing. Tubing with any depression, scratch, raised portion, or other surface defect will be difficult to seal.

4.4 Ensure:

A. No axial scratches along tubing where ferrule seats.

B. Ferrule(s) are not scratched or deformed.

C. Fittings components are of proper type.

D. Parts are not mixed or interchanged with another manufacturer.

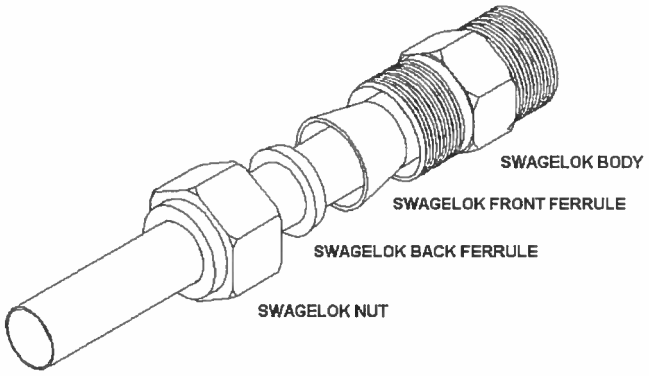
E. No damaged threads on fitting bodies and nuts.

NOTES:

- The small tapered end of ferrule goes into fitting body.
- Swagelok fittings have a two piece ferrule: front ferrule (large piece) and back ferrule (small piece).
- Do not use Teflon □tape on tube end of fitting body threads. A small amount of low- chloride lubricant on stainless steel threads can be used to minimize galling (do not get inside the process; (Swagelok Silver- or High Purity-Goop are acceptable).

4.5 Makeup nut and ferrule(s) on tubing (see Figure 4-1).

Figure 4-1. Swagelok Fitting Exploded View Showing Ferrules Orientation.



NOTE: Fittings are not normally disassembled prior to use as contaminants may enter fitting or ferrules may be lost.

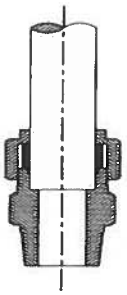
4.6 Align tubing with fitting so that tubing end easily enters fitting in proper alignment.

4.7 Insert tubing end until it bottoms against shoulder in fitting body. While holding tube end against shoulder in fitting body, tighten nut finger tight. This is necessary to prevent movement of the tube while the nut forces the ferrule to grip the tube and to seal through any minor imperfections that may exist on the outside of the surface (see Figure 4-2).

NOTES:

- If unexpected resistance is felt when threading nut to finger tight, then fitting should be cleaned or replaced, as applicable.
- Do not force an improperly fitted tube line into the fittings. If tubing is oval or will not easily fit through fitting nuts, ferrules, and bodies, do not force tubing into fittings.
- Tightening fittings finger tight means manually, with no tools.

Figure 4-2. Swagelok Fitting Cutaway View.



4.8 Scribe fitting at 6 o'clock position. Use indelible pen or felt tip marker. If desired, fitting body may also be marked temporarily to verify number of turns in Step 4.9.

> **NOTE:** When scribing nut and fitting body on fittings where scribe reference on body may be used for more than one nut (e.g., union, elbow, etc.), ensure that scribe marks relating to each nut are distinguishable.

4.9 While holding fitting body steady with backup wrench:

A. For tubing OD ≥ 1/4 inch: Tighten nut 1-1/4 turns (as shown in Figure 4-3 below left) to swage ferrule. (Nut mark should be at 9 o'clock position).

B. For tubing OD < 1/4 inch: Tighten nut 3/4 turn (as shown in Figure 4-4 below right) to swage ferrule. (Nut mark should be at 3 o'clock position).

Figure 4-3. Tightening Nut 1-1/4 Turns (for tubing OD .≥ 1/4 inch).

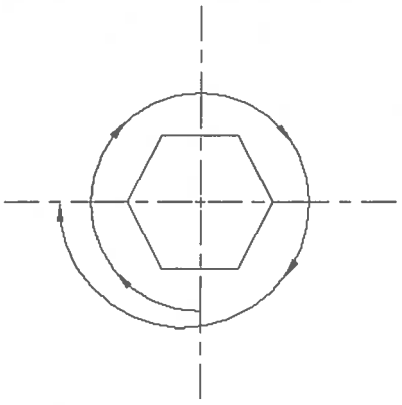
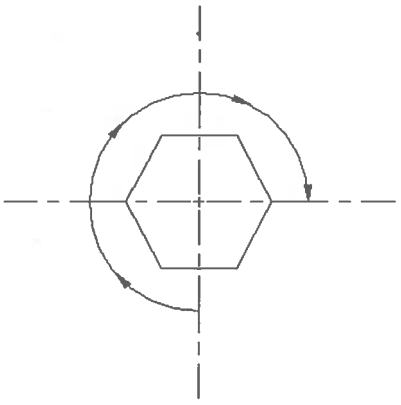


Figure 4-4. Tightening Nut 3/4 Turn (for tubing OD < 1/4 inch).



> **CAUTION:**
> - Never permit the fitting body to rotate during tube end make-up. **Two wrenches must be used.** Assemble port connectors to components first and hold with wrench while making up the tube joint. All types of union bodies must be held while each of the tube ends is makeup.
> - Never attempt to makeup by torque or feel. Always turn the nut the prescribed amount (listed above) regardless of torque required.

> **NOTES:**
> - A gap inspection gauge is used with Swagelok fittings to verify proper swaging and pull up (see Table 4-1).
> - Gap inspection gauges should be used unless physical makeup of fitting prevents their use.
> - Gap inspection gauge is not required on jam nut of Bulkhead Union Fitting or other fittings without shoulders. Step 4.10 provides alternative inspection method.
> - During initial installation using gap inspection gauge, Swagelok fittings do not require disassembly and visual inspection if made up to manufacturer's instructions.

Table 4-1. Swagelok Gap Double-Ended Inspection Gauges								
Tubing OD (inch)	1/8	1/4	5/16	3/8	1/2	5/8	3/4	1
Swagelok Gauge Series	200	400	500	600	810	1010	1210	1610

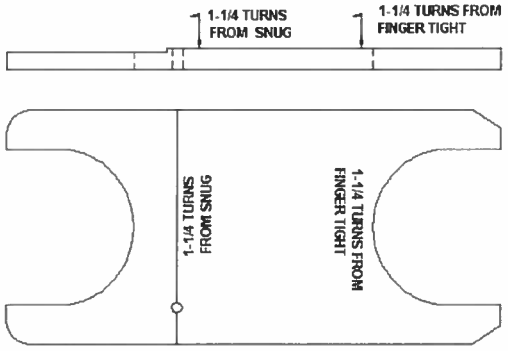
NOTE: Only the following Swagelok Gap Inspection Gauge ends are to be used in this procedure:

- For tubing OD ≥ 1/4 in.: Use 1-1/4 turns from finger tight end.
- For tubing OD < 1/4 in.: Use 3/4 turns from finger tight end.

C. Attempt to insert gap inspection gauge between fitting nut and body hex (Figure 4-5).

1. For tubing OD ≥ 1/4 inch: Use 1-1/4 turns from finger tight end.
2. For tubing OD < 1/4 inch: Use 3/4 turn from finger tight end.

Figure 4-5. Typical Swagelok Gap Gauge.



CAUTION: Do not tighten fittings with gap gauge in place.

NOTES:
- If gap inspection gauge fits between nut and body hex, fitting is not sufficiently tightened.
- If any tubing/fitting makeup is found to be questionable, then remake, replace, or repair as necessary.

3. If using Swagelok MS-IG 468 (multiple size) no-go gauge, measure from finger tight.

D. If gap inspection gauge fits between nut and body hex, tighten in 1/4 hex flat increments until gauge does NOT fit into space. DO NOT tighten more than 2 hex flats (1/3 turn) past:

1. For tubing OD ≥ 1/4 inch: 9 o'clock position (refer to Figure 4-3).
2. For tubing OD < 1/4 inch: 3 o'clock position (refer to Figure 4-4).

E. When gap inspection gauge will NOT fit between nut and body hex, installation of fitting is correct.

4.10 If a gap inspection tool cannot be used and personnel safety depends on proper makeup, then check for proper fitting makeup as follows:

> **NOTE:** Scribe mark is reference point used in subsequent fitting tightening.

A. Scribe fitting and nut in their final position.

> **CAUTION:** If tubing end does not sufficiently extend past ferrule, improper fitting seal may result.

B. Remove nut , disassemble fitting, and visually inspect for:

1. Ferrule(s) orientation is correct.
2. Ferrule(s) swaged.
3. Tubing extends past end of ferrule to ensure tubing bottoms out in fitting.
4. If end tubing is visible, verify tube end is properly cut and free of burrs.

> **NOTES:**
> - It is recommended that Swagelok fittings not be tightened > 1/6 to 1/4 turn past scribe mark.
> - When reconnecting fitting, a slight increase in resistance (torque rise) will be felt indicating ferrule is being resprung to its original position.
> - Fitting end plugs and port connections require only 1/4 inch turn from finger tight makeup in all sizes. Tightening fitting finger tight normally means manually, with no tools. Sizes 1/16 to 3/16 can be damaged (tube snapped or cut) by over tightening.

C. Reconnect nut as follows:

1. While ensuring tubing is aligned and bottomed against shoulder in fitting body, tighten nut finger tight.
2. Tighten nut to its original position as indicated by scribe marks, then snug slightly (with wrench), typically 1/6 to 1/4 turn maximum.

4.11 Verify fitting(s) makeup completed and document based on applicable Project Quality Management Plan.

Tube Fitting Tightening Due to Leaking Fitting

WARNING: Before tightening fittings, system must be depressurized.

NOTES:
- It is recommended that fittings not be tightened more than 1/6 to 1/4 turn past the scribe mark.
- If fitting is not scribed, tightening may be done using good craft practice.

5.1 If fitting leaks, tighten fitting in increments of 1/4 hex flat until leak stops.

5.2 If fitting still leaks, evaluate as follows:

A. If practical, take fitting apart and examine for scratches on tubing or ferrule, damaged threads, or improper tubing alignment. If no problems are found, or replacement is not required, reconnect per applicable steps of appropriate attachment.

B. Determine if fitting should be replaced. Take necessary action to replace fitting.

Tube Fitting Removal and Reconnection

6.1 Fitting Removal (system must be depressurized)

A. Inspect fitting for previously scribed marks.

B. If fitting is not scribed, before disconnecting, perform as follows:

1. Inspect fitting for leaks and indication of leaking.
2. Inspect fitting for looseness (by hand).
3. If leaks or looseness are noted:
   a. Evaluate the need to replace fitting.
   b. If necessary, replace fitting per applicable attachment of this section.

> **NOTES:**
> - When scribing nut and fitting body on fittings where scribe reference on body may be used for more than one nut (e.g., union, elbow, etc.), scribe marks relating to each nut are to be distinguishable.
> - For maximum number of remakes, mark the fitting and nut before disassembly to prevent over tightening caused by guesswork.

4. If no leaks or looseness are noted, scribe fitting. Use this mark as original installation scribe mark.

> **WARNING:** In all applications where root or instrument isolation valves are installed, tube caps or fittings can be used to release trapped pressure in instrument lines, after the root valve or instrument isolation valve(s) are closed. For other applications, Paragraph 1.6 of this section provides guidance.

5. Remove fitting. Ensure proper cleanliness level is maintained.

6.2 Fitting Reconnection

A. If both ends of tubing/fitting(s) are open, flush or blow down tubing/fitting(s), where practical.

B. Verify that visible internal and external surfaces of tubing and fitting(s) are clean of any foreign matter.

C. Check fittings visually for condition of threads, ferrule, and tubing. If fitting is damaged, initiate action to replace.

> **CAUTION:** If Safety Installation Collar was installed on Swagelok fitting, remove it before reconnection.

> **NOTE:** Safety Installation Collar may have been installed with Swagelok fittings on large OD tubing to verify proper swaging.

D. Insert assembly into fitting until ferrule seats into fitting.

> **NOTE:** If resistance is felt when threading nut to finger tight, fitting should be cleaned or replaced, as applicable.

E. Thread nut onto body finger tight and tighten to original scribe mark.

> **NOTES:**
> - A slight torque rise will be felt indicating ferrule is being resprung to its original position.
> - It is recommended that fittings NOT be tightened more than 1/6 to 1/4 turn past scribe mark.

F. If connecting swaged ferrule/tubing/nut assembly with new fitting body (where fitting body will not have scribe mark):

1. Tighten nut until rise in torque is felt.
2. Scribe fitting body (align with nut scribe mark).
3. Snug fitting slightly with wrench.

G. If fitting body and nut are scribed:

1. Retighten nut by hand.
2. With two wrenches, tighten nut to its original position as indicated by scribe marks. A noticeable increase in mechanical resistance will be felt indicating the original position. Then tighten 1/6 to 1/4 turn with wrench.
3. If torque rise is NOT felt, tighten nut an additional 1/12 turn (1/2 hex flat).

H. Verify and document based on applicable Project Quality Management Plan.

Tube Cap Installation

CAUTION:	Connecting, mixing or interchanging parts (caps, plugs, ferrules, bodies, etc.) with tube fittings made by different manufacturers (such as Parker to Swagelok) may cause improper fitting seal, damage, or injuries.

7.1 Inspect for damaged threads on fitting bodies and nuts.

7.2 Verify that visible internal and external surfaces of tubing and fitting(s) are clean of any foreign matter.

NOTE:	If resistance is felt when threading nut to finger tight, cap or fitting should be cleaned or replaced, as applicable.

7.3 While holding fitting body with backup wrench, tighten tube cap finger tight.

7.4 Using wrench, tighten tube cap 1/4 turn (1 1/2 hex flats) to seat tube cap.

7.5 Scribe tube cap in final position

7.6 If tube cap leaks

A. Mark tube cap and fitting.

B. Tighten tube cap an additional 1/2 hex flat. Repeat as necessary in 1/2 hex flat increments up to limit of 2 hex flats (1/3 turn).

C. Scribe tube cap in final position.

7.7 Verify and document based on applicable Project Quality Management Plan.

Tube Cap Reinstallation

8.1 Inspect for damaged threads on fitting bodies and nuts.

8.2 Verify that visible internal surfaces of tubing and fitting(s) are clean of any foreign matter.

> **NOTE:** If resistance is felt when threading nut to finger tight, cap or fitting should be cleaned or replaced, as applicable.

8.3 While holding fitting body with backup wrench, tighten tube cap finger tight.

8.4 Using wrench, tighten tube cap to original position.

8.5 If tube cap is not leaking, go to Step 8.7.

8.6 If tube cap leaks:

A. Mark tube cap and fitting.

B. Tighten tube cap an additional 1/2 hex flat. Repeat as necessary in 1/2 hex flat increments up to limit of 2 hex flats (1/3 turn).

8.7 Verify and document based on applicable Project Quality Management Plan.

END OF SECTION

FOR LANL USE ONLY

This project specification is based on LANL Master Specification 40 0511, Rev. 1, dated July 17, 2008.

SECTION 40 0527

PIPING AND TUBING INSPECTION CHECKLIST

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Inspection of piping and tubing installations per design documents.

B. Inspection of installation workmanship.

C. Supports.

D. Cutting.

E. Joining:

1. Fittings,
2. Welding,
3. Brazing,
4. Threading, and
5. Flange Assembly.

F. Bending.

G. Cleaning.

H. Leak Testing.

I. Insulation.

J. Documentation.

1.2 RELATED SECTIONS

A. Section 01 4000, "Quality Requirements."

B. Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

C. Section 22 0529, "Hangers and Supports for Plumbing Piping and Equipment."

D. Section 22 0548, "Vibration and Seismic Controls for Plumbing, Piping and Equipment."

E. Section 22 0713, "Plumbing and HVAC Insulation."

F. Section 22 0813, "Testing Piping Systems."

G. Section 40 0511, "Compression Fittings on Copper and Stainless-Steel Tubing."

1.3 ABBREVIATIONS AND ACRONYMS, DEFINITIONS, AND REFERENCES

A. Refer to Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

1.4 QUALITY ASSURANCE AND TESTING

A. Work identified in this section shall be in accordance with Section 01 4000, "Quality Requirements."

B. Perform inspections and testing in accordance with Section 22 0529, "Hangers and Supports for Plumbing Piping and Equipment;" Section 22 0713, "Plumbing

and HVAC Insulation;" Section 22 0813, "Testing Piping Systems;" and Section 40 0511, "Compression Fittings on Copper and Stainless-Steel Tubing."

C. Quality Assurance Program

1. The fabricator is responsible for maintaining quality and shall perform in-process and final inspection on his work as required herein. The fabricator must comply with all applicable federal, state, or local codes.

PART 2 PRODUCTS

A. Not Used.

PART 3 EXECUTION

3.1 INSPECTION ATTRIBUTES

A. General:

1. Approved design documents present.
2. Code to which it was designed identified (e.g., UPC, applicable ASME B31 code).
3. Design followed:
   a. Required materials used (metal, polymer, schedule, markings per material standard on tube, pipe, and fittings).
   b. No counterfeit materials.
4. Routing layout, configuration.
5. Elevations (if elevation is critical).
6. Slope (if slope is critical).
7. Location of components, instruments, fittings.
8. Orientation of components where flow direction is important (check valves, reducers, globe valves, etc.).
9. Support locations, types, attachments.
10. Integrity and workmanship.

3.2 CUTTING

A. Pipes are cut square.

B. Surfaces are free of sharp edges and burrs.

C. End preparation weld bevel for welded pipes.

3.3 JOINING SWAGE FITTINGS

A. Installer trained per LANL or manufacturer's course

B. Section 40 0511, "Compression Fittings on Copper and Stainless-Steel Tubing," followed for cutting, bending, and assembly of these.

1. Correct parts (body, nut and ferrules).
2. Tube ends cut square.
3. Clean and smooth tube ends.
4. Tube aligned straight.
5. Tube inserted into fitting body to right depth.
6. Finger tight followed by the right torque or turns (follow vendor's instructions).
7. Go/No-Go gage check where applicable (follow vendor's instructions).

3.4 THREADING

A. Pipe or tubing size.

B. Threading tool identification.

C. Cleanliness.

D. Proper thread lubricant-sealant.

E. Threads not damaged.

F. Proper alignment before joining.

G. Sufficient insertion of pipe threads.

H. Proper alignment after joining.

3.5 COLD BENDING

A. Tangent point marked.

B. Bend angle and dimensions.

C. Bend free of wrinkles.

D. Pipe or tubing wall not thinned below minimum design.

E. Ovality of cross section not over 8% of nominal diameter.

F. No deep gouges or scratches.

3.6 WELDING

A. Certified welding inspector accepts job:

1. Welder certified;
2. Correct welding procedure used;
3. Weld map documenting weld symbols (depth of penetration, weld-type fillet, butt, etc.);
4. Correct base metal used;
5. Correct filler metal used; and
6. Weld procedures followed.

3.7 CLEANING

A. Weld surfaces free of contaminants.

B. Inside piping surfaces free of all non-adhering material.

C. Verify no moisture in the system.

D. Special cleaning done when required (e.g. refrigerants, oxygen, tritium).

3.8 FLANGE ASSEMBLY

A. Proper support of both sides of open flange.

B. Removal of old gasket.

C. Cleanliness.

D. No flange-face imperfections.

E. Verify flange face finish compatible with new gasket.

F. Verify correct gasket.

G. Verify gasket condition.

H. Verify right bolts, verify size and markings.

I. Align flange and support flange ends.

J. Lubricate bolts and nuts (unless new and coated).

K. Verify compatibility of lubricant, if used.

L. Use washers.

M. Visual verification of fastener condition.

N. Verify use of correct fastener lubrication.

O. Verify adhesive compatibility, if used.

P. Verify Installation of all bolts.

Q. Torque wrench and multiplier calibration.

R. Torque bolts in star pattern, three passes.

S. Verify bolt torque.

T. Verify full engagement of nut (bolt threads at least flush with top on nut).

3.9 LEAK TESTING

A. General – All Testing:

1. Follow Section 22 0813, "Testing Piping Systems."

B. Hydrostatic Leak Test:

1. Reduce pressure to the design pressure prior to checking for leaks;
2. Test boundaries, valve alignment and closure;
3. Joints visible;
4. Pressure control and overpressure protection of test;
5. System relief devices isolated;
6. Water cleanliness and chemistry (ppm chloride limit on stainless);
7. Hydrotest pressure, considering changes in elevation;
8. Supports completed;
9. Temporary supports where necessary (hydro of steam or gas lines);
10. Variable springs constrained;
11. Expansion joints constrained;
12. Verification of pressure rating of components;
13. Use of strainers to protect equipment;
14. Ambient temperature above minimum;
15. Fill and venting;
16. Time at pressure;
17. Depressurize;
18. Visual inspection for leaks;
19. Repair of joints;
20. Tightening of leaking mechanical or flange joints;
21. Flush and water disposal;
22. Dry and clean pipe; and
23. System and valve alignment returned to specified condition.

C. Pneumatic Test Piping (typically Small Bore -- 2 inch and smaller -- and below 150 psi):

1. Owner approval for systems with greater than 2 cubic feet of volume;
2. Verify component pressure rating;
3. Examine assembly of all threaded, bolted, and other mechanical joints;
4. Verify test boundaries (valve alignment);
5. Joints visible;
6. Non-flammable nontoxic gas used;
7. Test pressure per Spec 22 0813, "Testing Piping Systems;"
8. Test rig equipped with Code pressure relief device;
9. Approved leak detection solution;
10. Initially pressurize gradually to lesser of 25 psi or 25 percent of test pressure for preliminary check;
11. Gradually increase pressure in steps, allow time between steps for strain equalization;
12. Reduce pressure to the design pressure prior to checking for leaks; and
13. Depressurize system following test to no more than operating level.

D. In-Service Leak Testing:

1. Joints are visible,
2. System is at normal operating pressure for at least 10 minutes,
3. Joints covered with bubble solution (gas),
4. No visible leaks (liquid), and
5. No bubbles at joints (gas).

3.10 SUPPORTS

A. Hangers and Supports installation are per Section 22 0529, "Hangers and Supports for Plumbing Piping and Equipment."

B. Conformance with Section 22 0548, "Vibration and Seismic Controls for Plumbing, Piping and Equipment."

C. Verify condition of the support steel; note any corrosion, or bent or deformed parts, missing bolts or cracks in or near welds.

D. Identify any missing bolts.

E. Identify any missing grout between the anchorage and mounted concrete surface.

F. Verify that structural surfaces are in close contact in bolted connections.

3.11 INSULATION

A. Insulation installation are per Section 22 0713, "Plumbing and HVAC Insulation."

B. Pipe surface clean and dry.

C. Type and condition of insulation.

D. Insulation thickness.

E. Type and condition of lagging (jacket).

F. Visual inspection of installation for workmanship.

3.12 DOCUMENTATION

A. Assembly drawing or sketch initialed at each swage joint (if required by QA plan).

B. Work package complete, signed-off, and filed.

END OF SECTION

FOR LANL USE ONLY

This project specification is based on LANL Master Specification 40 0527, Rev. 2, dated October 5, 2009.

SECTION 40 1813

LOW-VACUUM SYSTEMS PROCESS PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Process low-vacuum piping and specialties, designated "Process low vacuum" operating at 12 inches mercury (40.6 kPa vacuum) or less.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to this section.

1.3 RELATED SECTIONS

A. Section 01 2500, "Substitution Procedures."

B. Section 01 4000, "Quality Requirements."

C. Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

D. Section 01 8116, "Facility Environmental Requirements."

E. Section 07 6200, "Sheet Metal Flashing and Trim."

F. Section 07 8400, "Firestopping."

G. Section 13 4800, "Sound, Vibration, and Seismic Control."

H. Section 22 0529, "Hangers and Supports for Plumbing Piping and Equipment."

I. Section 22 0548, "Vibration and Seismic Controls for Plumbing, Piping and Equipment."

J. Section 22 0554, "Identification for Plumbing, HVAC, and Fire Piping and Equipment."

K. Section 22 0813, "Testing Piping Systems."

L. Section 22 1500, "Compressed-Air Systems."

1.4 ABBREVIATIONS AND ACRONYMS, DEFINITIONS, AND REFERENCES

A. Refer to Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

1.5 SUBMITTALS

A. All submittals shall be in accordance with the requirements of Exhibit I:

B. Product Data: For the following:

1. Vacuum pipes, tubes and fittings,
2. Vacuum valves and Automatic drain valves,
3. Process vacuum service connections, and
4. Instrumentation and Alarms.

C. Shop Drawings: Diagram power, signal, and control wiring.

D. Piping Material Certification: Signed by Installer certifying that process vacuum piping materials comply with ASME B31.9 requirements.

E. Qualification Data: For Installer and testing agency.

F. Welding/Brazing Procedures, per ASME *Boiler and Pressure Vessel Code* (B&PV), Section IX.

G. Welder/Brazer Certifications, per ASME B&PV Code, Section IX.

H. Welding/Brazing Inspection Reports, as applicable.

I. Field quality-control test reports.

J. Installation, Operation and Maintenance Data: For vacuum piping specialties to include installation, operation, and maintenance manuals.

1. Submit complete operation and maintenance instructions including step-by-step inspection, and maintenance procedures.

2. Include the manufacturer's name, equipment model number, service manual, parts list, and brief description of equipment and its basic operational features.

K. Pressure Design Certification, for pressure containing components made of listed materials but not made in accordance with a specification or standard listed in Table 926.1 of ASME B31.9 shall be substantiated by at least one of the following:

1. Engineering calculation(s)

2. Experimental stress analysis such as described in Appendix 6 in Section VIII, Division 2 of the ASME B&PV Code.

3. Proof test in accordance with UG-101 in Section VIII, Division 1 of the ASME B&PV Code.

1.6 QUALITY ASSURANCE

A. Work identified in this section shall be in accordance with Section 01 4000, "Quality Requirements."

B. Source Limitations: Obtain vacuum service connections of same type and from same manufacture as service connections provided for in Section 22 1500, "Compressed-Air Systems."

C. Brazing: Qualify processes and operators according to ASME B&PV Code: Section IX, "Welding and Brazing Qualifications," or AWS B2.2, "Standard for Brazing Procedure and Performance Qualification."

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

E. Comply with ASME B31.9, "Building Services Piping," for vacuum piping.

F. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum 5 years experience and having maintenance service based within 200 miles radius of installation.

1.7 QUALIFICATIONS

A. Installer Qualifications:

1. Pressure-Seal Joining Procedure for Copper Tubing: Qualify operators according to training provided by ASME B31.9.

B. Testing Agency Qualifications: An independent testing agency, with the experience and capability to conduct the vacuum piping testing indicated, that is an NRTL, and that is acceptable to authorities having jurisdiction.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Design the piping to operate in the environmental conditions specified in Section 01 8116, "Facility Environmental Requirements." Seismic requirements are located in Section 13 4800, "Sound, Vibration, and Seismic Control."

PART 2 PRODUCTS

2.1 PRODUCT OPTIONS AND SUBSTITUTIONS

A. Alternate products may be accepted; follow Section 01 2500, "Substitution Procedures."

2.2 PIPES, TUBES, AND FITTINGS

A. Copper Vacuum Tube: ASTM B 88, O60 temper, seamless, drawn temper that has been cleaned and sealed.

B. Wrought-Copper Fittings: ASME B16.22, solder-joint pressure type.

C. Copper Unions: ASME B16.22, wrought copper or cast-copper alloy.

D. Compression Type Fittings: Brass, ASTM B16, bar stock; ASTM B283, forgings.

1. Manufacturers: Swagelock, Inc.

E. Extruded-Tee Outlets: ASTM F 2014 procedure for making branch outlets in copper tube.

1. Manufacturers:

a. Parker, Inc.
b. T-DRILL Industries Inc.

2.3 JOINING MATERIALS

A. Solder Filler Metals: ASTM B 32, Grade 95TA, lead-free alloys. Include water-flushable flux according to ASTM B 813.

B. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

C. Threaded-Joint Tape: PTFE.

2.4 VALVES

A. Copper-Alloy Ball Valves: MSS SP-110, 3-piece body, brass or bronze.

1. Standard: MSS SP-110.
2. Description: Three-piece body, brass or bronze.
3. Pressure Rating: 300 psig minimum.
4. Ball: Full-port, chrome-plated brass.

5. Seats: PTFE or TFE.
6. Handle: Lever type with locking device.
7. Stem: Blowout proof with PTFE or TFE seal.
8. Ends: Manufacturer-installed copper-tube extensions.

B. Bronze Check Valves: Y-pattern.

1. Standard: MSS SP-80.
2. Description: Y-pattern, bronze.
3. Pressure Rating: 300 psig minimum.
4. Operation: Spring loaded.
5. Ends: Manufacturer-installed copper-tube extensions.

2.5 FLEXIBLE PIPE CONNECTORS

A. Manufacturers: Subject to compliance with Paragraph 1.5K of this specification section, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Flex-Hose Co., Inc.
2. Flexicraft Industries.
3. Hyspan Precision Products, Inc.
4. Mercer Rubber Co.
5. Metraflex, Inc.
6. Proco Products, Inc.
7. Unaflex.
8. Universal Metal Hose; a Hyspan Co.

B. Description: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.

1. Working-Pressure Rating: 200 psig (1380 kPa) minimum at 70 degree F, minimum temperature rating 400 degree F.
2. End Connections: Threaded copper pipe or plain-end copper tube.

PART 3 EXECUTION

3.1 PREPARATION

A. Cleaning of vacuum Tubing: If manufacturer-cleaned and -capped fittings or tubing are not available or if precleaned fittings or tubing must be recleaned because of exposure, have supplier or separate agency acceptable to authorities having jurisdiction perform the following procedures:

1. Clean tube and fittings, valves, gages, and other components of oil, grease, and other readily oxidizable materials.
2. Wash tubing and components in hot, alkaline-cleaner-water solution of sodium carbonate or trisodium phosphate in proportion of 1 lb (0.453 kg) of chemical to 3 gal. (11.3 L) of water.
   a. Scrub to ensure complete cleaning.
   b. Rinse with clean, hot water to remove cleaning solution.

3.2 PIPING INSTALLATION

A. Install piping in accordance with ASME B31.9, drawing plans, schematics, and diagrams indicate general location and arrangement of vacuum piping. Indicated

locations and arrangements were used to size pipe and calculate friction loss, expansion, air-compressor sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Construction Drawings.

B. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal and coordinate with other services occupying that space.

E. Install piping adjacent to equipment and specialties to allow service and maintenance.

F. Install vacuum and drain piping with 1 percent slope downward in direction of flow.

G. Install nipples, unions, and special fittings, and valves with pressure ratings same as or higher than piping pressure rating used in applications below unless otherwise indicated.

H. Install eccentric reducers, if available, where vacuum piping is reduced in direction of flow, with bottoms of both pipes and reducer fitting flush.

I. Provide drain leg and drain trap at end of each main and branch and at low points.

J. Install thermometer and vacuum gage on inlet piping to each vacuum producer and on each receiver and separator (if required).

K. Install piping to permit valve servicing.

L. Install piping free of sags and bends.

M. Install fittings for changes in direction and for branch connections. Extruded-tee branch outlets in copper tubing may be made where specified.

N. Install seismic restraints on vacuum piping. Seismic-restraint devices are specified in Section 22 0548, "Vibration and Seismic Controls for Plumbing, Piping and Equipment."

O. Connect vacuum piping to vacuum producers and to equipment requiring vacuum service.

P. Install unions, in copper vacuum tubing adjacent to each valve and at final connection to each piece of equipment, machine, and specialty.

Q. Install sleeves for piping penetrations of walls, ceilings, and floors.

R. Install escutcheons for piping penetrations of walls, ceilings, and floors.

3.3 VALVE INSTALLATION

A. Install shutoff valve at each connection to and from vacuum equipment and specialties.

B. Install check valves to maintain correct direction of vacuum flow to vacuum-producing equipment.

C. Install safety valves on vacuum receivers where recommended by specialty manufacturers.

D. Install automatic drain valves on equipment, specialties, and piping with drain connection. Run drain piping to floor drain, so contents spill over or into it.

E. Install flexible pipe connectors in suction inlet piping to each vacuum producer.

3.4 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs.

B. Remove scale, slag, dirt, and debris from outside of cleaned tubing and fittings before assembly.

C. Threaded Joints: Apply appropriate tape to external pipe threads.

D. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" Chapter. Continuously purge joint with oil-free dry nitrogen during brazing.

E. Soldered Joints: Apply water-flushable flux to tube end. Join copper tube and fittings according to ASTM B 828.

F. Extruded-Tee Outlets: Form branches in copper tube according to ASTM F 2014, with tools recommended by procedure manufacture.

G. Pressure-Sealed Joints: Join copper tube and copper and copper-alloy fittings with tools recommended by fitting manufacturer.

3.5 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements in Section 22 0529, "Hangers and Supports for Plumbing Piping and Equipment."

3.6 LABELING AND IDENTIFICATION

A. Install identifying labels and devices for vacuum piping, valves, and specialties. Comply with requirements in Section 22 0554, "Identification for Plumbing, HVAC, and Fire Piping and Equipment."

3.7 FIELD QUALITY CONTROL FOR LOW VACUUM SYSTEMS PROCESS PIPING

A. Perform tests and inspections of vacuum piping in process facilities and prepare test/inspection reports.

B. Tests and Inspections:

1. Vacuum Testing Coordination: Perform tests, inspections, verifications, and certification of vacuum piping systems with tests, inspections, and certification of compressed-air piping and gas piping systems.

2. Tests in first subparagraph and associated subparagraphs below are required by Installer.

3. Perform the following Installer tests:

a. Initial blow down.

b. Initial pressure test.

c. Standing pressure test for vacuum systems. Refer to Section 22 0813, "Testing Piping Systems," and ASME B31.9.

C. Remove and replace components that do not pass tests and inspections and retest as specified above.

3.8 DEMONSTRATION

A. Engage factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain vacuum alarm systems.

3.9 SCHEDULES

A. None.

END OF SECTION

SECTION 40 2319

PROCESS PLANT PROCESS PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. This section includes the general requirements for process plant piping systems applicable to ASME B31.3, *Process Piping*:

1. Category M Fluid Service:

   a. 93% Sulfuric Acid.

2. Normal Fluid Service:

   a. Low-level waste (including double-wall and single-wall exterior below grade piping), sulfuric acid (less than 10 wt% concentrations), and sodium hydroxide (all concentrations).

3. Category D Fluid Service:

   a. 25% Magnesium sulfate and 36% ferric sulfate.

B. Not included:

1. Hangers and supports, insulation, and identification.

2. Systems covered in other ASME B31 series or *Uniform Plumbing Code*, such as refrigerants (ASME B31.5), hydronics (ASME B31.9), natural gas (ASME B31.8, 49 CFR 192, and NFPA 54), and domestic water (UPC), and thus addressed in other sections.

1.2 RELATED SECTIONS

A. Section 01 2500, "Substitution Procedures."

B. Section 01 4000, "Quality Requirements."

C. Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

D. Section 01 4444, "Offsite Welding & Joining Requirements."

E. Section 01 4455, "Onsite Welding & Joining Requirements."

F. Section 07 8400, "Firestopping."

G. Section 22 0529, "Hangers and Support for Plumbing Piping and Equipment."

H. Section 22 0548, "Vibration and Seismic Controls for Plumbing, Piping and Equipment."

I. Section 22 0554, "Identification for Plumbing, HVAC, and Fire Piping and Equipment."

J. Section 22 0713, "Plumbing and HVAC Insulation."

K. Section 22 0813, "Testing Piping Systems."

L. Section 31 2000, "Earth Moving."

M. Section 40 0511, "Compression Fittings on Copper and Stainless-Steel Tubing."

N. Section 40 0527, "Piping and Tubing Inspection Checklist."

1.3 ABBREVIATIONS AND ACRONYMS, DEFINITIONS, AND REFERENCES

A. Refer to Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

1.4 SUBMITTALS

A. Submit the following in accordance with the requirements of Exhibit I and the record requirements in ASME B31.3 for welding/bonding (Sections 328.2.4 and A328.2.4), examination (Sections 341.4.1 and 341.4.3), procedure qualification (Section 300.2), and qualification (Sections 328.2.4, 342.1, and A328.2.4) and test (Section 345.2.7):

1. Catalog data on pipe materials, pipe fittings, valves, and accessories.
2. Installation instructions for all purchased components with manufacturer model numbers.
3. Certificate of Conformance (CoC) that is signed or otherwise authenticated by responsible managers within the supplying organization and that certifies the conformance of end-items to order requirements. CoC must include:
    a. Certification that the piping has been designed, manufactured, and constructed in accordance with the manufacturer's QA plan.
    b. Statement that the piping meets the ASTM A 312 inspection test requirements for Hydrostatic testing.
    c. PO number.
    d. Purchased item identified by part number.
4. Certifications of welders and qualified welding procedures per Section 01 4444, "Offsite Welding & Joining Requirements" and Section 01 4455, "Onsite Welding & Joining Requirements."
5. The Material Control Procedure shall be submitted for approval, prior to fabrication.
6. Pressure testing procedures and reports.
7. Helium leak test procedure/report.
8. Examination, testing, and inspection procedures/reports.
9. Certifications for testing, inspections, and non-destructive examination (NDE) personnel shall be submitted for approval, prior to fabrication.
10. All pipe installation isometrics and vendor specific data necessary for pipe stress analysis (including flange leakage analysis data) shall be supplied by the subcontractor to the contractor for review 30 days prior to scheduled installation date.
11. Receipt inspection report.
12. In-service leak test procedure and report.
13. For unlisted components (not listed in Table 326.1 or Appendix A of ASME B31.3), before fabrication submit approved piping stress calculations/analyses or alternative methods that document the acceptability of the specific piping system in accordance with ASME B31.3.

1.5 QUALITY ASSURANCE AND QUALITY CONTROL

A. Work identified in this section shall be done under a Quality Assurance Program in accordance with Section 01 4000, "Quality Requirements."

B. Steel Support Welding: Qualify processes and operators according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

C. Welding: Qualify processes and operators according to ASME *Boiler and Pressure Vessel Code* (B&PV): Section IX.

1. Comply with provisions in ASME B31.3 "Process Piping."

2. Comply with provisions in LANL *Engineering Standards Manual* (ESM) (ISD 341-2 and PD342, Chapter 13, "Welding, Joining, & NDE").

3. Certify that each welder has passed ASME qualification tests for welding processes involved and that certification is current before proceeding with work.

D. ASME Compliance: All process piping and tubing systems shall be fabricated, welded, erected, inspected, examined, and tested in accordance with this specification and the "Category M" and "Normal" fluid service category requirements in ASME B31.3, "Process Piping." Safety valves and pressure vessels shall bear the appropriate ASME label.

E. Plastic Pipe: Installers of double-wall plastic pipe shall be qualified in butt fusion techniques according to ASTM D 2657 and ASME B31.3, Section A328.2.

F. All work shall be performed in accordance with an approved Material Control Procedure. This procedure shall describe the control methods and documentation used to handle and monitor the use of controlled materials, such as stainless steel and welding filler materials. This procedure shall also address procurement controls, segregation of materials, and traceability of materials from receipt at the shop through processing and final assembly.

G. All personnel performing or witnessing liquid penetrant testing, helium leak testing, and sensitive leak tests shall be certified in accordance with ASNT-TC-1A and hold either Level II or Level III certification (unless otherwise covered by a variance). All visual weld inspections and in-process weld examinations shall be performed by certified welding inspectors qualified in accordance with AWS QC-1 and LANL ESM (Chapter 13). For non-metal piping, comply with ASME B31.3, Section A342. All test reports shall be signed by personnel who performed or witnessed the tests and hold either Level II or Level III certification. The personnel certifications shall be submitted for approval, prior to fabrication. Examination records including examiner's qualifications and procedures shall be retained for at least 5 years per ASME B31.3, Section 346.3.

H. Owner's Inspector and the Inspector's delegates shall have the rights to access as required by ASME B31.3, Section 340.3.

1.6 DESIGN AND PERFORMANCE CRITERIA

A. Buried piping design shall incorporate the requirements of Section 3.5.2 of ASCE Standard 4 and WRC Bulletin 425, "Welding Research Council Bulletin, A Review of Methods for the Analysis of Buried Pressure Piping," George Antaki, Bulletin 425, (September 1997) and the guidance provided in BNL-52361 (Brookhaven National Laboratory Report BNL-52361, "Seismic Design and Evaluation Guidelines for DOE High-Level Waste Storage Tanks and Appurtenances" shall be followed.

B. Seismic anchor movements (SAMs) at the buried pipe anchor connections to buildings, tanks, and other structures shall be considered. Loads are generated in a pipe as a result of the differential motion of anchor points, such as at building penetrations.

C. The maximum corrosion allowance for piping is 0.05 inches.

D. Threaded joints should be avoided in any service where crevice corrosion, severe erosion or cyclic loading (pressure or thermal) may occur.

E. Gasket materials shall be compatible with the fluids and service conditions.

PART 2 PRODUCTS

2.1 PRODUCT OPTIONS AND SUBSTITUTIONS

A. Alternate products may be accepted; follow Section 01 2500, "Substitution Procedures."

2.2 PIPING ABOVE GRADE

A. Stainless Steel Pipe and Fittings: Schedule 40, ASTM A 312/A 312M, Grade TP316 or TP304, unless otherwise indicated; seamless pipe and ASTM A 403/A 403M, Class S, seamless fittings matching pipe thickness and grade, for welded joints.

B. Clear PVC Pipe and Fittings (Sludge Thickening Tank Decant Piping): Schedule 80, ASTM D 1785 with ASTM D 2467 fittings matching pipe thickness and grade.

C. All piping and fittings, shall meet the requirements of ASME B31.3 for the "Normal" and M fluid service categories.

2.3 TUBING

A. Stainless Steel Tubing: ASTM A 269, Grade 316/316L or 304/304L, unless otherwise indicated.

B. All tubing shall meet the requirements of ASME B31.3 for the fluid service categories identified in Paragraph 1.1A of this specification.

2.4 BALL VALVES, ABOVE GRADE

A. Ball Valves, NPS 2 (DN 50) and Smaller: MSS SP-72, Class 150, 3 piece, with ASTM A182 Type 316 stainless-steel body, ASTM A479 Type 316 full-port stainless-steel ball, UHMWPE seals, and weld ends.

B. Ball Valves, NPS 3 (DN 80) and Larger: MSS SP-72, Class 150, 3 piece, with ASTM A182 Type 316 stainless-steel body, ASTM A479 Type 316 stainless-steel ball, UHMWPE seals, and flanged or butt-welding ends.

C. Manufacturers:

1. Conbraco.
2. Foster Valve Co.
3. Jamesbury, Inc.
4. Marvin Ball Valves; a division of Richards Industries.
5. NIBCO INC.
6. Flowtek.
7. Flowserve.

2.5 CHECK VALVES

A. Manufacturer: Swagelok.

B. Description:

1. Material: 316 SS.
2. Size: See drawings.
3. Working Pressure: 150 psig minimum.
4. End Connections: FNPT.

2.6 FLEXIBLE CONNECTORS

A. Manufacturer:

1. Swagelok.

B. Description:

1. Material: 304 SS braid with either 316L SS, PTFE, or PFA core.
2. Type: FT
3. Size: see drawings.
4. Working-Pressure Rating: 150 psig minimum.
5. End Connections: see Specialty Item List (60239831-LIST-004).

2.7 SINGLE- AND DOUBLE-WALL BELOW-GRADE EXTERIOR PIPING

A. HDPE

1. General

a. Pipe and fittings shall be provided by the manufacturer as a single-wall or double-wall piping system consisting of a product (inside or carrier) pipe and a containment (outer) pipe. Joining for both the product and containment pipes is by simultaneous thermal butt fusion.

b. System shall be manufactured and installed to provide the ability to incorporate low point leak detection.

c. The maximum operating pressure for the carrier pipe is 100 psig. The maximum design temperatures for these lines are 89 °F for the carrier pipe and 89 °F for the containment pipe.

d. Double-wall piping thermal expansion design shall be performed by the double-wall system designer to ensure that the primary containment is not overstressed.

2. Carrier and Containment Pipe

a. High density polyethylene (HDPE) extra-high molecular weight (EHMW) PE3408 pipe conforming to ASTM D 3350 with minimum cell classification values of 345464C and hydrostatic design basis of 1,600 psi at 23 C when tested in accordance with ASTM D 2837.

b. The pipe shall contain no recycled compound except that generated in the manufacturer's own plant from resin of the same raw material. The pipe shall be homogeneous throughout and free of visible cracks, holes, voids, foreign inclusions, or other defects that may affect the wall integrity.

c. During extrusion production, the HDPE pipe shall be continuously marked with durable printing including the following information:

1) Nominal Size,
2) Dimension Ratio,
3) Manufacturer Name and Product Series,
4) Cell Class,
5) ASTM Basis,
6) Pipe Test Category,
7) Plant Identification,
8) Production Date, and
9) Resin Supplier Code.

d. Product and containment pipe diameters shall have IPS (Iron Pipe Size) OD (outside diameter) and shall meet ASTM D 3035. Wall thickness shall conform to dimension ratio DR 11, rated for 160 psi at 73°F. The containment (outer) wall of pipe may alternatively conform to DR 17, rated for 100 psi at 73 °F, when accomplished in accordance with manufacturer's direction; the carrier (inner) pipe shall conform to DR 11 only.

e. Product piping shall be supported and centered inside the containment piping at spacings per the Plastic Piping Institute standards and manufacturer's recommendations. Supports shall have openings to permit the flow of liquid between the carrier pipe and the containment pipe. POSITION OPENINGS PROPERLY DURING INSTALLATION. Fittings may alternatively have a DR 17 (100 psi rating at 73 °F.) containment (outer) wall element provided that it has a DR 11 carrier (inner) wall element (160 psi rating at 73 °F), where joints involving fusion of DR 11 to DR 17 containment walls are accomplished in accordance with manufacturer's direction.

f. Approved Manufacturer: ASAHI (Poly-Flo or Fluid-Lok), Performance Pipe or LANL-approved equal.

3. Fittings

a. HDPE molded fittings in accordance with ASTM D 3261. Fabricated fittings are only allowed when molded fittings are not available. Fabricated tees shall be provided with reinforced branch connections. Fittings shall be manufactured from the same resin type and cell classification as the pipe itself.

b. High density polyethylene (HDPE) extra high molecular weight (EHMW) PE3408 molded fittings conforming to ASTM D 3350 with minimum cell classification values of 345464C and hydrostatic design basis of 1,600 psi at 23 C when tested in accordance with ASTM D 2837.

c. Fittings shall contain no recycled compound except that generated in the manufacturer's own plant from resin of the same raw material. The fittings shall be homogeneous throughout and free of visible cracks, holes, voids, foreign inclusions, or other defects that may affect the wall integrity.

d. All molded and fabricated fittings shall meet the design operating pressure requirements of the system as specified and based on ASTM D 2837.

e. Fittings shall be manufactured to the same IPS OD, DR and pressure/temperature ratings as the pipe. Fittings may alternatively have a DR17 (100 psi rating at 73°F) containment (outer) wall element provided that it has a DR11 carrier (inner) wall element (160 psi rating at 73°F), where joints involving fusion of DR11-to-DR17 containment walls are accomplished in accordance with manufacturer's direction.

f. End termination fittings shall be used to seal the annular space between the carrier and containment pipes at both ends. This fitting will also provide the transition to single wall piping.

g. HDPE flange adapter with ASTM A 395, ASME B16.1, 150-lb, coated metal ductile iron backing ring.

PART 3 EXECUTION

3.1 SPECIAL INSTALLATION INSPECTION

A. Hold for Inspection: Piping systems intended to carry highly toxic contents shall be inspected and approved per the requirements of the IBC as referenced in Test and Special Inspections Plan (60239831-TPLN-001, Section 5.2.2).

B. All fluid categories (M, D, and Normal)

1. LANL will act for DOE to authorize/provide Owners Inspectors or Representatives (Owner Inspectors will be qualified by CM-CE).

2. For the purposes of this section, Subcontractor (constructor) is responsible for all tasks identified as examination, inspection, and testing. At LANLs discretion, LANL Inspectors may serve as both the Manufacturer/Fabricator Examiner and Owners Inspector.

3. Visual examination:

a. Perform in accordance with ASME B31.3, Section 344.2. Acceptance criteria are as stated in ASME B31.3, Section 341.3.2 and in Table 341.3.2 for Category Normal, M and D Fluid Service. Comply with ASME B31.3, Section 341.4 (Normal and D Fluid Service) and Section M341.4 (M Fluid Service) for the scope of visual examination for each fluid category.

b. For bonding of plastics, perform in accordance with ASME B31.3, Section A341.4.1. Acceptance criteria for bonds (plastics) are as stated in ASME B31.3, Section A341.3.2 and in Table A341.3.2.

4. Liquid penetrant examination: Perform in accordance with ASME B&PV Code, Section V, Article 6 and ASME B31.3 Section 344.4. See LANL's ESM Chapter 13, Volume 6.

5. It is permissible to omit leak testing of any existing joints and connections previously tested and with potential to spread contamination. Initial service leak test shall be performed for these connections in accordance with ESM Chapter 17, "Pressure Safety," Post Modification /Maintenance Test section (e.g., Section I, Paragraph 13.0C).

6. Pressure Testing:

a. Follow Section 22 0813, "Testing of Piping Systems."

C. Category M Fluid Service (in addition to the above Paragraph 3.1A)

1. Fabrication including threaded, bolted, and other mechanical joints shall be 100% visually examined.

2. Perform random radiography of welds selected by LANL (at least 20% of circumferential butt and miter welds and of fabricated lap and branch connection welds) in accordance with ASME B31.3, Section 344.5 or random ultrasonic examination in accordance with ASME B31.3, Section 344.6.

   It is acceptable to substitute in-process inspection for radiography on a weld for weld basis where facility constraints preclude radiography. Perform in-process examination of at least 20% of welded joints using personnel other than those performing the work. It shall be supplemented by appropriate NDE examination specified by the engineering design or by the inspector. For bonding of plastics, perform in process examination of at least 5% of all bonded joints and to ensure that the work of each bonder and bonding operator making the joints is examined. See LANL's ESM Chapter 17, Pressure Safety (e.g., Section I, Paragraph 13.0A7) for details.

3. Sensitive Leak Testing: Perform a helium leak test to fulfill the sensitive leak test requirement in ASME B31.3, Section 345.8. Perform helium leak test in accordance with ASTM E498 or ASTM E499 with the following test pressures and acceptable leak rates.

   a. Test Pressure: (the lesser of 15 psig or 25% of the design pressure) psig

   b. Maximum Leakage: (less than 10-3) cc/sec.

D. Normal Fluid Service (In addition to the above Paragraph 3.1A on all services)

1. Perform random radiography of welds selected by LANL (not less than 5% of butt and miter groove) in accordance with ASME B31.3, Section 344.5 or random ultrasonic examination in accordance with ASME B31.3, Section 344.6.

   It is acceptable to substitute in-process inspection for radiography where facility constraints preclude radiography. Perform in-process examination of at least 5% of welded joints using personnel other than those performing the work. For bonding of plastics, perform in-process examination of at least 5% of all bonded joints and to ensure that the work of each bonder and bonding operator making the joints is examined. See LANL's ESM Chapter 17, Pressure Safety (e.g., Section I, Paragraph 13.0A7) for details.

E. Category D Fluid Service (In addition to the above Paragraph 3.1A)

1. Perform random radiography of welds selected by LANL (not less than 5% of butt and miter groove) in accordance with ASME B31.3, Section 344.5 or random ultrasonic examination in accordance with ASME B31.3, Section 344.6.

2. It is acceptable to substitute in-process inspection for radiography where facility constraints preclude radiography. Perform in-process examination of at least 5% of welded joints using personnel other than those

performing the work. For bonding of plastics, perform in-process examination of at least 5% of all bonded joints and to ensure that the work of each bonder and bonding operator making the joints is examined. See LANL's ESM Chapter 17, Pressure Safety (e.g., Section I, Paragraph 13.0A7) for details.

F. Certification and Records

1. Certificates of conformance shall be examined. The examiner shall provide the inspector with a certification that all the quality control requirements of the code and of the engineering design have been carried out.

3.2 INSTALLATION

A. General and Stainless Steel

1. Comply with ASME B31.3 for fluid service categories identified in Paragraph 1.1A of this specification.
2. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls
3. Install piping to maintain headroom and neither interfere with use of space nor take more space than necessary.
4. Group piping whenever practical at common elevations.
5. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
6. Provide access where valves and other equipment are not exposed.
7. Install valves with stems upright or horizontal, not inverted.
8. Slope water piping and provide drain valves at low points.
9. Pressure test piping system in accordance with Section 22 0813, "Testing Piping Systems."
10. Label piping system in accordance with Section 22 0554, "Identification for Plumbing, HVAC, and Fire Piping and Equipment."
11. If required, insulate piping system in accordance with Section 22 0713, "Plumbing and HVAC Insulation."
12. Seismically brace piping in accordance with Section 22 0548, "Vibration and Seismic Controls for Plumbing, Piping and Equipment."
13. Support piping system in accordance with Section 22 0529, "Hangers and Support for Plumbing Piping and Equipment."
14. Sleeve and caulk pipes penetrating exterior walls or interior bearing walls. Provide waterproof installation for exterior walls. Provide UL/FM approved through-penetration firestop system when penetrating fire- rated barriers (i.e., walls, floors, etc.) in accordance with Section 07 8400, "Firestopping."
15. Design drawings show approximate type, location, and depth of underground utilities based on a Ground Penetrating Radar survey. Results of the survey are approximate findings due to uncertainty in the nature of the technology. Excavation of the underground trench should

proceed with caution to prevent damage to existing underground utilities. Consider "pot holing" existing utilities before excavation.

16. Piping and Tubing Systems: Fabricate, inspect, examine, and test in accordance with ASME B31.3 fluid service categories identified in Paragraph 1.1A of this specification. Piping systems include all piping components (including instruments), pipe clamps and supports, instrument mounting plates and their attachment to structural frame work.

17. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

18. Flanged Joints: Where a metallic flange is bolted to a nonmetallic flange, both shall be flat faced and a full face gasket shall be used. Bolting torque shall be limited so that the nonmetallic flange is not overloaded. Load spreading devices may be used on the non-metallic flanges.

19. Gaskets: No more than one gasket shall be used in contact faces in a flange joint. Homogeneous elastomer (EPDM, Neoprene, nitrile and SBR) gaskets should be used only with flat face flanges.

20. Bolt torque: Use only calibrated torque wrenches and multipliers. Consult with gasket manufacturer, flange and bolting materials for torque values. See Appendix E, Table 4 of ASME B31.3 Process Piping Guide for additional information.

21. Brazed and braze welded joints may be used in Normal fluid service, but shall not be used in Category M fluid Service.

22. Socket welds shall not be used on piping for Fluid Category Normal or M liquid systems with radioactive and/or corrosive materials.

23. Compression fittings shall not be used in the piping containing radioactive materials except for instrumentation, and shall be installed per Section 40 0511, "Compression Fittings on Copper and Stainless Tubing."

24. Nonmetallic valves and specialty components (traps, strainers and separators) shall not be used in Category M fluid service.

25. Plastics shall not be used in flammable fluid service above ground unless they are 1 inch NPS or smaller and meet the requirements in ASME B31.3, Section A323.4.2.a.1. Nonmetal piping shall be safeguarded per ASME B31.3 Appendix G when used in other than Category D fluid service in accordance with ASME B31.3, Section A323.4.2.

26. Piping alignment shall comply with ASME B31.3, Section 335.1. Flange bolt holes shall be aligned within 1/8 inch maximum offset.

27. Identification and/or traceability marks on/with piping components shall not be removed or hidden by surface treatment, coating, or subdividing during installation unless other identification methods are implemented to ensure that all markings are properly transferred and traceability documentation is maintained for the components. Installer must verify that items are correct for the installation and have legible identification markings.

B. HDPE Piping

1. All HDPE pipe joints shall be joined by thermal butt fusion per manufacturer's procedures and instructions. Extrusion welding or hot gas welding of HDPE is prohibited.
2. Installers shall be pre-qualified through sufficient training in butt fusion techniques according to ASTM F 2620, Section 8 (Procedure 2).
3. A data logger shall be used to record time, pressure, and temperature for all heat fusion welds made for HDPE pipe joints and fittings.
4. HDPE pipe shall interface with other piping systems and equipment by means of HDPE flange adapters and coated metal back-up rings.
5. Sections of pipe having been discovered with cuts or gouges in excess of 10% of the pipe wall thickness shall be cut out and removed. The undamaged portions of the pipe shall be rejoined using the heat fusion joining method.
6. Fabricate and install all piping shown on the construction drawings, according to ASME B31.3, manufacturer's recommended procedures, and this specification. The piping shall be field located as indicated on the piping plan. The piping may be offset, lowered, or raised as required to avoid existing interferences. Deviations from locations identified on the drawings shall be approved by LANL and documented for incorporation into as-built drawings.
7. All piping shall be erected to ensure proper draining capability. Localized low or high points without vents and drains shall not be accepted. Continuous slope shall be maintained on all gravity lines. If low points cannot be avoided on pressurized lines, a 1" ball valve with a threaded plug in the outlet shall be provided at the low point.
8. Flanges or unions for pipe 1 ½" or larger shall be provided at connections to all equipment. The connections shall be made without strain at the pipe connections.
9. Route pipe in an orderly manner, maintain gradient, and group pipes at common elevations whenever practical. Route pipe parallel and perpendicular to walls. Maintain headroom and neither interfere with use of space or take more space than necessary. Piping intended to be straight shall be straight. Deflections or deviations from a straight line or grade shall be approved by LANL and shall be accomplished by the use of approved fittings.
10. Do not install underground piping when the bedding is wet or frozen.
11. Verify that excavations are to the required grade and depth.
12. Trenching, backfill, and compaction for underground pipe shall be in accordance with Section 31 2000, "Earth Moving."
13. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Observe manufacturer's recommendations for installation of plastic pipe. Contractor is responsible for consulting with the manufacturer for thermal expansion design of the double contained piping system.

14. All piping shall be arranged so as not to interfere with the removal or maintenance of adjacent equipment, valves, or other devices. Piping shall not block access to manholes, access covers, etc.

15. Valves shall be installed at the locations shown on the construction drawings and placed to permit easy operation and access. Valves shall be installed upright where possible. All valves will be installed with their stems horizontal or above.

16. Sleeve and caulk pipes passing through partitions, walls, and floors. Seal openings around pipe in fire-rated walls or floors with UL-approved fire retardant mastic.

17. Label piping systems according to Section 22 0554, "Identification for Plumbing, HVAC, and Fire Piping Equipment."

18. Support piping systems according to Section 22 0529, "Hangers and Supports for Plumbing Piping and Equipment."

C. Provide non-conducting dielectric connections whenever joining dissimilar metals.

3.3 FABRICATION, ASSEMBLY, AND ERECTION

A. Welding

1. Shall be in accordance ASME B31.3 and the LANL Welding Manuals.

B. Bending. The following guidance is provided for bending:

1. Wall thinning in tubing shall not exceed:

a. 12% – Bend radius of 5 pipe diameters,
b. 22% – Bend radius of 3 pipe diameters, and
c. 37% – Bend radius of 1.5 pipe diameters.

2. Tube bending differs from pipe bending in that it is usually performed in the field with a manually operated bender.

a. Measure and mark exactly, then insert tube in bender.

b. Always attempt to bend in the same direction. If backbending, be sure to compensate for tubing stretch or pickup.

c. Clamp tubing securely in bender.

d. Check to make certain that the length mark is tangent to the desired angle on the radius block or in line with the desired degree on the link member.

e. Bend accurately to the desired angle plus springback allowance.

f. Remove tube and check bend angle and measurement length.

C. Assembly and Erection

1. For tolerances on fabrication, refer to the Pipe Fabrication Institute Standard ES-3, "Fabrication Tolerances" and ASME B31.3 Paragraph 335. Tolerances used shall be the most stringent found in the two standards.

2. Typical tolerances for erection (field installation) are the larger of 6 in. or D/2 for safety-related piping and 12 in. or D for non-safety-related piping, while maintaining code, design, and vendor alignment and slope

requirements. Tolerance must not affect the sequential location of components, and fittings.

3. The following general requirements apply to buried pipe:

   a. Permits from the New Mexico Environment Department and environmental impact reports will be obtained by LANL.

   b. Bedding material should be granular, well graded, and capable of being compacted flat.

   c. Backfill or fill material should contain no rocks and stones larger than 2 in. in the greatest dimension and should be free of frozen lumps, vegetable matter, trash, chunks, or highly plastic clay or other unsatisfactory matter.

   d. As an option, Controlled Low-Strength Material (CLSM or "flowable fill") may be substituted for bedding material, embedment material, or backfill material.

   e. Prior to excavation, the existing underground structures and/or utilities should be located.

   f. Where the trench bottom is unstable or contains unsuitable material, this material should be excavated to a minimum depth of 6 in. The excavated material should then be replaced with suitable material, or CLSM.

   g. Compaction and testing will be done as per 31 2000.

   h. The minimum depth of cover shall be 4 ft (top of pipe to finished grade).

   i. The minimum slope or grade indicated on design documents shall be maintained regardless of other installation tolerance.

   j. The use of vertical installation tolerance shall not increase unvented high points unless these are explicitly approved.

   k. Upon completion of installation, record the as-installed piping geometry to within the tolerance as shown below:

      1) Vertical plane = + 1 in.
      2) Horizontal plane = + 3 in.

D. Joints

1. Flanged joints shall be in accordance with ASME B31.3.

   a. Flanged connection makeup shall follow the design guide of the piping manufacturer. Special gaskets, installation methods and torque values may apply.

3.4 EXAMINATION AND INSPECTION

A. Receipt Inspection

1. For all components and bulk materials used in the fabrication of piping and tubing systems, verify the following characteristics as part of the receipt inspection.

   a. Verify the quantity received matches bill of materials.

b. Verify that the material or component received matches the ASTM/ASME designation or manufacturer model number specified in the bill of materials.

c. Verify that the material or component has not been damaged during shipment and handling. Visually inspect the material and components for scratches, dents, punctures, etc.

d. Verify material or component has been stamped with the appropriate ASTM designation if applicable.

B. "Examination" is not limited to welds. Records, materials, fabrication, erection pressure testing, as-built, must also be examined as specified by ASME B31.3 for fluid service categories identified in Paragraph 1.1A of this specification. Refer to the following table for a list of examination attributes and the extent of required examination.

Extent of Required Examination							
	Material	Fabrication	Fabrication of Longitudinal Welds	Mechanical Joints	Erection	Complete system Meets Design (2)	Other Examinations
Category D	Random	Random	Random	Random	Random	Random	Random (3)
Normal	Random	5%(5)	100%	Random(1)	Random	Random	5% Vol. (4)
Category M	Random	100%	100%	100%	Random	Random	20% Vol.
High Pressure	100%	100%	100%	100%	Random	Random	100% Rad.
Severe Cyclic	Random	100%	100%	100%	100%	Random	100% Vol.

Notes:
(1) When pneumatic testing is to be used, 100% of mechanical joints shall be examined.
(2) Includes any additional examination or testing required by engineering.
(3) Category D Systems require welds to be random visually examined.
(4) When brazed joints are used, 5% in-process examination is performed.
(5) Socket welds require 5% visual examination of final weld.
Note: Vol = Volumetric weld examination such as a radiograph or ultrasonic.
Rad = Radiography

C. Guidance of specific examinations other than welds is provided below.

D. This is not intended to be an all-inclusive list of items to be examined.

1. Material

a. At point of installation, materials and components are sufficiently identified by markings, tags, or documentation to ensure they are in accordance with the specified requirements and traceable to the required documentation.

2. Mechanical Joints

a. Threads in the bolts and nuts to be free from nicks, burrs, grit, chips, and dirt and well lubricated prior to makeup.

b. Bolts extend completely through their nuts.

c. Manufacturer's and designer's installation instructions for expansion joints has been followed, and all factory-installed shipping bars, brackets, or other locking devices are in place and remain in place until after piping system closures are complete.

d. Any damage to the gasket seating surface which would prevent gasket seating has been repaired, or the flange replaced.

e. The nuts have been tightened in a staggered criss-cross pattern and in increments of not more than 1/3 the total required torque.

f. No more than one gasket is used between contact faces in assembling a flanged joint.

g. Galvanized flanges must be refaced with the appropriate surface finish after galvanizing is complete.

h. Prior to bolt up, flange faces are aligned within 1/16 in./ft (0.5%) measured across any diameter and flange bolt holes are aligned within 1/8 in. maximum offset.

i. Sealing surfaces of the flare of flared tubing joints are examined for imperfections before assembly.

j. Where the manufacturer's instructions call for a specified number of turns of the nut, these shall be counted from the point at which the nut becomes finger tight.

k. Threaded components are examined before assembly for cleanliness and continuity of threads and for conformance of threads with applicable standards.

l. Compound or lubricant used on bolt threads is suitable for the service conditions and shall not react unfavorably with either the service fluid or the piping material.

3. Erection

a. Piping is not distorted to bring it into alignment for joint assembly.

b. Wedges are not being used to laterally contain or position pipe for closure fit-ups.

c. The amount and direction of cold spring (defined as the intentional deformation of piping during assembly to produce a desired initial displacement and stress) is in accordance with the design values.

d. Support locations, type, and restraint direction are as specified in the design drawing.

e. Pipe slope has been maintained in the direction specified by the slope arrow and/or work point elevation indicated on the design drawing.

f. Changes in piping elevation have not impacted slope requirements, high-point vents, or low-point drains.

g. Upon completion of installation the as-installed piping geometry has been recorded on the design documents. Typical tolerances for erection (field installation) are the larger of 6 in. or D/2 for safety-related piping or 12 in. or D/2 for non-safety-related piping, while maintaining code, design, and vendor alignment and slope requirements. Tolerance must not affect the sequential location of components and fittings, or the centerline lengths.

h. Valves and other components are oriented as shown in design documents or manufacturer's requirements.

i. There are no visible defects, missing or damaged parts in piping, components, or piping supports.

4. Complete System Meets Design

a. Examination of erected piping for evidence of defects that would require repair or replacement, and for other evident deviation from the intent of the design.

b. Any additional requirements supplementing ASME B31.3 as specified by the design.

c. Cleanliness of piping is in accordance with the requirements of the applicable standard or as specified by design (see section 3.5 below).

E. Examiners shall have training and experience commensurate with the needs of the specified examinations. The employer shall certify records of examiners employed, showing dates and results of personnel qualifications, and shall maintain them and make them available to the Inspector.

3.5 CLEANING

A. Subcontractor shall be responsible for the cleanliness integrity of the system. Pipe, tube, and components shall be free of dirt, paint, metal chips, filings, flux, slag, weld spatter, scale, rust, grease, oil, waxes, or other contaminants that are easily seen with the unaided eye.

B. The use of acids and cleaning agents may damage polymer components, such as gaskets, seals, flexible tubing, etc. Consult supplier for chemical resistance of the component before use. The use of mineral acids and organic acids to clean austenitic stainless steel and nickel alloys shall be approved prior to use.

C. Ensure safeguards are taken to protect personnel from hazards of cleaning, which may include but not be limited to flying particulates, corrosive chemicals, and harmful vapors.

D. Weld joint areas and welds shall be pre-cleaned and post-cleaned by wire brushing and scrubbing with a solvent-moistened clean cloth unless otherwise specified.

E. Water flushing shall not be performed for systems designed for pneumatic testing only. Clean water having less than 250 ppm chlorine content shall be used for stainless steel systems. Pockets and dead legs shall be thoroughly flushed, and drained and dried upon completion of flushing.

F. Breathing air systems or strong oxidizer fluid service (oxygen or fluorine) system cleaning shall be performed in accordance with CGA (Compressed Gas Association) pamphlet G-4.1, Cleaning Equipment for Oxygen service. A minimum cleanliness level of 175A per ASTM G93 is required. See ESM Chapter 17, Pressure Safety, Oxygen and Oxidizing Media Components Cleanliness Section (I.12.P) requirements for details.

G. For radiological systems, Cleaning Methods and Inspection Criteria shall be in accordance with NQA-1 Subpart II and ASTM A380 for stainless steel, and approved cleaning and flushing procedures. At a minimum, Class C cleanness is required for carbon and low alloy steels. Class B cleanness is required for corrosion resistant alloys (stainless steel, nickel-base or cobalt-base alloys). Subcontractor shall submit cleaning procedures for approval.

3.6 LINE COVER

A. Radioactive Liquid Waste Line Cover: Provide cover, bedding, warning tape, and tracer wire per trench details and below-grade piping details. Refer to Section 31 2000, "Earth Moving" and Section 22 0554, "Identification for Plumbing, HVAC, and Fire Piping Equipment."

B. Underground pipe and fittings shall be buried at a minimum depth of 4 ft as measured from the top of pipe.

END OF SECTION

SECTION 40 9100

PRIMARY PROCESS MEASUREMENT DEVICES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. This section includes the specification for development of the primary process measurement devices.

B. It is the intent of this section to procure, install, connect, program, and calibrate the selected measurement devices as shown in the system drawings. Some equipment controls are specified in other portions of the subcontract documents. It is the responsibility of the bidder to read and conform to all sections of this specification, review all subcontract drawings of all divisions, and coordinate with all equipment suppliers of material specified under other sections of this specification.

C. The installation supervision, start up, and checkout necessary for the primary process devices shall be provided under this section.

D. Provide the necessary materials and manpower to participate in the testing, adjusting, and balance and the commissioning process as required by those sections of this specification.

E. Primary Process Measurement Devices:

1. pH-Level Measurement Devices,
2. Conductivity Process Measurement Devices,
3. Gas Pressure Process Measurement Devices,
4. Liquid Pressure Process Measurement Devices,
5. Temperature Process Measurement Devices,
6. Weight Process Measurement Devices,
7. Flow Process Measurement Devices, and
8. Level Process Measurement Devices.

F. This specification concerns the following low-level waste process measurement devices detailed on the Data Sheets included as Attachment 1.

1.2 RELATED SECTIONS

A. Section 01 2500, "Substitution Procedures."

B. Section 01 4000, "Quality Requirements."

C. Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

D. Section 01 6000, "Product Requirements."

E. Section 01 8116, "Facility Environmental Requirements."

F. Section 13 4800, "Sound, Vibration, and Seismic Control."

1.3 ABBREVIATIONS AND ACRONYMS, DEFINITIONS, AND REFERENCES

A. Refer to Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

B. Drawings:

1. Drawing C55864, Sheet D-6010, "Influent Filter System Roughing Filters P&ID."
2. Drawing C55864, Sheet D-6011, "Reaction/Precipitation System Mixing Chamber P&ID."
3. Drawing C55864, Sheet D-6012, "Reaction/Precipitation System TK-1101 P&ID."
4. Drawing C55864, Sheet D-6013, "Reaction/Precipitation System TK-1102 P&ID."
5. Drawing C55864, Sheet D-6014, "Microfiltration System Microfilter P&ID."
6. Drawing C55864, Sheet D-6015, "Microfiltration System Clean-In-Place Skid P&ID."
7. Drawing C55864, Sheet D-6016, "Reverse Osmosis System TK-1301 P&ID."
8. Drawing C55864, Sheet D-6017, "Reverse Osmosis System P-1302 P&ID."
9. Drawing C55864, Sheet D-6018, "Reverse Osmosis System Reverse Osmosis Arrays P&ID."
10. Drawing C55864, Sheet D-6019, "Reverse Osmosis System TAC-4302 P&ID."
11. Drawing C55864, Sheet D-6020, "Reverse Osmosis System TK-1304 P&ID."
12. Drawing C55864, Sheet D-6021, "Polishing System Pump and FLT-1401 P&ID."
13. Drawing C55864, Sheet D-6022, "Polishing System FLT-1043 and FLT-1405 P&ID."
14. Drawing C55864, Sheet D-6023, "Solids Collection & Concentration System TK-1707 and Pump P&ID."
15. Drawing C55864, Sheet D-6024, "Solids Collection & Concentration System Rotary Filter P&ID."
16. Drawing C55864, Sheet D-6025, "Solids Collection & Concentration System TK-1702 and Pump P&ID."
17. Drawing C55864, Sheet D-6026, "Solids Collection & Concentration System TK-1704 and Pump P&ID."
18. Drawing C55864, Sheet D-6027, "Solids Collection & Concentration System TK-1703 and Pump P&ID."
19. Drawing C55864, Sheet D-6028, "De-Watering System TK-1705 and Pump P&ID."
20. Drawing C55864, Sheet D-6029, "De-Watering System EVAP-1701, EVAP-1702 P&ID."
21. Drawing C55864, Sheet D-6030, "De-Watering System TK-1706 and Pump P&ID."

22. Drawing C55867, Sheet D-6410, "Effluent Storage System TK-1501 P&ID."

23. Drawing C55867, Sheet D-6411, "Effluent Storage System TK-1502 P&ID."

24. Drawing C55867, Sheet D-6412, "Effluent Storage System Sample – pH Adjustment P&ID."

25. Drawing C55867, Sheet M-6400, "Air Flow Diagram and Sequence of Operations."

26. Drawing C55864, Sheet P-6001, "Process and Fire Water Drain P&ID."

27. Drawing C55864, Sheet P-6004, "Sewer System P&ID."

28. Drawing C55864, Sheet P-6006, "CAM and FAS P&ID."

29. Drawing C55864, Sheet P-6102, "Argon and P-10 Gas Supply P&ID."

30. Drawing C55865, Sheet P-6200, "Natural Gas P&ID."

31. Drawing C55865, Sheet P-6201, "Potable & Non-Potable Water P&ID."

32. Drawing C55865, Sheet P-6202, "Compressed Air P&ID."

1.4 SUBMITTALS

A. Provide the following in accordance with the requirements of Exhibit I and timeline specified.

1. Before Fabrication:

a. Documentation of International Organization for Standardization (ISO 9001) certification (if applicable).

b. Provide a copy of the Quality Assurance Plan identifying procurement, design, fabrication, test and inspection, material traceability, and nonconformity controls for approval by Los Alamos National Laboratory (LANL) prior to Subcontract award.

c. Catalog data sheets on instrumentation, which show performance characteristics, dimensions, material of fabrication, and other characteristics necessary to ensure conformity with the design requirements.

d. Provide leak test procedure.

e. Provide weld inspection procedure.

f. Provide functional test procedure.

g. American Society of Mechanical Engineers (ASME)-certified Weld Inspector Records.

h. Manufacturer's assembly drawings, wiring diagrams, and electrical schematics.

i. Support plan outlining product support for products in PART 2 of this section. Identify which products are available for 5 years or more. Identify if the parts are "off-the-shelf."

2. Before Shipment:

   a. Certificates of Conformance (COC) for all instrumentation, attesting that items are in accordance with specified requirements.

   b. Detailed installation instructions for instrumentation devices.

   c. Listing of configuration parameters.

   d. Loop diagrams for all instrumentation and hardwired interlocks (one instrument and related input/output per loop drawing).

   e. Functional test report for instrumentation devices per Paragraph 1.8C.

   f. Manufacturer's operating procedures, including safety and troubleshooting procedures, for instrumentation devices.

   g. Manufacturer's maintenance procedures, including service schedules, recommended spare parts, and warranties for instrumentation devices.

   h. Storage and handling procedure: long term storage, humidity trimming, temperature conditioning, shelf life limits.

   i. Listing of associated tag names with firmware version number.

3. With Shipment:

   a. Base material and weld filler material Certified Material Test Report (CMTR).

   b. Leak test report per Paragraph 1.8B.

   c. Weld inspection report per Paragraph 1.8A.

   d. Calibration certification traceable to the National Institute of Standards and Technology (NIST) for all instrumentation.

   e. Evidence of nationally recognized testing laboratory (NRTL) or Underwriters Laboratories, Inc. (UL) listing or labeling for all instrumentation.

   f. Miscellaneous hardware such as specialty cables, keys, configuration or calibration tools, handheld programming devices, converters, device drivers etc. necessary to utilize any of the supplied process control auxiliary devices and applicable resident software for its intended function.

   g. Each shipment container shall include a packing list of all items contained in that shipment container. Also, a copy of each packing list shall be sent to the LANL Subcontractor Technical Representative (STR).

1.5 QUALITY ASSURANCE

A. Seller's Quality Assurance Requirements:

1. Work Identified in this section shall be done under a Quality Assurance Program in accordance with Section 01 4000, "Quality Requirements."

B. Receipt Inspection:

1. Generally, all equipment and accessories installed under this subcontract shall be inspected and tested by the Subcontractor in the presence of the LANL Startup and Commissioning Representative and approved before acceptance. The Subcontractor shall furnish all labor, material, and equipment required for testing. The Subcontractor shall be responsible for all repairs and retesting as required.

2. Upon receipt, the instruments will be visually inspected by a qualified Subcontractor Quality Control Inspector for any damage or abnormalities that could affect their performance in accordance with the Quality Assurance Program.

3. Documentation will be reviewed by a qualified Subcontractor Quality Control Inspector to determine that the required documentation as specified in Paragraph 1.4 is present and traceable to the instruments.

C. Calibration and Material Certifications:

1. Instruments to be calibrated by manufacturer. Calibration shall be traceable to NIST standards.

2. Calibration documentation is to be included with the instruments at time of delivery.

3. Material certification for all process-wetted materials to be included with the instrument at time of delivery.

D. Storage and Handling:

1. In addition to the requirements in Section 01 6000, "Product Requirements," comply with the following requirements:

   a. Vendor shall comply with Section 01 4000, "Quality Requirements." The supplied equipment specified in this document shall be considered Level B for the shipping, handling, and storage requirements listed below.

   b. Vendor shall prepare, pack, handle, load, ship, and store all materials and equipment for shipment in accordance with Section 01 4000, "Quality Requirements."

   c. Vendor shall be responsible for any damage resulting from improper packing until acceptance. Subcontractor shall inspect all materials upon receipt.

   d. Each shipment container shall include a packing list of all items contained in that shipment container. Also, a copy of each packing list shall be sent to the LANL Subcontractor Technical Representative (STR).

   e. Vendor shall be responsible for providing any special devices needed for the delivery of any equipment and/or material.

   f. Vendor shall define any heating, air conditioning, humidity control, or other storage criteria for equipment that is to be installed for regular use or is intended to be used as spare.

g. Vendor shall define long-term storage limits and maintenance procedures that are required to ensure these limits.

h. Vendor shall define shelf-life limits of all supplied equipment.

i. All openings shall be capped, plugged, or otherwise sealed against the intrusion or water, dirt, and debris. Water shall be removed from cavities to protect against damage caused by freezing and desiccant inserted, if appropriate.

E. Personnel Qualification:

1. Personnel installing instrumentation devices shall be familiar with type of instrument, and required installation practices. Refer to vendor's Quality Assurance Plan for additional requirements for installation personnel.

2. Nondestructive examination of welds (where welding is used) shall be conducted by a Weld Inspector qualified in accordance with *ASME Boiler and Pressure Vessel Code* (B&PV) (Section IX, "Welding and Brazing Qualifications").

F. Nonconformance:

1. Nonconformance of an instrument shall be documented and corrected before shipment. If found on receipt, nonconformance shall be documented and corrected before installation at the expense of the subcontractor in accordance with Section 01 4000, "Quality Requirements."

G. Electrical Suitability:

1. All process control auxiliary devices shall be UL- or NRTL-listed or labeled.

1.6 ENVIRONMENTAL REQUIREMENTS

A. Design the process components to operate at a design altitude of 7,500 ft above sea level and in the general environmental conditions specified in Section 01 8116, "Facility Environmental Requirements." Seismic requirements are located in Section 13 4800, "Sound, Vibration, and Seismic Control."

B. For compatibility issues, additional component specific process conditions are listed on the data sheets and can include process streams with H_2SO_4, NaOH, $Fe_2(SO4)_3$, $MgSO_4$, alpha, and tritium.

1.7 RECORDS

A. Furnish complete spare parts lists, operating instructions, and maintenance literature.

B. Provide record drawings as required by the general subcontract requirements.

C. Supply instrumentation device software and configuration management type tools as applicable:

1. Verified listing of parameter values for each device required to comply with individual device datasheets.

2. Licensed copies of all specialty software needed for controlled configuration.

D. Supply calibrations records for each tagged instrument.

1.8 TESTING

A. Nondestructive Examination:

1. Examine all welds on measurement devices in accordance with ASME B31.3 (Chapter VIII, Part 10, "Inspection, Examination, and Testing Requirements"). Instrument datasheets indicate the fluid service. Submit results of the examination per Paragraph 1.4A.3.c.

B. Leak Test:

1. Perform leak test on all devices in accordance with ASME B31.3 (Chapter VIII, Part 10). Instrument datasheets indicate the fluid service. Submit results of the leak test per Paragraph 1.4A.3.b.

C. Pre-Functional Test:

1. Use a 4-20-mA signal generator and verify that each instrument is calibrated to the engineering span documented in the datasheets included with this section. Submit results of the Pre-Functional Test per Paragraph 1.4A.2.e.

1.9 TRAINING

A. Provide 20 hours of training to cover all general aspects of instrumentation installation, wiring, calibration techniques, programming, configuration management of devices, and parameter entry.

B. Provide 200 hours startup support to LANL startup and commissioning personnel. Support functions to include troubleshooting, point verification, performance trending, and sequence of operation verification.

C. Provide 40 hours of onsite training during the warranty period. The Subcontractor shall provide this training at the request of LANL.

1.10 SERVICE AND WARRANTY

A. For all instrumentation devices provide one-year warranty including travel costs.

B. If the manufacturer has a standard warranty that exceeds one year then the longer warranty shall be provided.

PART 2 PRODUCTS

2.1 PRODUCT OPTIONS AND SUBSTITUTIONS

A. Refer to Section 01 2500, "Substitution Procedures."

2.2 PRIMARY PROCESS MEASUREMENT DEVICES

A. Chemical Properties Process Measurement Devices

1. pH-Level Measurement Devices:

a. Measuring Element – Pt1000 platinum resistor;
b. Wetted Material – Ryton R4 body, glass element;
c. Power Requirements – Loop powered;
d. Output – HART 4 to 20 mA;
e. Transmitter Manufacturer – Yokogawa, Model FLXA21 Series; and

f. Probe Manufacturer – Yokogawa, Model FU20 Series.

B. Electromagnetic Process Measurement Devices

1. Conductivity Process Measurement Devices:

a. Measuring Element – 316 stainless steel;
b. Wetted Material – PVC body, Victrex PEEK element;
c. Power Requirements – Loop powered;
d. Output – HART 4 to 20 mA;
e. Transmitter Manufacturer – Yokogawa, Model FLXA21 Series; and
f. Probe Manufacturer – Yokogawa, Model ISC40G Series.

2. Gas Pressure Process Measurement Devices:

a. Wetted Material – Hastelloy C276;
b. Power Requirements – Loop powered;
c. Accuracy – ± 0.2 percent;
d. Range – 0 to 200 kPa gauge;
e. Output – HART 4 to 20 mA; and
f. Manufacturer – Yokogawa, Model EJA530A Series.

3. Leak Detection Devices:

a. Manufacturer – RAYCHEM TRACE TEK, Model TT-MINI-PROBE / TTC-1 Alarm Module.

4. Leak Detection Devices for Pipe-in-Pipe:

a. Sensor – Liquidwatch Water Probe Assembly PWS-LW;

b. Monitor – LiquidWatch® Leak Detection System; and

c. Recommended Manufacturer – Asahi.

5. Liquid Pressure Process Measurement Devices Type I:

a. Wetted Material – Hastelloy C276;
b. Power Requirements – Loop powered;
c. Accuracy – ± 0.2 percent;
d. Range – 0 to 200 kPa gauge;
e. Output – HART 4 to 20 mA; and
f. Manufacturer – Yokogawa, Model EJA530A Series.

6. Liquid Pressure Process Measurement Devices Type II:

a. Wetted Material – 316L Stainless Steel;
b. Process Connection – Cl 150-lb flange/diaphragm seal;
c. Power Requirements – None;
d. Accuracy – ±0.5% Span;
e. Range – 15 to 1,500 psi;
f. Output – None;
g. Gauge Manufacturer – Ashcroft Type 1279; and
h. Seal Manufacturer – Ashcroft Series 102.

7. Liquid Pressure Switches:

a. Wetted Material – Brass Body with Buna-N seal;
b. Accuracy – ± 0.2 percent;
c. Range – 0 to 200 kPa gauge;
d. Output – Dry Contact 1 ampere, 24V dc; and

e. Manufacturer – Ashcroft, APA Series.

8. Temperature Process Measurement Devices:

a. Measuring Element – Pt100 resistance temperature detector (RTD);
b. Wetted Material – 316 stainless-steel thermal well;
c. Process Connection – Tapered thermal well, threaded, 1/2-in. national pipe thread (NPT);
d. Power Requirements – Loop powered;
e. Accuracy – ± 0.2 percent;
f. Range – -328 to 932 °F;
g. Output – None; and
h. Element/Thermowell Assembly Manufacturer – Wika, Model TR10.

9. Temperature Room Measurement Devices:

a. Measuring Element – Pt100 resistance temperature detector (RTD);
b. Power Requirements – Loop powered;
c. Accuracy – ± 0.05 percent of the measuring span;
d. Range – -328 to 1562 °F;
e. Output – None; and
f. Recommended Manufacturer – Wika.

C. Miscellaneous Properties Process Measurement Devices

1. Flow Process Measurement Devices for Process or Corrosive Fluid:

a. Measuring Element – Electrode;
b. Wetted Material – PFA, Hastelloy C276;
c. Process Connection – In-line flange;
d. Power Requirements – Loop powered;
e. Accuracy – ± 0.35 percent;
f. Range – 0 to 100 gpm;
g. Output – HART 4 to 20 mA; and
h. Transmitter Manufacturer – Yokogawa, Model: AXF Series.

2. Flow Process Measurement Devices for Water and Natural Gas:

a. Measuring Element – Vortex Shedder;
b. Wetted Material – 316 stainless-steel tube, Duplex Stainless Steel shedder bar;
c. Power Requirements – Loop powered;
d. Accuracy – ± 0.075 percent;
e. Output – HART 4 to 20 mA; and
f. Transmitter Manufacturer – Yokogawa, Model DY Series.

3. Flow Process Measurement Devices for Air:

a. Measuring Element – Rotometer;
b. Process Connection – 3/8-in. inner NPT;
c. Float Material – PVDF;
d. Range – 0 to 6,300 l/h; and
e. Manufacturer – Yokogawa, Model: RAGK.

4. Level Process Measurement Devices Type I:

a. Measuring Element – Radar horn antenna;
b. Wetted Material – Hastelloy C22;

c. Power Requirements – Loop powered;
d. Process Connection – ASME Class 150-lb raised-face flange;
e. Accuracy – ± 20mm;
f. Range – 0 to 30 m;
g. Output – HART 4 to 20 mA; and
h. Transmitter Manufacturer – Ohmart-Vega, Model Vegapuls 66.

5. Level Process Measurement Devices Type II:

a. Measuring Element – Pressure tap;
b. Wetted Material – Hastelloy C276;
c. Power Requirements – Loop powered;
d. Process Connection – ASME Class 150-lb flange;
e. Accuracy – 0.2 percent span;
f. Range – See Attachment 1;
g. Output – HART 4 to 20 mA; and
h. Transmitter Manufacturer – Yokogawa, Series EJA118.

PART 3 EXECUTION

3.1 GENERAL

A. Provide the control devices as specified in PART 2 of this section; and all field hardware, conduit, wiring etc., for a complete installation..

B. Install all aspects of the system in compliance with all applicable codes, regulations, and all related Subcontract documents.

C. Install all materials in accordance with the published manufacturer's recommendations without exception.

D. Where miscellaneous materials are required to complete an installation (isolation valves for pressure sensors, etc.), supply the materials as defined in the relevant section of this specification. Install them under this section of this specification, unless otherwise noted.

E. Coordinate with other trades where installation of a particular component requires other trades to be involved. Installation coordination includes the correct placement of thermowells, flow switches, dampers, control valves, control power circuits, etc. Care shall be exercised to identify locations that meet the requirements of the manufacture including upstream and downstream distances, pressures, temperatures, etc.

F. All signal wiring requiring shielding shall have the shield terminated at the controller end only. Trim and insulate the shield wire at the device end.

G. Label all wiring with permanent labels indicating the point device identifier. Install a phenolic label mounted at the device indicating the device type and point identifier name.

H. Label all field devices with 1-in. by 3-in. phenolic labels. Labels shall include the point name and device name. Labels shall be glued, attached with screws, or stainless wire in the case of valves.

3.2 PRIMARY PROCESS MEASUREMENT DEVICES

A. Ensure all process connections for measurement devices are helium leak tight.

B. Instruments with an electrical input or output shall be UL- or NRTL-listed or labeled.

C. Install instruments in accordance with manufacturer's installation instructions and facility requirements providing all of the required gaskets, flanges, thermal compounds, insulation, piping, fittings, and manual valves for shutoff, equalization, purging, and calibration. Replace or repair any damaged insulation after devices are installed to match existing work and repair any damaged galvanized surfaces with zinc paint. In applications where sensors cannot be directly mounted to the tank by a threaded or flanged connection, provide a mounting bracket for connection to the inside tank wall.

D. Instruments with an NPT connection shall be installed per manufacturer requirements. Minimum basic requirements include: verifying that threads are clean, torque "snug-tight" using a thread locking compound. Do not over tighten the instrument or use the instrument housing for tightening purposes.

E. Chemical Properties Process Measurement Devices

1. pH-Level Measurement Devices:

a. Locate the sensor connection in a threaded tee or fitting to allow the sensor to be completely immersed in the fluid being monitored and allow for removal of the sensor for replacement. Locate and mount the transmitter remote from the sensor with any digital readout positioned for easy viewing.

F. Electromagnetic Process Measurement Devices

1. Conductivity Process Measurement Devices:

a. Install conductivity probes vertically and in accordance with the manufacturer's instructions with any indicators and transmitters accessible for maintenance and calibration. Locate the sensor connection in a threaded tee or fitting to allow the sensor to be completely immersed in the fluid being monitored and allow for removal of the sensor for replacement. Locate and mount the transmitter remote from the sensor with any digital readout positioned for easy viewing.

G. Physical Properties Process Measurement Devices

1. Pressure Process Measurement Devices

a. General:

1) Incorporate appropriate snubbers in all pressure taps. Include valves for isolation, venting, and taps for calibration. For pressure transducers, differential pressure sensors and switches, install nulling valves.

2) Install drains for pressure sensors and switches installed on liquid or stream lines.

b. Pressure Sensor Devices:

1) Verify pressure sensors and pressure transducers by calibration.

c. Pressure Switch Devices:

1) Adjust pressure switches to the proper setpoint and verify by calibration.

2) Select switch contact ratings and duty for the application.

2. Temperature Process Measurement Devices

a. Installation:

1) Install temperature sensors, switches, and RTDs in thermowells when the device is installed in a pipe, in a liquid system, or when susceptible to corrosion or vibration. Install assemblies so they are readily accessible and allow for easy replacement.

b. Thermowells:

1) Fill thermowells with conductive heat transfer fluid recommended by supplier prior to installation.

3. Weight Process Measurement Devices

a. Install weight sensors in accordance with the manufacturer's instructions with any indicators and transmitters accessible for maintenance and calibration. Verify weight sensors by calibration.

H. Miscellaneous Properties Process Measurement Devices

1. Flow Process Measurement Devices

a. General Installation:

1) Install flow sensors with 10.0 pipe diameter of minimum straight unobstructed piping upstream and 5.0 pipe diameters downstream. Install meters for gases and vapors in vertical piping and meters for liquids in horizontal piping, unless otherwise recommended by the manufacturer or indicated in this specification. Locate the sensor connection in a threaded tee or fitting to allow for removal of the sensor for replacement. The sensor is to be completely immersed in the fluid being monitored. Locate and mount the transmitter remote from the sensor with any digital readout positioned for easy viewing.

b. Magnetic Flowmeter:

1) Install meter in vertical piping so that the flow tube remains full of process fluid under all operating conditions. Provide a minimum of 5.0 pipe diameters straight run upstream and 2.0 pipe diameters straight run downstream.

c. Vortex Shedding Flowmeters:

1) Install vortex shedding flowmeters with the top above the pipeline in horizontal pipe run installations and with the direction of the flow upward in vertical pipe run installations. Align the flowmeter to the direction of the flow and mount it rigidly and vibration free. Install the sensors with 10.0 pipe diameter of minimum straight unobstructed piping upstream and 5.0 pipe diameters downstream.

2. Level Process Measurement Devices

a. Liquid Level Sensors:

1) Locate the sensing probe close to and parallel with the tank or sump wall. Locate the sensor connection in a threaded tee or fitting to allow to sensor to be positioned for the fluid being monitored and to allow for removal of the sensor for replacement. Locate and mount the transmitter remote from the sensor with any digital readout positioned for easy viewing.

b. Ultrasonic Level Sensors:

1) Install the sensor vertically in the top of the tank, in accordance with the manufacturer's instructions with access for maintenance and calibration. Position the sensor to maximize the return echo and minimize the vessel obstructions in the sensor's line of sight. Maintain the minimum recommended distance from the tank fill operations and the side of the tank.

c. Liquid Level Switch:

1) Install liquid level switches in accordance with the manufacturer's instructions. Locate the switch for maintenance and calibration. In applications where switches cannot be directly mounted to the tank by a threaded or flanged connection, provide a mounting bracket for connection to the inside tank wall.

d. Enclosures:

1) Penetrate all enclosures from the bottom and seal using a silicone rubber sealant to preclude entry of water.

3.3 FIELD TESTING AND ADJUSTING EQUIPMENT

A. Testing: The Subcontractor shall provide personnel, equipment, instrumentation, and supplies necessary to perform site testing. LANL will witness the testing, and written permission shall be obtained from LANL before proceeding with testing.

B. Data: Original copies of data produced, including the results of each test procedure, shall be turned over to LANL at the conclusion of each phase of testing prior to LANL approval of the test.

C. Test Procedures: The test procedures shall cover actual equipment and functions specified for the project.

PART 4 ATTACHMENT 1 DATA SHEETS

Component EIN	Component Name	Class	Drawing / Sheet No.	Data Sheet
LLW-AIT-1100	TK-1101 pH Level Indicating Transmitter	NS	C55864 / D-6012	AIT-1100
LLW-AIT-1125	TK-1101 Discharge pH Level Indicating Transmitter	NS	C55864 / D-6012	AIT-1125
LLW-AIT-1301	TK-1301 Outlet pH Level Indicating Transmitter	NS	C55864 / D-6016	AIT-1301
LLW-AIT-1302	TK-1301 Feed pH Level Indicating Transmitter	NS	C55864 / D-6016	AIT-1302
LLW-AIT-1345	TK-1304 Inlet pH Level Indicating Transmitter	NS	C55864 / D-6020	AIT-1345
LLW-AIT-1346	TK-1304 Outlet pH Level Indicating Transmitter	NS	C55864 / D-6020	AIT-1346
LLW-AIT-1509	TK-1501 pH Level Indicating Transmitter	NS	C55867 / D-6410	AIT-1509
LLW-AIT-1529	TK-1502 pH Level Indicating Transmitter	NS	C55867 / D-6411	AIT-1529
LLW-CIT-1301	TK-1301 Conductivity Indicating Transmitter	NS	C55864 / D-6016	CIT-1301
LLW-CIT-1343	TK-1304 Conductivity Indicating Transmitter	NS	C55864 / D-6020	CIT-1343
LLW-CIT-1527	LLW Effluent Conductivity Indicating Transmitter	NS	C55867 / D-6412	CIT-1527
FAC-FI-5010	CAM Exhaust Flow Indicator	NS	C55864 / P-6006	FI-5010
FAC-FI-5011	CAM Exhaust Flow Indicator	NS	C55864 / P-6006	FI-5011
FAC-FI-5012	CAM Exhaust Flow Indicator	NS	C55864 / P-6006	FI-5012
FAC-FI-5013	CAM Exhaust Flow Indicator	NS	C55864 / P-6006	FI-5013
FAC-FI-5014	CAM Exhaust Flow Indicator	NS	C55864 / P-6006	FI-5014
FAC-FI-5015	CAM Exhaust Flow Indicator	NS	C55864 / P-6006	FI-5015
FAC-FI-5016	CAM Exhaust Flow Indicator	NS	C55864 / P-6006	FI-5016
FAC-FI-5017	CAM Exhaust Flow Indicator	NS	C55864 / P-6006	FI-5017
FAC-FI-5018	CAM Exhaust Flow Indicator	NS	C55864 / P-6006	FI-5018
FAC-FI-5019	CAM Exhaust Flow Indicator	NS	C55864 / P-6006	FI-5019
FAC-FI-5020	FAS Flow Indicator	NS	C55864 / P-6006	FI-5020
FAC-FI-5021	FAS Flow Indicator	NS	C55864 / P-6006	FI-5021
FAC-FI-5022	FAS Flow Indicator	NS	C55864 / P-6006	FI-5022
FAC-FI-5023	FAS Flow Indicator	NS	C55864 / P-6006	FI-5023
FAC-FI-5024	FAS Flow Indicator	NS	C55864 / P-6006	FI-5024
FAC-FI-5025	FAS Flow Indicator	NS	C55864 / P-6006	FI-5025
FAC-FI-5026	FAS Flow Indicator	NS	C55864 / P-6006	FI-5026
FAC-FI-5027	FAS Flow Indicator	NS	C55864 / P-6006	FI-5027
FAC-FI-5028	FAS Flow Indicator	NS	C55864 / P-6006	FI-5028
FAC-FI-5029	FAS Flow Indicator	NS	C55864 / P-6006	FI-5029
FAC-FI-5030	FAS Flow Indicator	NS	C55864 / P-6006	FI-5030
FAC-FI-5031	FAS Flow Indicator	NS	C55864 / P-6006	FI-5031
FAC-FI-5032	FAS Flow Indicator	NS	C55864 / P-6006	FI-5032
FAC-FI-5033	FAS Flow Indicator	NS	C55864 / P-6006	FI-5033
FAC-FI-5034	FAS Flow Indicator	NS	C55864 / P-6006	FI-5034
FAC-FI-5035	FAS Flow Indicator	NS	C55864 / P-6006	FI-5035
FAC-FI-5036	FAS Flow Indicator	NS	C55864 / P-6006	FI-5036
FAC-FI-5037	FAS Flow Indicator	NS	C55864 / P-6006	FI-5037
FAC-FI-5038	FAS Flow Indicator	NS	C55864 / P-6006	FI-5038

Component EIN	Component Name	Class	Drawing / Sheet No.	Data Sheet
FAC-FI-5039	FAS Flow Indicator	NS	C55864 / P-6006	FI-5039
LLW-FIT-1102	LLW Waste Inlet Feed Flow Indicating Transmitter	NS	C55864 / D-6010	FIT-1102
LLW-FIT-1311	RO Feed Recycle Flow Indicating Transmitter	NS	C55864 / D-6017	FIT-1311
LLW-FIT-1315	RO Inlet Feed Flow Indicating Transmitter	NS	C55864 / D-6017	FIT-1315
LLW-FIT-1352	RO Permeate Feed Flow Indicating Transmitter	NS	C55864 / D-6018	FIT-1352
LLW-FIT-1403	RO Permeate Recycle Flow Indicating Transmitter	NS	C55864 / D-6021	FIT-1403
LLW-FIT-1405	Ion Exchange Feed Flow Indicating Transmitter	NS	C55864 / D-6021	FIT-1405
LLW-FIT-1515	Treated Effluent Flow Transmitter	NS	C55867 / D-6412	FIT-1515
LLW-FIT-1700	Evaporator Condensate Recycle Flow Indicating Transmitter	NS	C55864 / D-6030	FIT-1700
LLW-FIT-1701	Evaporator Condensate Recirc. Flow Indicating Transmitter	NS	C55864 / D-6030	FIT-1701
LLW-FIT-1705	P-1701 Outlet Flow Indicating Transmitter	NS	C55864 / D-6024	FIT-1705
LLW-FIT-1707	Rotary Press Filtrate Recirc. Flow Indicating Transmitter	NS	C55864 / D-6023	FIT-1707
LLW-FIT-1708	Rotary Press Filtrate Recycle Flow Indicating Transmitter	NS	C55864 / D-6023	FIT-1708
LLW-FIT-1711	Sludge Thickening Flow Indicating Transmitter	NS	C55864 / D-6025	FIT-1711
LLW-FIT-1719	P-1703 Thickener Decant Recirc. Flow Indicating Transmitter	NS	C55864 / D-6027	FIT-1719
LLW-FIT-1721	P-1703 Thickener Decant Recycle Flow Indicating Transmitter	NS	C55864 / D-6027	FIT-1721
PWC-FIT-5600	Potable Water Flow Indicating Transmitter	NS	C55865 / P-6201	FIT-5600
NG-FIT-5811	Natural Gas Flow Indicating Transmitter	NS	C55865 / P-6200	FIT-5811
CS-FSL-4003	P-4003 (Sodium Hydroxide) Flow Switch Low	NS	C55864 / D-6012	FSL-4003
CS-FSL-4006	P-4006 (Sodium Hydroxide) Flow Switch Low	NS	C55864 / D-6016	FSL-4006
CS-FSL-4007	P-4007 (Sulfuric Acid) Flow Switch Low	NS	C55864 / D-6016	FSL-4007
CS-FSL-4010	P-4010 (Sodium Hydroxide) Flow Switch Low	NS	C55864 / D-6020	FSL-4010
CS-FSL-4011	P-4011 (Sulfuric Acid) Flow Switch Low	NS	C55864 / D-6020	FSL-4011
CS-FSL-4012	P-4012 (Sulfuric Acid) Flow Switch Low	NS	C55867 / D-6412	FSL-4012
CS-FSL-4013	P-4013 (Sodium Hydroxide) Flow Switch Low	NS	C55867 / D-6412	FSL-4013
LLW-LIT-1123	TK-1101 Level Indicating Transmitter	NS	C55864 / D-6012	LIT-1123
LLW-LIT-1124	TK-1102 Level Indicating Transmitter	NS	C55864 / D-6013	LIT-1124
LLW-LIT-1302	TK-1301 Level Indicating Transmitter	NS	C55864 / D-6016	LIT-1302
LLW-LIT-1344	TK-1304 Level Indicating Transmitter	NS	C55864 / D-6020	LIT-1344
LLW-LIT-1511	TK-1501 Level Indicating Transmitter	NS	C55867 / D-6410	LIT-1511
LLW-LIT-1537	TK-1502 Level Indicating Transmitter	NS	C55867 / D-6411	LIT-1537
LLW-LIT-1700	TK-1706 Level Indicating Transmitter	NS	C55864 / D-6030	LIT-1700
LLW-LIT-1710	TK-1707 Level Indicating Transmitter	NS	C55864 / D-6023	LIT-1710
LLW-LIT-1716	TK-1702 Level Indicating Transmitter	SS	C55864 / D-6025	LIT-1716
LLW-LIT-1722	TK-1705 Level Indicating Transmitter	NS	C55864 / D-6028	LIT-1722
LLW-LIT-1723	TK-1703 Level Indicating Transmitter	NS	C55864 / D-6027	LIT-1723
LLW-LSH-5701	Process Area Sump Level Switch High	NS	C55864 / P-6001	LSH-5701

Component EIN	Component Name	Class	Drawing / Sheet No.	Data Sheet
LLW-LSH-5704	Corridor Fire Water Sump Level Switch High	NS	C55864 / P-6001	LSH-5704
LLW-LSH-5705	Wet Lab Sump Level Switch High	NS	C55864 / P-6001	LSH-5705
LLW-LSH-5706	Effluent Storage Containment Level Switch High	NS	C55867 / D-6410	LSH-5706
LLW-LI-5707 LLW-LSH-5707 LLW-LSH-5708	PIP Leak Detection Monitor LLW to Effluent Sampling, PIP Leak Detection, Fire Water to Effluent Sampling, PIP Leak Detection	NS	C55867 / D-6410	LI-5707 LSH-5707 LSH-5708
LLW-LSH-5710	Wet Lab Utility Trench Level Switch High	NS	C55864 / P-6001	LSH-5710
CA-PI-1108	CA to FLT-1101 Pressure Gauge	NS	C55864 / D-6010	PI-1108
CA-PI-1311	CA to ROU-1301 Pressure Gauge	NS	C55864 / D-6018	PI-1311
LLW-PI-1317	ROU-1301 Concentrate Pressure Gauge	NS	C55864 / D-6018	PI-1317
CA-PI-1438	CA to P-1701 Pressure Gauge	NS	C55864 / D-6012	PI-1438
LLW-PI-1401	P-1407 Skid Inlet Pressure Gauge	NS	C55864 / D-6021	PI-1401
LLW-PI-1718	P-1703 Inlet Pressure Gauge	NS	C55864 / D-6027	PI-1718
LLW-PI-1724	P-1705 Inlet Pressure Gauge	NS	C55864 / D-6028	PI-1724
LLW-PI-1757	P-1707 Inlet Pressure Gauge	NS	C55864 / D-6023	PI-1757
LLW-PI-1758	P-1707 Discharge Pressure Gauge	NS	C55864 / D-6023	PI-1758
LLW-PIT-1104	FLT-1101 Inlet Pressure Indicating Transmitter	NS	C55864 / D-6010	PIT-1104
LLW-PIT-1106	FLT-1101 Outlet Pressure Indicating Transmitter	NS	C55864 / D-6010	PIT-1106
LLW-PIT-1211	MF Inlet Pressure Indicating Transmitter	NS	C55864 / D-6014	PIT-1211
LLW-PIT-1218	MF Outlet Pressure Indicating Transmitter	NS	C55864 / D-6014	PIT-1218
LLW-PIT-1309	P-1302 Skid Inlet Pressure Indicating Transmitter	NS	C55864 / D-6017	PIT-1309
LLW-PIT-1313	P-1302 Skid Discharge Pressure Indicating Transmitter	NS	C55864 / D-6017	PIT-1313
LLW-PIT-1316	RO Inlet Pressure Indicating Transmitter	NS	C55864 / D-6017	PIT-1316
LLW-PIT-1337	RO Permeate Tank Inlet Pressure Indicating Transmitter	NS	C55864 / D-6020	PIT-1337
LLW-PIT-1402	P-1407 Discharge Pressure Indicating Transmitter	NS	C55864 / D-6021	PIT-1402
LLW-PIT-1406	P-1408 Discharge Pressure Indicating Transmitter	NS	C55864 / D-6021	PIT-1406
LLW-PIT-1410	FLT-1401, FLT-1402 Inlet Pressure Indicating Transmitter	NS	C55864 / D-6021	PIT-1410
LLW-PIT-1411	FLT-1401, FLT-1402 Outlet Pressure Indicating Transmitter	NS	C55864 / D-6021	PIT-1411
LLW-PIT-1422	FLT-1403, FLT-1404 Inlet Pressure Indicating Transmitter	NS	C55864 / D-6022	PIT-1422
LLW-PIT-1423	FLT-1403, FLT-1404 Outlet Pressure Indicating Transmitter	NS	C55864 / D-6022	PIT-1423
LLW-PIT-1437	FLT-1405, FLT-1406 Outlet Pressure Indicating Transmitter	NS	C55864 / D-6022	PIT-1437
LLW-PIT-1445	FLT-1405, FLT-1406 Inlet Pressure Indicating Transmitter	NS	C55864 / D-6022	PIT-1445
LLW-PIT-1516	P-1503 Inlet Pressure Indicating Transmitter	NS	C55867 / D-6411	PIT-1516
LLW-PIT-1517	P-1503 Outlet Pressure Indicating Transmitter	NS	C55867 / D-6411	PIT-1517
LLW-PIT-1703	P-1701 Inlet Pressure Indicating Transmitter	NS	C55864 / D-6012	PIT-1703
LLW-PIT-1704	P-1701 Outlet Pressure Indicating Transmitter	NS	C55864 / D-6024	PIT-1704

Component EIN	Component Name	Class	Drawing / Sheet No.	Data Sheet
LLW-PIT-1712	P-1702 Discharge Pressure Indicating Transmitter	NS	C55864 / D-6025	PIT-1712
LLW-PIT-1715	P-1702 Supply Pressure Indicating Transmitter	NS	C55864 / D-6025	PIT-1715
LLW-PIT-1720	P-1703 Outlet Pressure Indicating Transmitter	NS	C55864 / D-6027	PIT-1720
LLW-PIT-1725	P-1705 Outlet Pressure Indicating Transmitter	NS	C55864 / D-6028	PIT-1725
LLW-PIT-1732	P-1706 Outlet Pressure Indicating Transmitter	NS	C55864 / D-6030	PIT-1732
CA-PIT-5407	Compressed Air Outlet Pressure Indicating Transmitter	NS	C55864 / P-6202	PIT-5407
NPWC-PIT-5603	Non-Potable Water Pressure Indicating Transmitter	NS	C55865 / P-6201	PIT-5603
NG-PIT-5804	Natural Gas Pressure Indicating Transmitter	NS	C55865 / P-6200	PIT-5804
P10-PT-5946	P-10 Gas Pressure Transmitter	NS	C55864 / P-6102	PT-5946
AR-PT-5951	Argon Gas Dewar-001 Pressure Transmitter	NS	C55864 / P-6102	PT-5951
AR-PT-5953	Argon Gas Dewar-002 Pressure Transmitter	NS	C55864 / P-6102	PT-5953
LLW-TE-1303	TK-1301 Inlet RTD	NS	C55864 / D-6016	TE-1303
LLW-TE-1740	Condenser 1 RTD	NS	C55864 / D-6029	TE-1740
LLW-TE-1741	Evaporator 1 RTD	NS	C55864 / D-6029	TE-1741
LLW-TE-1742	Evaporator 2 RTD	NS	C55864 / D-6029	TE-1742
LLW-TE-1743	Evaporator 3 RTD	NS	C55864 / D-6029	TE-1743
LLW-TE-1744	Evaporator 4 RTD	NS	C55864 / D-6029	TE-1744
LLW-TE-1745	Condenser 2 RTD	NS	C55864 / D-6029	TE-1745
LLW-TE-5371	Effluent Sample Building Air Temperature	NS	C55867 / M-6400	TE-5371

AECOM

pH Analyzer Instrument

DATA SHEET NO.	REV.
AIT-1100	A

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Project: RLWTF

TAG NO: LLW-AIT-1100

Hookup Drawings:	N/A	Loop Wiring Diagrams:	M-6170
Spec No:	40 9100	Line / Vessel Number:	TK-1101
P&ID:	D-6012	Line ID: N/A	Size: N/A Schedule: N/A
Asset No:		Manufacturer:	Yokogawa
Service Description:	Reaction / Precipitation System TK-1101	Model:	FLXA21-D-E-D-AA-P1-NN-A-N-LA-N-NN/UM/SCT
Safety Class	NS	Quality Assurance Level	ML-4

PROCESS CONDITIONS

Pressure:						Units	Fluid:	LLW
Oper:	N/A	Design:	1	H2OTst:	N/A	atm	Area Classification:	N/A
Temperature:							Ambient Temperature Requirements:	N/A
Min:	N/A	Normal:	75	Max:	125	deg F	Service: TK-1102	Critical: N/A
Flow:							pH:	Units
Min:	N/A	Normal:	N/A	Max:	N/A	N/A	Min: 6 Normal: 10.8 Max: 11	

ELEMENT

Tag Name:	LLW-AE-1100	SS Tag:	Yes
Type:	Plug in flow		
Process Connection:	3/4" NPT		
Electrical Connection:	VP connector		
Isothermal Point:	pH 7		
Max Pressure Rating:	145 PSIG	Max temperature:	221 deg F
Body Material:	Ryton	Electrode Material:	Glass
Insulation Material	N/A	O-ring Material:	N/A
90% Temp resp	< 2 min	Temp Element:	Pt1000
Element Diameter	0.86 in		
Element Length:	7.36 in		
Immersion Length:	0.89 in		
Manufacturer:	Yokogawa		
Model:	FU20-VP–T1-NPT/FPS		

TRANSMITTER

Voltage:	24V dc				
Power Wiring:	Loop	Signal Type:	4 - 20 mA		
Communication Protoc	HART	Location:	Remote		
Smart:	Yes	Indicate:	Yes	Isolate:	No
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP	6	IP2:	6
Ambient Temperature Compensation:	Yes				
Factory Calibration:	Yes				
Comp Algorithm:	Matrix ±3%				
Conduit Connectio	qty 3 M20 Gland				
Operating Temp:	-4 to 131 deg F	Humidity:	10 to 95% RH		
Body Material:	Stainless Steel				
SS Tag:	Yes				
Accuracy:	≤0.01 pH	Calibrated Range:	-2 to 16 pH		

FITTING SUBASSEMBLY

Type:	Adapter		
Assy Length:	N/A		
Assy Diameter:	1 in		
Assy Material:	SS 316	O-ring Material	N/A
Process Connection:	1 in NPT		
Signal Connection:	N/A		
Manufacturer:	Yokogawa		
Model:	K1547PK		

CONNECTING HEAD

Gas Group:	N/A	Enclosure Protection IP	N/A	IP2:	N/A
Material:	Stainless Steel				
Style:	Variopin				
Sensor Connection:	Cable				
Conduit Connection:	N/A				
Termination Strip:	No				
Manufacturer:	Yokogawa				
Model:	WU10-V-S-05				

NOTES

Transmitter		Element		Immersion Fitting	
FLXA21	Model	FU20	Wide Body Sensor	K1547PK	MNPT 316 SS Mounting Adapter
-D	Power Supply	-VP	Variopin Connector		
-E	Stainless steel housing w/Epoxy coating				
-D	Anti-glare LCD display	T1	Temperature Element (Pt)		
-AA	General Purpose (non-hazardous)	NPT	Dome shape Model		
-P1-NN	1st input PH/ORP, no 2nd input				
-A-N	40-20 mA +Hart				
-LA-N-NN	English				
/UM/SCT	Universal mounting kit//SS tag				

AECOM

pH Analyzer Instrument

DATA SHEET NO.			REV.
AIT-1125			A
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Project:	RLWTF							
TAG NO:	LLW-AIT-1125	Hookup Drawings:	N/A	Loop Wiring Diagrams:	M-6175			
		Spec No:	40 9100	Line / Vessel Number:	LLW-167-SS150			
Asset No:		P&ID:	D-6012	Line ID:	N/A	Size:	1.5"	Schedule: N/A
Service Description:	TK-1101 Discharge pH Level Indicating Transmitter			Manufacturer:	Yokogawa			
				Model:	FLXA21-D-E-D-AA-P1-NN-A-N-LA-N-NN/UM/SCT			
Safety Class	NS			Quality Assurance Level	ML-4			

PROCESS CONDITIONS

Pressure:						Units
Oper:	45	Design:	100	H2OTst:	150	atm
Temperature:						
Min:	75	Normal:	125	Max:	125	deg F
Flow:						
Min:	N/A	Normal:	36.6	Max:	N/A	gpm

Fluid:	LLW					
Area Classification:	N/A					
Ambient Temperature Requirements:	N/A					
Service:	RXN	Critical:	N/A			
pH:						Units
Min:	6	Normal:	10.8	Max:	11	

ELEMENT

Tag Name:	LLW-AE-1125	SS Tag:	Yes
Type:	Plug in flow		
Process Connection:	3/4" NPT		
Electrical Connection:	VP connector		
Isothermal Point:	pH 7		
Max Pressure Rating:	145 PSIG	Max temperature:	221 deg F
Body Material:	Ryton	Electrode Material:	Glass
Insulation Material	N/A	O-ring Material:	N/A
90% Temp resp	< 2 min	Temp Element:	Pt1000
Element Diameter	0.86 in		
Element Length:	7.36 in		
Immersion Length:	0.89 in		
Manufacturer:	Yokogawa		
Model:	FU20-VP--T1-NPT/FPS		

TRANSMITTER

Voltage:	24V dc				
Power Wiring:	2-Wire	Signal Type:	4 - 20 mA		
Communication Protocol:	HART	Location:	Remote		
Smart:	Yes	Indicate:	Yes	Isolate:	No
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1	6	IP2:	6
Ambient Temperature Compensation:	Yes				
Factory Calibration:	Yes				
Comp Algorithm:	Matrix ±3%				
Conduit Connection	qty 3 M20 Gland				
Operating Temp:	-4 to 131 deg F	Humidity:	10 to 95% RH		
Body Material:	Stainless Steel				
SS Tag:	Yes				
Accuracy:	≤0.01 pH	Calibrated Range:	-2 to 16 pH		

FITTING SUBASSEMBLY

Type:	Adapter		
Assy Length:	N/A		
Assy Diameter:	1 in		
Assy Material:	SS 316	O-ring Material	N/A
Process Connection:	1 in NPT		
Signal Connection:	N/A		
Manufacturer:	Yokogawa		
Model:	K1547PK		

CONNECTING HEAD

Gas Group:	N/A	Enclosure Protection IP1	N/A	IP2:	N/A
Material:	Stainless Steel				
Style:	Variopin				
Sensor Connection:	Cable				
Conduit Connection:	N/A				
Termination Strip:	No				
Manufacturer:	Yokogawa				
Model:	WU10-V-S-05				

NOTES

Transmitter		Element		Immersion Fitting	
FLXA21	Model	FU20	Wide Body Sensor	K1547PK	MNPT 316 SS Mounting Adapter
-D	Power Supply	-VP	Variopin Connector		
-E	Stainless steel housing w/Epoxy coating				
-D	Anti-glare LCD display	T1	Temperature Element (Pt)		
-AA	General Purpose (non-hazardous)	NPT	Dome shape Model		
-P1-NN	1st input PH/ORP, no 2nd input				
-A-N	40-20 mA +Hart				
-LA-N-NN	English				
/UM/SCT	Universal mounting kit//SS tag				

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Project: RLWTF

TAG NO: LLW-AIT-1125

Hookup Drawings:	N/A	Loop Wiring Diagrams:	M-6175
Spec No	40 9100	Line / Vessel Number:	LLW-167-SS150
P&ID:	D-6012	Line ID: N/A	Size: 1.5" Schedule: N/A
Asset No:		Manufacturer:	Yokogawa
Service Description:	TK-1101 Discharge pH Level Indicating Transmitter	Model:	FLXA21-D-E-D-AA-P1-NN-A-N-LA-N-NN/UM/SCT
Safety Class	NS	Quality Assurance Level	ML-4

PROCESS CONDITIONS

Pressure:						Units	Fluid:	LLW
Oper:	45	Design:	100	H2OTst:	150	atm	Area Classification:	N/A
Temperature:							Ambient Temperature Requirements:	N/A
Min:	75	Normal:	125	Max:	125	deg F	Service: RXN	Critical: N/A
Flow:							pH:	Units
Min:	N/A	Normal:	36.6	Max:	N/A	gpm	Min: 6 Normal: 10.8 Max: 11	

ELEMENT

Tag Name:	LLW-AE-1125	SS Tag:	Yes
Type:	Plug in flow		
Process Connection:	3/4" NPT		
Electrical Connection:	VP connector		
Isothermal Point:	pH 7		
Max Pressure Rating:	145 PSIG	Max temperature:	221 deg F
Body Material:	Ryton	Electrode Material:	Glass
Insulation Material	N/A	O-ring Material:	N/A
90% Temp resp	< 2 min	Temp Element:	Pt1000
Element Diameter	0.86 in		
Element Length:	7.36 in		
Immersion Length:	0.89 in		
Manufacturer:	Yokogawa		
Model:	FU20-VP–T1-NPT/FPS		

TRANSMITTER

Voltage:	24V dc				
Power Wiring:	2-Wire	Signal Type:	4 - 20 mA		
Communication Protocc	HART	Location:	Remote		
Smart:	Yes	Indicate:	Yes	Isolate:	No
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP	6	IP2:	6
Ambient Temperature Compensation:	Yes				
Factory Calibration:	Yes				
Comp Algorithm:	Matrix ±3%				
Conduit Connectio	qty 3 M20 Gland				
Operating Temp:	-4 to 131 deg F	Humidity:	10 to 95% RH		
Body Material:	Stainless Steel				
SS Tag:	Yes				
Accuracy:	≤0.01 pH	Calibrated Range:	-2 to 16 pH		

FITTING SUBASSEMBLY

Type:	Adapter		
Assy Length:	N/A		
Assy Diameter:	1 in		
Assy Material:	SS 316	O-ring Material	N/A
Process Connection:	1 in NPT		
Signal Connection:	N/A		
Manufacturer:	Yokogawa		
Model:	K1547PK		

CONNECTING HEAD

Gas Group:	N/A	Enclosure Protection IP	N/A	IP2:	N/A
Material:	Stainless Steel				
Style:	Variopin				
Sensor Connection:	Cable				
Conduit Connection:	N/A				
Termination Strip:	No				
Manufacturer:	Yokogawa				
Model:	WU10-V-S-05				

NOTES

Transmitter		Element		Immersion Fitting	
FLXA21	Model	FU20	Wide Body Sensor	K1547PK	MNPT 316 SS Mounting Adapter
-D	Power Supply	-VP	Variopin Connector		
-E	Stainless steel housing w/Epoxy coating				
-D	Anti-glare LCD display	T1	Temperature Element (Pt)		
-AA	General Purpose (non-hazardous)	NPT	Dome shape Model		
-P1-NN	1st input PH/ORP, no 2nd input				
-A-N	40-20 mA +Hart				
-LA-N-NN	English				
/UM/SCT	Universal mounting kit//SS tag				

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pH Analyzer Instrument

DATA SHEET NO.	REV.
AIT-1301	A

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Project: RLWTF

TAG NO:	LLW-AIT-1301	Hookup Drawings:	N/A	Loop Wiring Diagrams:	M-6215			
		Spec No:	40 9100	Line / Vessel Number:	LLW-208-SS150			
Asset No:		P&ID:	D-6016	Line ID:	1.61"	Size:	1.5"	Schedule: 40
Service Description:	TK-1301 Outlet pH Level Indicating Transmitter			Manufacturer:	Yokogawa			
				Model:	FLXA21-D-E-D-AA-P1-NN-A-N-LA-N-NN/UM/SCT			
Safety Class	NS			Quality Assurance Level	ML-4			

PROCESS CONDITIONS

Pressure:						Units	Fluid:	LLW
Oper:	45	Design:	100	H2OTst:	150	atm	Area Classification:	N/A
Temperature:							Ambient Temperature Requirements:	N/A
Min:	75	Normal:	125	Max:	125	deg F	Service: RO	Critical: N/A
Flow:							pH:	Units
Min:	N/A	Normal:	33.1	Max:	N/A	gpm	Min: 6 Normal: 7.5 Max: 11	

ELEMENT

Tag Name:	LLW-AE-1301	SS Tag:	Yes
Type:	Plug in flow		
Process Connection:	3/4" NPT		
Electrical Connection:	VP connector		
Isothermal Point:	pH 7		
Max Pressure Rating:	145 PSIG	Max temperature:	221 deg F
Body Material:	Ryton	Electrode Material:	Glass
Insulation Material	N/A	O-ring Material:	N/A
90% Temp resp	< 2 min	Temp Element:	Pt1000
Element Diameter	0.86 in		
Element Length:	7.36 in		
Immersion Length:	0.89 in		
Manufacturer:	Yokogawa		
Model:	FU20-VP--T1-NPT/FPS		

TRANSMITTER

Voltage:	24V dc				
Power Wiring:	2-Wire	Signal Type:	4 - 20 mA		
Communication Protocc	HART	Location:	Remote		
Smart:	Yes	Indicate:	Yes	Isolate:	No
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP	6	IP2:	6
Ambient Temperature Compensation:	Yes				
Factory Calibration:	Yes				
Comp Algorithm:	Matrix ±3%				
Conduit Connectior	qty 3 M20 Gland				
Operating Temp:	-4 to 131 deg F	Humidity:	10 to 95% RH		
Body Material:	Stainless Steel				
SS Tag:	Yes				
Accuracy:	≤0.01 pH	Calibrated Range:	-2 to 16 pH		

FITTING SUBASSEMBLY

Type:	Adapter		
Assy Length:	N/A		
Assy Diameter:	1 in		
Assy Material:	SS 316	O-ring Material	N/A
Process Connection:	1 in NPT		
Signal Connection:	N/A		
Manufacturer:	Yokogawa		
Model:	K1547PK		

CONNECTING HEAD

Gas Group:	N/A	Enclosure Protection IP	N/A	IP2:	N/A
Material:	Stainless Steel				
Style:	Variopin				
Sensor Connection:	Cable				
Conduit Connection:	N/A				
Termination Strip:	No				
Manufacturer:	Yokogawa				
Model:	WU10-V-S-05				

NOTES

Transmitter		Element		Immersion Fitting	
FLXA21	Model	FU20	Wide Body Sensor	K1547PK	MNPT 316 SS Mounting Adapter
-D	Power Supply	-VP	Variopin Connector		
-E	Stainless steel housing w/Epoxy coating				
-D	Anti-glare LCD display	T1	Temperature Element (Pt)		
-AA	General Purpose (non-hazardous)	NPT	Dome shape Model		
-P1-NN	1st input PH/ORP, no 2nd input				
-A-N	40-20 mA +Hart				
-LA-N-NN	English				
/UM/SCT	Universal mounting kit//SS tag				

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pH Analyzer Instrument

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AIT-1302	A

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Project: RLWTF

TAG NO: LLW-AIT-1302

Hookup Drawings:	N/A	Loop Wiring Diagrams:	M-6218
Spec No	40 9100	Line / Vessel Number:	LLW-180-SS150
P&ID:	D-6016	Line ID: 2.07" Size: 2" Schedule:	40
Asset No:		Manufacturer:	Yokogawa
Service Description:	TK-1301 Feed pH Level Indicating Transmitter	Model:	FLXA21-D-E-D-AA-P1-NN-A-N-LA-N-NN/UM/SCT
Safety Class	NS	Quality Assurance Level	ML-4

PROCESS CONDITIONS

Pressure:						Units
Oper:	45	Design:	100	H2OTst:	150	atm
Temperature:						
Min:	75	Normal:	125	Max:	125	deg F
Flow:						
Min:	N/A	Normal:	31.6	Max:	N/A	gpm

Fluid:	LLW
Area Classification:	N/A
Ambient Temperature Requirements:	N/A
Service: RO	Critical: N/A

pH:						Units
Min:	6	Normal:	10.8	Max:	11	

ELEMENT

Tag Name:	LLW-AE-1302	SS Tag:	Yes
Type:	Plug in flow		
Process Connection:	3/4" NPT		
Electrical Connection:	VP connector		
Isothermal Point:	pH 7		
Max Pressure Rating:	145 PSIG	Max temperature:	221 deg F
Body Material:	Ryton	Electrode Material:	Glass
Insulation Material	N/A	O-ring Material:	N/A
90% Temp resp	< 2 min	Temp Element:	Pt1000
Element Diameter	0.86 in		
Element Length:	7.36 in		
Immersion Length:	0.89 in		
Manufacturer:	Yokogawa		
Model:	FU20-VP--T1-NPT/FPS		

TRANSMITTER

Voltage:	24V dc		
Power Wiring:	2-Wire	Signal Type:	4 - 20 mA
Communication Protocc	HART	Location:	Remote
Smart: Yes	Indicate: Yes	Isolate:	No
Electrical Protection:	N/A	Temperature Category:	N/A
Gas Group: N/A	Enclosure Protection IP: 6	IP2:	6
Ambient Temperature Compensation:	Yes		
Factory Calibration:	Yes		
Comp Algorithm:	Matrix ±3%		
Conduit Connectio	qty 3 M20 Gland		
Operating Temp:	-4 to 131 deg F	Humidity:	10 to 95% RH
Body Material:	Stainless Steel		
SS Tag:	Yes		
Accuracy:	≤0.01 pH	Calibrated Range:	-2 to 16 pH

FITTING SUBASSEMBLY

Type:	Adapter		
Assy Length:	N/A		
Assy Diameter:	1 in		
Assy Material:	SS 316	O-ring Material	N/A
Process Connection:	1 in NPT		
Signal Connection:	N/A		
Manufacturer:	Yokogawa		
Model:	K1547PK		

CONNECTING HEAD

Gas Group:	N/A	Enclosure Protection IP:	N/A	IP2:	N/A
Material:	Stainless Steel				
Style:	Variopin				
Sensor Connection:	Cable				
Conduit Connection:	N/A				
Termination Strip:	No				
Manufacturer:	Yokogawa				
Model:	WU10-V-S-05				

NOTES

Transmitter		Element		Immersion Fitting	
FLXA21	Model	FU20	Wide Body Sensor	K1547PK	MNPT 316 SS Mounting Adapter
-D	Power Supply	-VP	Variopin Connector		
-E	Stainless steel housing w/Epoxy coating				
-D	Anti-glare LCD display	T1	Temperature Element (Pt)		
-AA	General Purpose (non-hazardous)	NPT	Dome shape Model		
-P1-NN	1st input PH/ORP, no 2nd input				
-A-N	40-20 mA +Hart				
-LA-N-NN	English				
/UM/SCT	Universal mounting kit//SS tag				

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pH Analyzer Instrument

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Project:	RLWTF	P.O.	
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TAG NO:	LLW-AIT-1345	Hookup Drawings:	N/A	Loop Wiring Diagrams:	M-6265
		Spec No:	40 9100	Line / Vessel Number:	LLW-245-SS150
Asset No:		P&ID:	D-6020	Line ID: 1.61" Size: 1.5"	Schedule: N/A
Service Description:	TK-1304 Inlet pH Level Indicating Transmitter			Manufacturer:	Yokogawa
				Model:	FLXA21-D-E-D-AA-P1-NN-A-N-LA-N-NN/UM/SCT
Safety Class	NS	Quality Assurance Level			ML-4

PROCESS CONDITIONS

Pressure:						Units	Fluid:	LLW
Oper:	45	Design:	100	H2OTst:	150	atm	Area Classification:	N/A
Temperature:							Ambient Temperature Requirements:	N/A
Min:	75	Normal:	125	Max:	125	deg F	Service: RO	Critical: N/A
Flow:							pH:	Units
Min:	N/A	Normal:	25.2	Max:	N/A	gpm	Min: 6 Normal: 6.5	Max: 11

ELEMENT

Tag Name:	LLW-AE-1345	SS Tag:	Yes
Type:	Plug in flow		
Process Connection:	3/4" NPT		
Electrical Connection:	VP connector		
Isothermal Point:	pH 7		
Max Pressure Rating:	145 PSIG	Max temperature:	221 deg F
Body Material:	Ryton	Electrode Material:	Glass
Insulation Material	N/A	O-ring Material:	N/A
90% Temp resp	< 2 min	Temp Element:	Pt1000
Element Diameter	0.86 in		
Element Length:	7.36 in		
Immersion Length:	0.89 in		
Manufacturer:	Yokogawa		
Model:	FU20-VP–T1-NPT/FPS		

TRANSMITTER

Voltage:	24V dc				
Power Wiring:	2-Wire	Signal Type:	4 - 20 mA		
Communication Protocc	HART	Location:	Remote		
Smart:	Yes	Indicate:	Yes	Isolate:	No
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP	6	IP2:	6
Ambient Temperature Compensation:	Yes				
Factory Calibration:	Yes				
Comp Algorithm:	Matrix ±3%				
Conduit Connectior	qty 3 M20 Gland				
Operating Temp:	-4 to 131 deg F	Humidity:	10 to 95% RH		
Body Material:	Stainless Steel				
SS Tag:	Yes				
Accuracy:	≤0.01 pH	Calibrated Range:	-2 to 16 pH		

FITTING SUBASSEMBLY

Type:	Adapter		
Assy Length:	N/A		
Assy Diameter:	1 in		
Assy Material:	SS 316	O-ring Material	N/A
Process Connection:	1 in NPT		
Signal Connection:	N/A		
Manufacturer:	Yokogawa		
Model:	K1547PK		

CONNECTING HEAD

Gas Group:	N/A	Enclosure Protection IP	N/A	IP2:	N/A
Material:	Stainless Steel				
Style:	Variopin				
Sensor Connection:	Cable				
Conduit Connection:	N/A				
Termination Strip:	No				
Manufacturer:	Yokogawa				
Model:	WU10-V-S-05				

NOTES

Transmitter		Element		Immersion Fitting	
FLXA21	Model	FU20	Wide Body Sensor	K1547PK	MNPT 316 SS Mounting Adapter
-D	Power Supply	-VP	Variopin Connector		
-E	Stainless steel housing w/Epoxy coating				
-D	Anti-glare LCD display	T1	Temperature Element (Pt)		
-AA	General Purpose (non-hazardous)	NPT	Dome shape Model		
-P1-NN	1st input PH/ORP, no 2nd input				
-A-N	40-20 mA +Hart				
-LA-N-NN	English				
/UM/SCT	Universal mounting kit//SS tag				

AECOM

pH Analyzer Instrument

DATA SHEET NO.			REV.
AIT-1346			A
SHEET	OF	DATE	
1	1	1-17-13	

NO.	BY	DATE	REVISION

BY	CHK'D	PROC.	APPR.
NCC	AME		

P.O.	
REQ.	

Project: RLWTF

TAG NO: LLW-AIT-1346

Hookup Drawings:	N/A	Loop Wiring Diagrams:	M-6266
Spec No:	40 9100	Line / Vessel Number:	LLW-264-SS150
P&ID:	D-6020	Line ID: 2.07" Size: 2"	Schedule: 40
Asset No:		Manufacturer:	Yokogawa
Service Description:	TK-1304 Outlet pH Level Indicating Transmitter	Model:	FLXA21-D-E-D-AA-P1-NN-A-N-LA-N-NN/UM/SCT
Safety Class	NS	Quality Assurance Level	ML-4

PROCESS CONDITIONS

Pressure:						Units	Fluid:	LLW
Oper:	45	Design:	100	H2OTst:	150	atm	Area Classification:	N/A
Temperature:							Ambient Temperature Requirements:	N/A
Min:	75	Normal:	125	Max:	125	deg F	Service: RO	Critical: N/A
Flow:							pH:	Units
Min:	N/A	Normal:	50	Max:	N/A	gpm	Min: 6 Normal: 6.5 Max: 11	

ELEMENT

Tag Name:	LLW-AE-1346	SS Tag:	Yes
Type:	Plug in flow		
Process Connection:	3/4" NPT		
Electrical Connection:	VP connector		
Isothermal Point:	pH 7		
Max Pressure Rating:	145 PSIG	Max temperature:	221 deg F
Body Material:	Ryton	Electrode Material:	Glass
Insulation Material	N/A	O-ring Material:	N/A
90% Temp resp	< 2 min	Temp Element:	Pt1000
Element Diameter	0.86 in		
Element Length:	7.36 in		
Immersion Length:	0.89 in		
Manufacturer:	Yokogawa		
Model:	FU20-VP–T1-NPT/FPS		

TRANSMITTER

Voltage:	24V dc				
Power Wiring:	2-Wire	Signal Type:	4 - 20 mA		
Communication Protocol:	HART	Location:	Remote		
Smart:	Yes	Indicate:	Yes	Isolate:	No
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP:	6	IP2:	6
Ambient Temperature Compensation:	Yes				
Factory Calibration:	Yes				
Comp Algorithm:	Matrix ±3%				
Conduit Connection:	qty 3 M20 Gland				
Operating Temp:	-4 to 131 deg F	Humidity:	10 to 95% RH		
Body Material:	Stainless Steel				
SS Tag:	Yes				
Accuracy:	≤0.01 pH	Calibrated Range:	-2 to 16 pH		

FITTING SUBASSEMBLY

Type:	Adapter		
Assy Length:	N/A		
Assy Diameter:	1 in		
Assy Material:	SS 316	O-ring Material	N/A
Process Connection:	1 in NPT		
Signal Connection:	N/A		
Manufacturer:	Yokogawa		
Model:	K1547PK		

CONNECTING HEAD

Gas Group:	N/A	Enclosure Protection IP:	N/A	IP2:	N/A
Material:	Stainless Steel				
Style:	Variopin				
Sensor Connection:	Cable				
Conduit Connection:	N/A				
Termination Strip:	No				
Manufacturer:	Yokogawa				
Model:	WU10-V-S-05				

NOTES

Transmitter		Element		Immersion Fitting	
FLXA21	Model	FU20	Wide Body Sensor	K1547PK	MNPT 316 SS Mounting Adapter
-D	Power Supply	-VP	Variopin Connector		
-E	Stainless steel housing w/Epoxy coating				
-D	Anti-glare LCD display	T1	Temperature Element (Pt)		
-AA	General Purpose (non-hazardous)	NPT	Dome shape Model		
-P1-NN	1st input PH/ORP, no 2nd input				
-A-N	40-20 mA +Hart				
-LA-N-NN	English				
/UM/SCT	Universal mounting kit//SS tag				

AECOM

pH Analyzer Instrument

DATA SHEET NO.			REV.
AIT-1509			A
SHEET	OF	DATE	
1	1	1-17-13	

NO.	BY	DATE	REVISION

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NCC	AME		

P.O.	
REQ.	

Project: RLWTF

TAG NO: LLW-AIT-1509

Hookup Drawings:	N/A	Loop Wiring Diagrams:	M-6375
Spec No	40 9100	Line / Vessel Number:	TK-1501
P&ID:	D-6410	Line ID: N/A	Size: N/A Schedule: N/A
Asset No:		Manufacturer:	Yokogawa
Service Description:	TK-1501 pH Level Indicating Transmitter	Model:	FLXA21-D-E-D-AA-P1-NN-A-N-LA-N-NN/UM/SCT
Safety Class	NS	Quality Assurance Level	ML-4

PROCESS CONDITIONS

Pressure:						Units	Fluid:	LLW
Oper:	45	Design:	100	H2OTst:	150	atm	Area Classification:	N/A
Temperature:							Ambient Temperature Requirements:	N/A
Min:	75	Normal:	125	Max:	125	deg F	Service: EFF	Critical: N/A
Flow:							pH:	Units
Min:	N/A	Normal:	N/A	Max:	N/A	gpm	Min: 6 Normal: 6.5 Max: 11	

ELEMENT

Tag Name:	LLW-AE-1509	SS Tag:	Yes
Type:	Plug in flow		
Process Connection:	3/4" NPT		
Electrical Connection:	VP connector		
Isothermal Point:	pH 7		
Max Pressure Rating:	145 PSIG	Max temperature:	221 deg F
Body Material:	Ryton	Electrode Material:	Glass
Insulation Material	N/A	O-ring Material:	N/A
90% Temp resp	< 2 min	Temp Element:	Pt1000
Element Diameter	0.86 in		
Element Length:	7.36 in		
Immersion Length:	0.89 in		
Manufacturer:	Yokogawa		
Model:	FU20-VP–T1-NPT/FPS		

TRANSMITTER

Voltage:	24V dc				
Power Wiring:	2-Wire		Signal Type:	4 - 20 mA	
Communication Protocc	HART		Location:	Remote	
Smart:	Yes	Indicate:	Yes	Isolate:	No
Electrical Protection:	N/A		Temperature Category:	N/A	
Gas Group:	N/A	Enclosure Protection IP	6	IP2:	6
Ambient Temperature Compensation:	Yes				
Factory Calibration:	Yes				
Comp Algorithm:	Matrix ±3%				
Conduit Connectior	qty 3 M20 Gland				
Operating Temp:	-4 to 131 deg F		Humidity:	10 to 95% RH	
Body Material:	Stainless Steel				
SS Tag:	Yes				
Accuracy:	≤0.01 pH		Calibrated Range:	-2 to 16 pH	

FITTING SUBASSEMBLY

Type:	K1523DD Mounting Adapter for FD 40 Assembly		
Assy Length:	1.5 meter		
Assy Diameter:	2 in		
Assy Material:	PVC	O-ring Material	Silicon Rubber
Process Connection:	DN80 Flange		
Signal Connection:	N/A		
Manufacturer:	Yokogawa		
Model:	FD40V28-15-F2*B/PH5		

CONNECTING HEAD

Gas Group:	N/A	Enclosure Protection IP	N/A	IP2:	N/A
Material:	Stainless Steel				
Style:	Junction Box				
Sensor Connection:	WU10-V-S-04 Sensor / WF10-05-F Connector Cable				
Conduit Connection:	N/A				
Termination Strip:	No				
Manufacturer:	Yokogawa				
Model:	BA10 Junction Box				

NOTES

Transmitter		Element		Immersion Fitting	
FLXA21	Model	FU20	Wide Body Sensor	K1523DD	Mounting Adapter for FD 40 Assembly
-D	Power Supply	-VP	Variopin Connector	FD40V28	Immersion Fitting, PVC
-E	Stainless steel housing w/Epoxy coating			-15	Length in decimeters
-D	Anti-glare LCD display	T1	Temperature Element (Pt)	-F2*B	Flange, PVC, ANSI 2" 150lbs, Style B
-AA	General Purpose (non-hazardous)	NPT	Dome shape Model	/PH5	Protection Hose for 5.5m cable
-P1-NN	1st input PH/ORP, no 2nd input				
-A-N	40-20 mA +Hart			Cable and Junction Box	
-LA-N-NN	English			4 meter Sensor Cable / 5 meter connector cable	
/UM/SCT	Universal mounting kit//SS tag				

F

AECOM

pH Analyzer Instrument

DATA SHEET NO.			REV.
AIT-1529			A
SHEET	OF	DATE	
1	1	1-17-13	

NO.	BY	DATE	REVISION

BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project: RLWTF

TAG NO: LLW-AIT-1529

Hookup Drawings:	N/A	Loop Wiring Diagrams:	M-6385
Spec No	40 9100	Line / Vessel Number:	TK-1502
P&ID:	D-6411	Line ID: N/A	Size: N/A Schedule: N/A
Asset No:		Manufacturer:	Yokogawa
Service Description:	TK-1502 pH Level Indicating Transmitter	Model:	FLXA21-D-E-D-AA-P1-NN-A-N-LA-N-NN/UM/SCT
Safety Class	NS	Quality Assurance Level	ML-4

PROCESS CONDITIONS

Pressure:						Units	Fluid:	LLW
Oper:	45	Design:	100	H2OTst:	150	atm	Area Classification:	N/A
Temperature:							Ambient Temperature Requirements:	N/A
Min:	75	Normal:	125	Max:	125	deg F	Service: EFF	Critical: N/A
Flow:							pH:	Units
Min:	N/A	Normal:	N/A	Max:	N/A	gpm	Min: 6 Normal: 6.5	Max: 11

ELEMENT

Tag Name:	LLW-AE-1529	SS Tag:	Yes
Type:	Plug in flow		
Process Connection:	3/4" NPT		
Electrical Connection:	VP connector		
Isothermal Point:	pH 7		
Max Pressure Rating:	145 PSIG	Max temperature:	221 deg F
Body Material:	Ryton	Electrode Material:	Glass
Insulation Material	N/A	O-ring Material:	N/A
90% Temp resp	< 2 min	Temp Element:	Pt1000
Element Diameter	0.86 in		
Element Length:	7.36 in		
Immersion Length:	0.89 in		
Manufacturer:	Yokogawa		
Model:	FU20-VP–T1-NPT/FPS		

TRANSMITTER

Voltage:	24V dc				
Power Wiring:	2-Wire	Signal Type:	4 - 20 mA		
Communication Protocc	HART	Location:	Remote		
Smart:	Yes	Indicate:	Yes	Isolate:	No
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP	6	IP2:	6
Ambient Temperature Compensation:	Yes				
Factory Calibration:	Yes				
Comp Algorithm:	Matrix ±3%				
Conduit Connectio	qty 3 M20 Gland				
Operating Temp:	-4 to 131 deg F	Humidity:	10 to 95% RH		
Body Material:	Stainless Steel				
SS Tag:	Yes				
Accuracy:	≤0.01 pH	Calibrated Range:	-2 to 16 pH		

FITTING SUBASSEMBLY

Type:	K1523DD Mounting Adapter for FD 40 Assembly		
Assy Length:	1.5 meter		
Assy Diameter:	2 in		
Assy Material:	PVC	O-ring Material	Silicon Rubber
Process Connection:	DN80 Flange		
Signal Connection:	N/A		
Manufacturer:	Yokogawa		
Model:	FD40V28-15-F2*B/PH5		

CONNECTING HEAD

Gas Group:	N/A	Enclosure Protection IP	N/A	IP2:	N/A
Material:	Stainless Steel				
Style:	Junction Box				
Sensor Connection:	WU10-V-S-04 Sensor / WF10-05-F Connector Cable				
Conduit Connection:	N/A				
Termination Strip:	No				
Manufacturer:	Yokogawa				
Model:	BA10 Junction Box				

NOTES

Transmitter		Element		Immersion Fitting	
FLXA21	Model	FU20	Wide Body Sensor	K1523DD	Mounting Adapter for FD 40 Assembly
-D	Power Supply	-VP	Variopin Connector	FD40V28	Immersion Fitting, PVC
-E	Stainless steel housing w/Epoxy coating			-15	Length in decimeters
-D	Anti-glare LCD display	T1	Temperature Element (Pt)	-F2*B	Flange, PVC, ANSI 2" 150lbs, Style B
-AA	General Purpose (non-hazardous)	NPT	Dome shape Model	/PH5	Protection Hose for 5.5m cable
-P1-NN	1st input PH/ORP, no 2nd input				
-A-N	40-20 mA +Hart			Cable and Junction Box	
-LA-N-NN	English			4 meter Sensor Cable / 5 meter connector cable	
/UM/SCT	Universal mounting kit//SS tag				

F

AECOM

Analyzer Instrument

Conductivity

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
CIT-1301			A
SHEET	OF	DATE	
1	1	01-17-13	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project:	RLWTF						
TAG NO:	LLW-CIT-1301	Hookup Drawings:	N/A	Loop Wiring Diagrams:	M-6216		
		Spec No:	40 9100	Line / Vessel Number:	TK-1301		
Asset No:		P&ID:	D-6016	Line ID: N/A	Size: N/A	Schedule:	N/A
Service Description:	Conductivity in RO pH Adjustment Tank 1301			Manufacturer:	Yokogawa		
				Model:	FLXA21-D-E-D-AA-C5-NN-A-N-LA-N-NN/UM/SCT		
Safety Class	NS	Quality Assurance Level		ML-4			

PROCESS CONDITIONS

Pressure:						Units	Fluid:	LLW
Oper:	N/A	Design:	1	H2OTst:	N/A	atm	Area Classification:	N/A
Temperature:							Ambient Temperature Requirements:	N/A
Min:	N/A	Normal:	75	Max:	125	deg F	Service: TK-1301	Critical: N/A
Flow:							pH:	Units
Min:	N/A	Normal:	N/A	Max:	N/A	N/A	Min: 7 Normal: 7.5 Max: 11	

ELEMENT

Tag Name:	LLW-AE-1301	SS Tag:	Yes
Type:	Inductive Conductivity		
Process Connection:	2" screw-in coupling		
Electrical Connection:	VP connector		
Isothermal Point:	N/A		
Max Pressure Rating:	300 PSIG	Max temperature:	270 deg F
Body Material:	PVC	Electrode Material:	Victrex PEEK
Insulation Material	N/A	O-ring Material:	Viton
90% Temp resp	< 5 min	Temp Element:	Pt1000
Element Diameter	1.85 in		
Element Length:	7.16 in		
Immersion Length:	4.88 in		
Manufacturer:	Yokogawa		
Model:	ISC40G-GG-T1-05		

TRANSMITTER

Voltage:	24V dc				
Power Wiring:	Loop	Signal Type:	4 - 20 mA		
Communication Protocc	HART	Location:	Remote		
Smart:	Yes	Indicate:	Yes	Isolate:	No
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP	6	IP2:	6
Ambient Temperature Compensation:	Yes				
Factory Calibration:	Yes				
Comp Algorithm:	Matrix ±3%				
Conduit Connectior	qty 3 M20 Gland				
Operating Temp:	-4 to 131 deg F	Humidity:	10 to 95% RH		
Body Material:	Stainless Steel				
SS Tag:	Yes				
Accuracy:	≤0.01 pH	Calibrated Range:	-2 to 16 pH		

FITTING SUBASSEMBLY

Type:	Immersion Fitting		
Assy Length:	N/A		
Assy Diameter:	1.97 in		
Assy Material:	PVC-C	O-ring Material	Viton
Process Connection:	AISI 316SS 2" 150 lbs		
Signal Connection:	N/A		
Manufacturer:	Yokogawa		
Model:	ISC40FD-V-15-SFA		

CONNECTING HEAD

Gas Group:	N/A	Enclosure Protection IP	N/A	IP2:	N/A
Material:	Stainless Steel				
Style:	Junction Box				
Sensor Connection:	WF10-05-F Connector Cable				
Conduit Connection:	N/A				
Termination Strip:	No				
Manufacturer:	Yokogawa				
Model:	BA10 Junction Box				

NOTES

Transmitter		Element		Immersion Fitting	
FLXA21	Model	ISC40G	General Purpose Conductivity Sensor	ISC40FD	Immersion Fitting
-D	Power Supply	-GG	Glass filled PEEK, general model	-V	Material PVC-C
-E	Stainless steel housing w/Epoxy coating	T1	Temperature Element (Pt)	-15	Probe Length 1.5 Meters
-D	Anti-glare LCD display	-05	Cable Length, 5 Meter	-SFA	AISI316 SS 2" Flange
-AA	General Purpose (non-hazardous)				
-C5-NN	1st input Conductivity, no 2nd input				
-A-N	40-20 mA +Hart				
-LA-N-NN	English				
/UM/SCT	Universal mounting kit//SS tag				

Cable and Junction Box

4 meter Sensor Cable / 5 meter connector cable

AECOM

Analyzer Instrument

Conductivity

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
CIT-1343			A
SHEET	OF	DATE	
1	1	01-17-13	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project:	RLWTF						
TAG NO:	LLW-CIT-1343	Hookup Drawings:	N/A	Loop Wiring Diagrams:	M-6263		
		Spec No:	40 9100	Line / Vessel Number:	TK-1304		
Asset No:		P&ID:	D-6020	Line ID:	N/A	Size: N/A	Schedule: N/A
Service Description:	RO Permeate Holding Tank 1304			Manufacturer:	Yokogawa		
				Model:	FLXA21-D-E-D-AA-C5-NN-A-N-LA-N-NN/UM/SCT		
Safety Class	NS	Quality Assurance Level		ML-4			

PROCESS CONDITIONS

Pressure:						Units	Fluid:	LLW
Oper:	N/A	Design:	1	H2OTst:	N/A	atm	Area Classification:	N/A
Temperature:							Ambient Temperature Requirements:	N/A
Min:	N/A	Normal:	75	Max:	125	deg F	Service: TK-1304	Critical: N/A
Flow:							pH:	Units
Min:	N/A	Normal:	N/A	Max:	N/A	N/A	Min: 6 Normal: 6.5 Max: 8	

ELEMENT

Tag Name:	LLW-AE-1343	SS Tag:	Yes
Type:	Inductive Conductivity		
Process Connection:	2" screw-in coupling		
Electrical Connection:	VP connector		
Isothermal Point:	N/A		
Max Pressure Rating:	300 PSIG	Max temperature:	270 deg F
Body Material:	PVC	Electrode Material:	Victrex PEEK
Insulation Material	N/A	O-ring Material:	Viton
90% Temp resp	< 5 min	Temp Element:	Pt1000
Element Diameter	1.85 in		
Element Length:	7.16 in		
Immersion Length:	4.88 in		
Manufacturer:	Yokogawa		
Model:	ISC40G-GG-T1-05		

TRANSMITTER

Voltage:	24V dc		
Power Wiring:	Loop	Signal Type:	4 - 20 mA
Communication Protocc	HART	Location:	Remote
Smart: Yes	Indicate: Yes	Isolate:	No
Electrical Protection:	N/A	Temperature Category:	N/A
Gas Group: N/A	Enclosure Protection IP	6	IP2: 6
Ambient Temperature Compensation:	Yes		
Factory Calibration:	Yes		
Comp Algorithm:	Matrix ±3%		
Conduit Connectior	qty 3 M20 Gland		
Operating Temp:	-4 to 131 deg F	Humidity:	10 to 95% RH
Body Material:	Stainless Steel		
SS Tag:	Yes		
Accuracy:	≤0.01 pH	Calibrated Range:	-2 to 16 pH

FITTING SUBASSEMBLY

Type:	Immersion Fitting		
Assy Length:	N/A		
Assy Diameter:	1.97 in		
Assy Material:	PVC-C	O-ring Material	Viton
Process Connection:	AISI 316SS 2" 150 lbs		
Signal Connection:	N/A		
Manufacturer:	Yokogawa		
Model:	ISC40FD-V-15-SFA		

CONNECTING HEAD

Gas Group:	N/A	Enclosure Protection IP	N/A	IP2: N/A
Material:	Stainless Steel			
Style:	Junction Box			
Sensor Connection:	WU10-V-S-04 Sensor / WF10-05-F Connector Cable			
Conduit Connection:	N/A			
Termination Strip:	No			
Manufacturer:	Yokogawa			
Model:	BA10 Junction Box			

NOTES

Transmitter

FLXA21	Model
-D	Power Supply
-E	Stainless steel housing w/Epoxy coating
-D	Anti-glare LCD display
-AA	General Purpose (non-hazardous)
-C5-NN	1st input Conductivity, no 2nd input
-A-N	40-20 mA +Hart
-LA-N-NN	English
/UM/SCT	Universal mounting kit//SS tag

Element

ISC40G	General Purpose Conductivity Sensor
-GG	Glass filled PEEK, general model
T1	Temperature Element (Pt)
-05	Cable Length, 5 Meter

Immersion Fitting

ISC40FD	Immersion Fitting
-V	Material PVC-C
-15	Probe Length 1.5 Meters
-SFA	AISI316 SS 2" Flange

Cable and Junction Box

4 meter Sensor Cable / 5 meter connector cable

AECOM

Analyzer Instrument

Conductivity

DATA SHEET NO.	REV.
CIT-1527	A

NO.	BY	DATE	REVISION

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1	1	01-17-13

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REQ.	

Project:	RLWTF							
TAG NO:	LLW-CIT-1527	Hookup Drawings:	N/A	Loop Wiring Diagrams:	M-6397			
		Spec No:	40 9100	Line / Vessel Number:	LLW-303-SS150			
Asset No:		P&ID:	D-6412	Line ID:	3.07"	Size:	3"	Schedule: 40
Service Description:	Effluent Recirculation / Discharge			Manufacturer:	Yokogawa			
				Model:	FLXA21-D-E-D-AA-C5-NN-A-N-LA-N-NN/UM/SCT			
Safety Class	NS	Quality Assurance Level		ML-4				

PROCESS CONDITIONS

Pressure:						Units	Fluid:	LLW
Oper:	N/A	Design:	1	H2OTst:	N/A	atm	Area Classification:	N/A
Temperature:							Ambient Temperature Requirements:	N/A
Min:	N/A	Normal:	75	Max:	125	deg F	Service: EFF	Critical: N/A
Flow:							Conductivity	Units
Min:	N/A	Normal:	N/A	Max:	N/A	N/A	Min: 0 / Normal: 5 / Max: 50	mS/m

ELEMENT

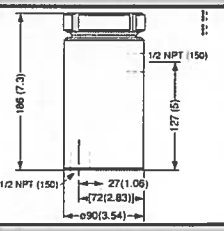
Tag Name:	LLW-CE-1527	SS Tag:	Yes
Type:	Inductive Conductivity		
Process Connection:	2" screw-in coupling		
Electrical Connection:	VP connector		
Isothermal Point:	N/A		
Max Pressure Rating:	300 PSIG	Max temperature:	270 deg F
Body Material:	PVC	Electrode Material:	Victrex PEEK
Insulation Material	N/A	O-ring Material:	Viton
90% Temp resp	< 5 min	Temp Element:	Pt1000
Element Diameter	1.85 in		
Element Length:	7.16 in		
Immersion Length:	4.88 in		
Manufacturer:	Yokogawa		
Model:	ISC40G-GG-T1-05		

TRANSMITTER

Voltage:	24V dc				
Power Wiring:	Loop	Signal Type:	4 - 20 mA		
Communication Protocol:	HART	Location:	Remote		
Smart:	Yes	Indicate:	Yes	Isolate:	No
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1	6	IP2:	6
Ambient Temperature Compensation:	Yes				
Factory Calibration:	Yes				
Comp Algorithm:	Matrix ±3%				
Conduit Connection	qty 3 M20 Gland				
Operating Temp:	-4 to 131 deg F	Humidity:	10 to 95% RH		
Body Material:	Stainless Steel				
SS Tag:	Yes				
Accuracy:	≤0.01 pH	Calibrated Range:	-2 to 16 pH		

FITTING SUBASSEMBLY

Type:	Flow Fitting		
Assy Length:	7.3 in (w / 5 in flow offset)		
Assy Diameter:	3.54 in		
Assy Material:	SS	O-ring Material	Viton
Process Connection:	1/2 in FNPT		
Signal Connection:	N/A		
Manufacturer:	Yokogawa		
Model:	ISC40FF-S-A/MS/M		



NOTES

Transmitter		Element		Flow Fitting	
FLXA21	Model	ISC40G	General Purpose Conductivity Sensor	ISC40FF	Flow Fitting Subassembly
-D	Power Supply	-GG	Glass filled PEEK, general model	-S	AISI 316 Stainless Steel
-E	Stainless steel housing w/Epoxy coating	T1	Temperature Element (Pt)	-A	NPT
-D	Anti-glare LCD display	-03	Cable Length, 3 Meter	/MS	Wall/pipe for SSI Flow Fitting -AA
General Purpose (non-hazardous)				/M	Material Certificate 3.1 EN 10024
-C5-NN	1st input Conductivity, no 2nd input				for wetted metal parts only
-A-N	40-20 mA +Hart				
-LA-N-NN	English				
/UM/SCT	Universal mounting kit//SS tag				

Cable and Junction Box
4 meter Sensor Cable / 5 meter connector cable

AECOM

Flow Instrument
Rotameter

DATA SHEET NO.			REV.
FI-5010			A
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1	1	1-17-13	

NO.	BY	DATE	REVISION

BY	CHK'D	PROC.	APPR.
NCC	AME		

P.O.	
REQ.	

Project:	RLWTF								
TAG NO:	FAC-FI-5010	Hookup Drawings:	N/A	Loop Wiring Diagram:	N/A'				
		Spec:	28 3233	Line / Vessel Number:	N/A				
Asset No:		P&ID:	P-6007	Line ID:		Size:	3/8 in	Schedule:	Tubing
Service Description:	CAM 5010 exhaust			Manufacturer:	Brooks				
				Model:	1358F-1A4GC2B1C				
Safety Level:	NS			Quality Level:	ML-4				

PROCESS CONDITIONS

Fluid:	Air				Liquid:	Units:	Vapor:	Units:	Differential:	Units:
Fluid State Present:	N/A		Flow :	Min:	N/A	N/A		l/hr	N/A	N/A
Compressibility (Z):	N/A	Units:		Normal (Operating)	N/A		4500		N/A	
Temperature @ Operating:	75	deg F		Max (Full Scale):	N/A		6300		N/A	
Pressure @ Operating:	11.7	in Hg	SG/Density @ Operating:	Air				N/A		
Vapor Pressure:	N/A		Viscosity @ Operating:	Air				N/A		
Base Pressure:	N/A		Specific Heat Ratio (C_P/C_V):	N/A			% Solids:	N/A		
Base Temperature:	N/A		Steam % Quality or °Superheat:	N/A			Pipe Material:	N/A		
Flange Material:	N/A		Flange Rating:	N/A						

METER

Tube Material:	Borosilicate Glass	Float Material:	316 SS
Process Conn:	3/8" NPT		
Process Conn Material:	316 Stainless Steel		
Holder Material:	316 Stainless Steel		
Scale Range:	3.4 scfm	Rangeability:	10:1
Rated Accuracy:	±10% (full scale)	Meter Length:	75 mm
Max Temp:	250 deg F	Max Press:	200 psig
Fitting Material:	316 SS	O-ring Material:	Viton
SS Tag:	Yes	Mounting:	Panel Install

VALVE

Valve Location:	Inlet	Valve Size:	N/A
Tube packing	Viton		

NOTES

1358F-1A4GC2B1C
1358F - Size 8 SHO-RATE "50" Flow Indicator
1 - TUBE: R-8M-75-1 (Cut-Off)
A - FLOAT (316 STAINLESS STEEL): 8-RV-8
4 - SCALE TYPE / SIDE PLATE ARRANGEMENT: Stainless Steel Detachable Scale Mounted to Right Side Plate
G - SCALE INSCRIPTION: Special Calibration, 10% Full Scale Air
C - TUBE PACKING AND O-RING MATERIALS FOR METER / VALVE: Viton Tube Packing, Viton O-ring
2 - FITTING AND ADAPTER MATERIAL / PROCESS CONNECTION SIZE AND TYPE: 3/8" NPT Connection, 316 Stainless Steel Fitting and Adapter
B - VALVE CONFIGURATION: Standard Stainless Steel Needle Valve on Inlet
1 - CONNECTION ORIENTATION: Inlet Port Back, Outlet Port Back
C - ACCESSORIES: Stainless Steel Side Plates
Filter Holder: F&J Model FJ-46P - Diameter: 47 mm; Connection: 3/8" FPT
Critical Flow Venturi: Flow Systems Part No. SN-06-NPT-0.XXX-SS - 3/8" MNPT Hex Body,

AECOM

Flow Instrument
Rotameter

DATA SHEET NO.			REV.
FI-5011			A
SHEET	OF	DATE	
1	1	1-17-13	

NO.	BY	DATE	REVISION

BY	CHK'D	PROC.	APPR.
NCC	AME		

P.O.	
REQ.	

Project:	RLWTF

TAG NO:	FAC-FI-5011	Hookup Drawings:	N/A	Loop Wiring Diagram:	N/A'					
		Spec:	28 3233	Line / Vessel Number:	N/A					
Asset No:		P&ID:	P-6007	Line ID:		Size:	3/8 in	Schedule:	Tubing	
Service Description:	CAM 5011 exhaust			Manufacturer:	Brooks					
				Model:	1358F-1A4GC2B1C					
Safety Level:	NS			Quality Level:	ML-4					

PROCESS CONDITIONS

Fluid:	Air		Flow:		Liquid:	Units:	Vapor:	Units:	Differential:	Units:
Fluid State Present:	N/A			Min:	N/A	N/A		l/hr	N/A	N/A
Compressibility (Z):	N/A	Units:		Normal (Operating)	N/A		4500		N/A	
Temperature @ Operating:	75	deg F		Max (Full Scale):	N/A		6300		N/A	
Pressure @ Operating:	11.7	in Hg	SG/Density @ Operating:	Air				N/A		
Vapor Pressure:	N/A		Viscosity @ Operating:	Air				N/A		
Base Pressure:	N/A		Specific Heat Ratio (C_P/C_V):	N/A		% Solids:	N/A			
Base Temperature:	N/A		Steam % Quality or °Superheat:	N/A		Pipe Material:	N/A			
Flange Material:	N/A		Flange Rating:	N/A						

METER

Tube Material:	Borosilicate Glass	Float Material:	316 SS
Process Conn:	3/8" NPT		
Process Conn Material:	316 Stainless Steel		
Holder Material:	316 Stainless Steel		
Scale Range:	3.4 scfm	Rangeability:	10:1
Rated Accuracy:	±10% (full scale)	Meter Length:	75 mm
Max Temp:	250 deg F	Max Press:	200 psig
Fitting Material:	316 SS	O-ring Material:	Viton
SS Tag:	Yes	Mounting:	Panel Install

VALVE

Valve Location:	Inlet	Valve Size:	N/A
Tube packing	Viton		

NOTES

1358F-1A4GC2B1C
1358F - Size 8 SHO-RATE "50" Flow Indicator
1 - TUBE: R-8M-75-1 (Cut-Off)
A - FLOAT (316 STAINLESS STEEL): 8-RV-8
4 - SCALE TYPE / SIDE PLATE ARRANGEMENT: Stainless Steel Detachable Scale Mounted to Right Side Plate
G - SCALE INSCRIPTION: Special Calibration, 10% Full Scale Air
C - TUBE PACKING AND O-RING MATERIALS FOR METER / VALVE: Viton Tube Packing, Viton O-ring
2 - FITTING AND ADAPTER MATERIAL / PROCESS CONNECTION SIZE AND TYPE: 3/8" NPT Connection, 316 Stainless Steel Fitting and Adapter
B - VALVE CONFIGURATION: Standard Stainless Steel Needle Valve on Inlet
1 - CONNECTION ORIENTATION: Inlet Port Back, Outlet Port Back
C - ACCESSORIES: Stainless Steel Side Plates
Filter Holder: F&J Model FJ-46P - Diameter: 47 mm; Connection: 3/8" FPT
Critical Flow Venturi: Flow Systems Part No. SN-06-NPT-0.XXX-SS - 3/8" MNPT Hex Body,

AECOM

Flow Instrument
Rotameter

DATA SHEET NO.			REV.
FI-5012			A
SHEET	OF	DATE	
1	1	1-17-13	

NO.	BY	DATE	REVISION

BY	CHK'D	PROC.	APPR.
NCC	AME		

P.O.	
REQ.	

Project:	RLWTF

TAG NO:	FAC-FI-5012	Hookup Drawings:	N/A	Loop Wiring Diagram:	N/A'	
		Spec:	28 3233	Line / Vessel Number:	N/A	
Asset No:		P&ID:	P-6007	Line ID:	Size: 3/8 in	Schedule: Tubing
Service Description:	CAM 5012 exhaust			Manufacturer:	Brooks	
				Model:	1358F-1A4GC2B1C	
Safety Level:	NS			Quality Level:	ML-4	

PROCESS CONDITIONS

Fluid:	Air				Liquid:	Units:	Vapor:	Units:	Differential:	Units:	
Fluid State Present:	N/A		Flow:	Min:	N/A	N/A		l/hr	N/A	N/A	
Compressibility (Z):	N/A	Units:		Normal (Operating)	N/A		4500		N/A		
Temperature @ Operating:	75	deg F		Max (Full Scale):	N/A		6300		N/A		
Pressure @ Operating:	11.7	in Hg	SG/Density @ Operating:		Air			N/A			
Vapor Pressure:	N/A		Viscosity @ Operating:		Air			N/A			
Base Pressure:	N/A		Specific Heat Ratio (C_P/C_V):		N/A		% Solids:		N/A		
Base Temperature:	N/A		Steam % Quality or °Superheat:		N/A		Pipe Material:		N/A		
Flange Material:	N/A		Flange Rating:		N/A						

METER

Tube Material:	Borosilicate Glass	Float Material:	316 SS
Process Conn:	3/8" NPT		
Process Conn Material:	316 Stainless Steel		
Holder Material:	316 Stainless Steel		
Scale Range:	3.4 scfm	Rangeability:	10:1
Rated Accuracy:	±10% (full scale)	Meter Length:	75 mm
Max Temp:	250 deg F	Max Press:	200 psig
Fitting Material:	316 SS	O-ring Material:	Viton
SS Tag:	Yes	Mounting:	Panel Install

VALVE

Valve Location:	Inlet	Valve Size:	N/A
Tube packing	Viton		

NOTES

1358F-1A4GC2B1C
1358F - Size 8 SHO-RATE "50" Flow Indicator
1 - TUBE: R-8M-75-1 (Cut-Off)
A - FLOAT (316 STAINLESS STEEL): 8-RV-8
4 - SCALE TYPE / SIDE PLATE ARRANGEMENT: Stainless Steel Detachable Scale Mounted to Right Side Plate
G - SCALE INSCRIPTION: Special Calibration, 10% Full Scale Air
C - TUBE PACKING AND O-RING MATERIALS FOR METER / VALVE: Viton Tube Packing, Viton O-ring
2 - FITTING AND ADAPTER MATERIAL / PROCESS CONNECTION SIZE AND TYPE: 3/8" NPT Connection, 316 Stainless Steel Fitting and Adapter
B - VALVE CONFIGURATION: Standard Stainless Steel Needle Valve on Inlet
1 - CONNECTION ORIENTATION: Inlet Port Back, Outlet Port Back
C - ACCESSORIES: Stainless Steel Side Plates
Filter Holder: F&J Model FJ-46P - Diameter: 47 mm; Connection: 3/8" FPT
Critical Flow Venturi: Flow Systems Part No. SN-06-NPT-0.XXX-SS - 3/8" MNPT Hex Body,

AECOM

Flow Instrument
Rotameter

DATA SHEET NO.	REV.
FI-5013	A

SHEET	OF	DATE
1	1	1-17-13

NO.	BY	DATE	REVISION

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NCC	AME		

P.O.	
REQ.	

Project:	RLWTF

TAG NO:	FAC-FI-5013	Hookup Drawings:	N/A	Loop Wiring Diagram:	N/A'
		Spec:	28 3233	Line / Vessel Number:	N/A
Asset No:		P&ID:	P-6007	Line ID:	Size: 3/8 in Schedule: Tubing
Service Description:	CAM 5013 exhaust			Manufacturer:	Brooks
				Model:	1358F-1A4GC2B1C
Safety Level:	NS			Quality Level:	ML-4

PROCESS CONDITIONS

					Liquid:	Units:	Vapor:	Units:	Differential:	Units:
Fluid:	Air		Flow:	Min:	N/A	N/A		l/hr	N/A	N/A
Fluid State Present:	N/A			Normal (Operating)	N/A		4500		N/A	
Compressibility (Z):	N/A	Units:		Max (Full Scale):	N/A		6300		N/A	
Temperature @ Operating:	75	deg F	SG/Density @ Operating:		Air			N/A		
Pressure @ Operating:	11.7	in Hg	Viscosity @ Operating:		Air			N/A		
Vapor Pressure:	N/A		Specific Heat Ratio (C_P/C_V):		N/A		% Solids:	N/A		
Base Pressure:	N/A		Steam % Quality or °Superheat:		N/A		Pipe Material:	N/A		
Base Temperature:	N/A		Flange Rating:		N/A					
Flange Material:	N/A									

METER

Tube Material:	Borosilicate Glass	Float Material:	316 SS
Process Conn:	3/8" NPT		
Process Conn Material:	316 Stainless Steel		
Holder Material:	316 Stainless Steel		
Scale Range:	3.4 scfm	Rangeability:	10:1
Rated Accuracy:	±10% (full scale)	Meter Length:	75 mm
Max Temp:	250 deg F	Max Press:	200 psig
Fitting Material:	316 SS	O-ring Material:	Viton
SS Tag:	Yes	Mounting:	Panel Install

VALVE

Valve Location:	Inlet	Valve Size:	N/A
Tube packing	Viton		

NOTES

1358F-1A4GC2B1C
1358F - Size 8 SHO-RATE "50" Flow Indicator
1 - TUBE: R-8M-75-1 (Cut-Off)
A - FLOAT (316 STAINLESS STEEL): 8-RV-8
4 - SCALE TYPE / SIDE PLATE ARRANGEMENT: Stainless Steel Detachable Scale Mounted to Right Side Plate
G - SCALE INSCRIPTION: Special Calibration, 10% Full Scale Air
C - TUBE PACKING AND O-RING MATERIALS FOR METER / VALVE: Viton Tube Packing, Viton O-ring
2 - FITTING AND ADAPTER MATERIAL / PROCESS CONNECTION SIZE AND TYPE: 3/8" NPT Connection, 316 Stainless Steel Fitting and Adapter
B - VALVE CONFIGURATION: Standard Stainless Steel Needle Valve on Inlet
1 - CONNECTION ORIENTATION: Inlet Port Back, Outlet Port Back
C - ACCESSORIES: Stainless Steel Side Plates
Filter Holder: F&J Model FJ-46P - Diameter: 47 mm; Connection: 3/8" FPT
Critical Flow Venturi: Flow Systems Part No. SN-06-NPT-0.XXX-SS - 3/8" MNPT Hex Body,

AECOM

Flow Instrument
Rotameter

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
FI-5014			A
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1	1	1-17-13	
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NCC	AME		
P.O.			
REQ.			

Project:	RLWTF								
TAG NO:	FAC-FI-5014	Hookup Drawings:	N/A	Loop Wiring Diagram:	N/A'				
		Spec:	28 3233	Line / Vessel Number:	N/A				
Asset No:		P&ID:	P-6007	Line ID:		Size:	3/8 in	Schedule:	Tubing
Service Description:	CAM 5014 exhaust			Manufacturer:	Brooks				
				Model:	1358F-1A4GC2B1C				
Safety Level:	NS			Quality Level:	ML-4				

PROCESS CONDITIONS

Fluid:	Air					Liquid:	Units:	Vapor:	Units:	Differential:	Units:
Fluid State Present:	N/A		Flow:	Min:		N/A	N/A		l/hr	N/A	N/A
Compressibility (Z):	N/A	Units:		Normal (Operating)		N/A		4500		N/A	
Temperature @ Operating:	75	deg F		Max (Full Scale):		N/A		6300		N/A	
Pressure @ Operating:	11.7	in Hg	SG/Density @ Operating:		Air				N/A		
Vapor Pressure:	N/A		Viscosity @ Operating:		Air				N/A		
Base Pressure:	N/A		Specific Heat Ratio (C_P/C_V):		N/A		% Solids:		N/A		
Base Temperature:	N/A		Steam % Quality or °Superheat:		N/A		Pipe Material:		N/A		
Flange Material:	N/A		Flange Rating:		N/A						

METER

Tube Material:	Borosilicate Glass	Float Material:	316 SS
Process Conn:	3/8" NPT		
Process Conn Material:	316 Stainless Steel		
Holder Material:	316 Stainless Steel		
Scale Range:	3.4 scfm	Rangeability:	10:1
Rated Accuracy:	±10% (full scale)	Meter Length:	75 mm
Max Temp:	250 deg F	Max Press:	200 psig
Fitting Material:	316 SS	O-ring Material:	Viton
SS Tag:	Yes	Mounting:	Panel Install

VALVE

Valve Location:	Inlet	Valve Size:	N/A
Tube packing	Viton		

NOTES

1358F-1A4GC2B1C
1358F - Size 8 SHO-RATE "50" Flow Indicator
1 - TUBE: R-8M-75-1 (Cut-Off)
A - FLOAT (316 STAINLESS STEEL): 8-RV-8
4 - SCALE TYPE / SIDE PLATE ARRANGEMENT: Stainless Steel Detachable Scale Mounted to Right Side Plate
G - SCALE INSCRIPTION: Special Calibration, 10% Full Scale Air
C - TUBE PACKING AND O-RING MATERIALS FOR METER / VALVE: Viton Tube Packing, Viton O-ring
2 - FITTING AND ADAPTER MATERIAL / PROCESS CONNECTION SIZE AND TYPE: 3/8" NPT Connection, 316 Stainless Steel Fitting and Adapter
B - VALVE CONFIGURATION: Standard Stainless Steel Needle Valve on Inlet
1 - CONNECTION ORIENTATION: Inlet Port Back, Outlet Port Back
C - ACCESSORIES: Stainless Steel Side Plates
Filter Holder: F&J Model FJ-46P - Diameter: 47 mm; Connection: 3/8" FPT
Critical Flow Venturi: Flow Systems Part No. SN-06-NPT-0.XXX-SS - 3/8" MNPT Hex Body,

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Flow Instrument
Rotameter

DATA SHEET NO.			REV.
FI-5015			A
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1	1	1-17-13	

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NCC	AME		

P.O.	
REQ.	

Project:	RLWTF								
TAG NO:	FAC-FI-5015	Hookup Drawings:	N/A	Loop Wiring Diagram:	N/A'				
		Spec:	28 3233	Line / Vessel Number:	N/A				
Asset No:		P&ID:	P-6007	Line ID:		Size:	3/8 in	Schedule:	Tubing
Service Description:	CAM 5015 exhaust			Manufacturer:	Brooks				
				Model:	1358F-1A4GC2B1C				
Safety Level:	NS			Quality Level:	ML-4				

PROCESS CONDITIONS

Fluid:	Air				Liquid:	Units:	Vapor:	Units:	Differential:	Units:	
Fluid State Present:	N/A		Flow:	Min:	N/A	N/A		l/hr	N/A	N/A	
Compressibility (Z):	N/A	Units:		Normal (Operating)	N/A		4500		N/A		
Temperature @ Operating:	75	deg F		Max (Full Scale):	N/A		6300		N/A		
Pressure @ Operating:	11.7	in Hg	SG/Density @ Operating:		Air			N/A			
Vapor Pressure:	N/A		Viscosity @ Operating:		Air			N/A			
Base Pressure:	N/A		Specific Heat Ratio (C_p/C_v):		N/A		% Solids:	N/A			
Base Temperature:	N/A		Steam % Quality or °Superheat:		N/A		Pipe Material:	N/A			
Flange Material:	N/A		Flange Rating:		N/A						

METER

Tube Material:	Borosilicate Glass	Float Material:	316 SS
Process Conn:	3/8" NPT		
Process Conn Material:	316 Stainless Steel		
Holder Material:	316 Stainless Steel		
Scale Range:	3.4 scfm	Rangeability:	10:1
Rated Accuracy:	±10% (full scale)	Meter Length:	75 mm
Max Temp:	250 deg F	Max Press:	200 psig
Fitting Material:	316 SS	O-ring Material:	Viton
SS Tag:	Yes	Mounting:	Panel Install

VALVE

Valve Location:	Inlet	Valve Size:	N/A
Tube packing	Viton		

NOTES

1358F-1A4GC2B1C
1358F - Size 8 SHO-RATE "50" Flow Indicator
1 - TUBE: R-8M-75-1 (Cut-Off)
A - FLOAT (316 STAINLESS STEEL): 8-RV-8
4 - SCALE TYPE / SIDE PLATE ARRANGEMENT: Stainless Steel Detachable Scale Mounted to Right Side Plate
G - SCALE INSCRIPTION: Special Calibration, 10% Full Scale Air
C - TUBE PACKING AND O-RING MATERIALS FOR METER / VALVE: Viton Tube Packing, Viton O-ring
2 - FITTING AND ADAPTER MATERIAL / PROCESS CONNECTION SIZE AND TYPE: 3/8" NPT Connection, 316 Stainless Steel Fitting and Adapter
B - VALVE CONFIGURATION: Standard Stainless Steel Needle Valve on Inlet
1 - CONNECTION ORIENTATION: Inlet Port Back, Outlet Port Back
C - ACCESSORIES: Stainless Steel Side Plates
Filter Holder: F&J Model FJ-46P - Diameter: 47 mm; Connection: 3/8" FPT
Critical Flow Venturi: Flow Systems Part No. SN-06-NPT-0.XXX-SS - 3/8" MNPT Hex Body,

AECOM

Flow Instrument
Rotameter

DATA SHEET NO.	REV.
FI-5016	A

SHEET	OF	DATE
1	1	1-17-13

NO.	BY	DATE	REVISION

BY	CHK'D	PROC.	APPR.
NCC	AME		

P.O.	
REQ.	

Project:	RLWTF

TAG NO:	FAC-FI-5016	Hookup Drawings:	N/A	Loop Wiring Diagram:	N/A'	
		Spec:	28 3233	Line / Vessel Number:	N/A	
Asset No:		P&ID:	P-6007	Line ID:	Size: 3/8 in	Schedule: Tubing
Service Description:	CAM 5016 exhaust			Manufacturer:	Brooks	
				Model:	1358F-1A4GC2B1C	
Safety Level:	NS			Quality Level:	ML-4	

PROCESS CONDITIONS

					Liquid:	Units:	Vapor:	Units:	Differential:	Units:
Fluid:	Air		Flow:	Min:	N/A	N/A		l/hr	N/A	N/A
Fluid State Present:	N/A			Normal (Operating)	N/A		4500		N/A	
Compressibility (Z):	N/A	Units:		Max (Full Scale):	N/A		6300		N/A	
Temperature @ Operating:	75	deg F								
Pressure @ Operating:	11.7	in Hg	SG/Density @ Operating:		Air			N/A		
Vapor Pressure:	N/A		Viscosity @ Operating:		Air			N/A		
Base Pressure:	N/A		Specific Heat Ratio (C_P/C_V):		N/A		% Solids:	N/A		
Base Temperature:	N/A		Steam % Quality or °Superheat:		N/A		Pipe Material:	N/A		
Flange Material:	N/A		Flange Rating:		N/A					

METER

Tube Material:	Borosilicate Glass	Float Material:	316 SS
Process Conn:	3/8" NPT		
Process Conn Material:	316 Stainless Steel		
Holder Material:	316 Stainless Steel		
Scale Range:	3.4 scfm	Rangeability:	10:1
Rated Accuracy:	±10% (full scale)	Meter Length:	75 mm
Max Temp:	250 deg F	Max Press:	200 psig
Fitting Material:	316 SS	O-ring Material:	Viton
SS Tag:	Yes	Mounting:	Panel Install

VALVE

Valve Location:	Inlet	Valve Size:	N/A
Tube packing	Viton		

NOTES

1358F-1A4GC2B1C
1358F - Size 8 SHO-RATE "50" Flow Indicator
1 - TUBE: R-8M-75-1 (Cut-Off)
A - FLOAT (316 STAINLESS STEEL): 8-RV-8
4 - SCALE TYPE / SIDE PLATE ARRANGEMENT: Stainless Steel Detachable Scale Mounted to Right Side Plate
G - SCALE INSCRIPTION: Special Calibration, 10% Full Scale Air
C - TUBE PACKING AND O-RING MATERIALS FOR METER / VALVE: Viton Tube Packing, Viton O-ring
2 - FITTING AND ADAPTER MATERIAL / PROCESS CONNECTION SIZE AND TYPE: 3/8" NPT Connection, 316 Stainless Steel Fitting and Adapter
B - VALVE CONFIGURATION: Standard Stainless Steel Needle Valve on Inlet
1 - CONNECTION ORIENTATION: Inlet Port Back, Outlet Port Back
C - ACCESSORIES: Stainless Steel Side Plates
Filter Holder: F&J Model FJ-46P - Diameter: 47 mm; Connection: 3/8" FPT
Critical Flow Venturi: Flow Systems Part No. SN-06-NPT-0.XXX-SS - 3/8" MNPT Hex Body,

AECOM

Flow Instrument
Rotameter

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
FI-5017			A
SHEET	OF	DATE	
1	1	1-17-13	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project:	RLWTF								
TAG NO:	FAC-FI-5017	Hookup Drawings:	N/A	Loop Wiring Diagram:	N/A'				
		Spec:	28 3233	Line / Vessel Number:	N/A				
Asset No:		P&ID:	P-6007	Line ID:		Size:	3/8 in	Schedule:	Tubing
Service Description:	CAM 5017 exhaust			Manufacturer:	Brooks				
				Model:	1358F-1A4GC2B1C				
Safety Level:	NS			Quality Level:	ML-4				

PROCESS CONDITIONS

Fluid:	Air					Liquid:	Units:	Vapor:	Units:	Differential:	Units:
Fluid State Present:	N/A		Flow:	Min:		N/A	N/A		l/hr	N/A	N/A
Compressibility (Z):	N/A	Units:		Normal (Operating)		N/A		4500		N/A	
Temperature @ Operating:	75	deg F		Max (Full Scale):		N/A		6300		N/A	
Pressure @ Operating:	11.7	in Hg	SG/Density @ Operating:		Air				N/A		
Vapor Pressure:	N/A		Viscosity @ Operating:		Air				N/A		
Base Pressure:	N/A		Specific Heat Ratio (C_P/C_V):		N/A		% Solids:		N/A		
Base Temperature:	N/A		Steam % Quality or °Superheat:		N/A		Pipe Material:		N/A		
Flange Material:	N/A		Flange Rating:		N/A						

METER

Tube Material:	Borosilicate Glass	Float Material:	316 SS
Process Conn:	3/8" NPT		
Process Conn Material:	316 Stainless Steel		
Holder Material:	316 Stainless Steel		
Scale Range:	3.4 scfm	Rangeability:	10:1
Rated Accuracy:	±10% (full scale)	Meter Length:	75 mm
Max Temp:	250 deg F	Max Press:	200 psig
Fitting Material:	316 SS	O-ring Material:	Viton
SS Tag:	Yes	Mounting:	Panel Install

VALVE

Valve Location:	Inlet	Valve Size:	N/A
Tube packing	Viton		

NOTES

1358F-1A4GC2B1C

1358F - Size 8 SHO-RATE "50" Flow Indicator

1 - TUBE: R-8M-75-1 (Cut-Off)

A - FLOAT (316 STAINLESS STEEL): 8-RV-8

4 - SCALE TYPE / SIDE PLATE ARRANGEMENT: Stainless Steel Detachable Scale Mounted to Right Side Plate

G - SCALE INSCRIPTION: Special Calibration, 10% Full Scale Air

C - TUBE PACKING AND O-RING MATERIALS FOR METER / VALVE: Viton Tube Packing, Viton O-ring

2 - FITTING AND ADAPTER MATERIAL / PROCESS CONNECTION SIZE AND TYPE: 3/8" NPT Connection, 316 Stainless Steel Fitting and Adapter

B - VALVE CONFIGURATION: Standard Stainless Steel Needle Valve on Inlet

1 - CONNECTION ORIENTATION: Inlet Port Back, Outlet Port Back

C - ACCESSORIES: Stainless Steel Side Plates

Filter Holder: F&J Model FJ-46P - Diameter: 47 mm; Connection: 3/8" FPT

Critical Flow Venturi: Flow Systems Part No. SN-06-NPT-0.XXX-SS - 3/8" MNPT Hex Body,

AECOM

Flow Instrument
Rotameter

DATA SHEET NO.			REV.
FI-5018			A
SHEET	OF	DATE	
1	1	1-17-13	

NO.	BY	DATE	REVISION

BY	CHK'D	PROC.	APPR.
NCC	AME		

P.O.	
REQ.	

Project:	RLWTF								
TAG NO:	FAC-FI-5018	Hookup Drawings:	N/A	Loop Wiring Diagram:	N/A'				
		Spec:	28 3233	Line / Vessel Number:	N/A				
Asset No:		P&ID:	P-6007	Line ID:		Size:	3/8 in	Schedule:	Tubing
Service Description:	CAM 5018 exhaust			Manufacturer:	Brooks				
				Model:	1358F-1A4GC2B1C				
Safety Level:	NS			Quality Level:	ML-4				

PROCESS CONDITIONS

Fluid:	Air		Flow:		Liquid:	Units:	Vapor:	Units:	Differential:	Units:	
Fluid State Present:	N/A			Min:	N/A	N/A		l/hr	N/A	N/A	
Compressibility (Z):	N/A	Units:		Normal (Operating)	N/A		4500		N/A		
Temperature @ Operating:	75	deg F		Max (Full Scale):	N/A		6300		N/A		
Pressure @ Operating:	11.7	in Hg	SG/Density @ Operating:		Air			N/A			
Vapor Pressure:	N/A		Viscosity @ Operating:		Air			N/A			
Base Pressure:	N/A		Specific Heat Ratio (C_P/C_V):		N/A		% Solids:		N/A		
Base Temperature:	N/A		Steam % Quality or °Superheat:		N/A		Pipe Material:		N/A		
Flange Material:	N/A		Flange Rating:		N/A						

METER

Tube Material:	Borosilicate Glass	Float Material:	316 SS
Process Conn:	3/8" NPT		
Process Conn Material:	316 Stainless Steel		
Holder Material:	316 Stainless Steel		
Scale Range:	3.4 scfm	Rangeability:	10:1
Rated Accuracy:	±10% (full scale)	Meter Length:	75 mm
Max Temp:	250 deg F	Max Press:	200 psig
Fitting Material:	316 SS	O-ring Material:	Viton
SS Tag:	Yes	Mounting:	Panel Install

VALVE

Valve Location:	Inlet	Valve Size:	N/A
Tube packing	Viton		

NOTES

1358F-1A4GC2B1C
1358F - Size 8 SHO-RATE "50" Flow Indicator
1 - TUBE: R-8M-75-1 (Cut-Off)
A - FLOAT (316 STAINLESS STEEL): 8-RV-8
4 - SCALE TYPE / SIDE PLATE ARRANGEMENT: Stainless Steel Detachable Scale Mounted to Right Side Plate
G - SCALE INSCRIPTION: Special Calibration, 10% Full Scale Air
C - TUBE PACKING AND O-RING MATERIALS FOR METER / VALVE: Viton Tube Packing, Viton O-ring
2 - FITTING AND ADAPTER MATERIAL / PROCESS CONNECTION SIZE AND TYPE: 3/8" NPT Connection, 316 Stainless Steel Fitting and Adapter
B - VALVE CONFIGURATION: Standard Stainless Steel Needle Valve on Inlet
1 - CONNECTION ORIENTATION: Inlet Port Back, Outlet Port Back
C - ACCESSORIES: Stainless Steel Side Plates
Filter Holder: F&J Model FJ-46P - Diameter: 47 mm; Connection: 3/8" FPT
Critical Flow Venturi: Flow Systems Part No. SN-06-NPT-0.XXX-SS - 3/8" MNPT Hex Body,

AECOM

Flow Instrument
Rotameter

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
FI-5019			A
SHEET	OF	DATE	
1	1	1-17-13	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project:	RLWTF									
TAG NO:	FAC-FI-5019	Hookup Drawings:	N/A	Loop Wiring Diagram:	N/A'					
		Spec:	28 3233	Line / Vessel Number:	N/A					
Asset No:		P&ID:	P-6007	Line ID:		Size:	3/8 in	Schedule:	Tubing	
Service Description:	CAM 5019 exhaust			Manufacturer:	Brooks					
				Model:	1358F-1A4GC2B1C					
Safety Level:	NS			Quality Level:	ML-4					

PROCESS CONDITIONS

Fluid:	Air			Flow:		Liquid:	Units:	Vapor:	Units:	Differential:	Units:
Fluid State Present:	N/A				Min:	N/A	N/A		l/hr	N/A	N/A
Compressibility (Z):	N/A	Units:			Normal (Operating)	N/A		4500		N/A	
Temperature @ Operating:	75	deg F			Max (Full Scale):	N/A		6300		N/A	
Pressure @ Operating:	11.7	in Hg		SG/Density @ Operating:		Air			N/A		
Vapor Pressure:	N/A			Viscosity @ Operating:		Air			N/A		
Base Pressure:	N/A			Specific Heat Ratio (C_P/C_V):		N/A		% Solids:		N/A	
Base Temperature:	N/A			Steam % Quality or °Superheat:		N/A		Pipe Material:		N/A	
Flange Material:	N/A			Flange Rating:		N/A					

METER

Tube Material:	Borosilicate Glass	Float Material:	316 SS
Process Conn:	3/8" NPT		
Process Conn Material:	316 Stainless Steel		
Holder Material:	316 Stainless Steel		
Scale Range:	3.4 scfm	Rangeability:	10:1
Rated Accuracy:	±10% (full scale)	Meter Length:	75 mm
Max Temp:	250 deg F	Max Press:	200 psig
Fitting Material:	316 SS	O-ring Material:	Viton
SS Tag:	Yes	Mounting:	Panel Install

VALVE

Valve Location:	Inlet	Valve Size:	N/A
Tube packing	Viton		

NOTES

1358F-1A4GC2B1C
1358F - Size 8 SHO-RATE "50" Flow Indicator
1 - TUBE: R-8M-75-1 (Cut-Off)
A - FLOAT (316 STAINLESS STEEL): 8-RV-8
4 - SCALE TYPE / SIDE PLATE ARRANGEMENT: Stainless Steel Detachable Scale Mounted to Right Side Plate
G - SCALE INSCRIPTION: Special Calibration, 10% Full Scale Air
C - TUBE PACKING AND O-RING MATERIALS FOR METER / VALVE: Viton Tube Packing, Viton O-ring
2 - FITTING AND ADAPTER MATERIAL / PROCESS CONNECTION SIZE AND TYPE: 3/8" NPT Connection, 316 Stainless Steel Fitting and Adapter
B - VALVE CONFIGURATION: Standard Stainless Steel Needle Valve on Inlet
1 - CONNECTION ORIENTATION: Inlet Port Back, Outlet Port Back
C - ACCESSORIES: Stainless Steel Side Plates
Filter Holder: F&J Model FJ-46P - Diameter: 47 mm; Connection: 3/8" FPT
Critical Flow Venturi: Flow Systems Part No. SN-06-NPT-0.XXX-SS - 3/8" MNPT Hex Body,

AECOM

Flow Instrument
Rotameter

DATA SHEET NO.	REV.
FI-5020	A

SHEET	OF	DATE
1	1	1-17-13

NO.	BY	DATE	REVISION

BY	CHK'D	PROC.	APPR.
NCC	AME		

P.O.	
REQ.	

Project:	RLWTF

TAG NO:	FAC-FI-5020	Hookup Drawings:	N/A	Loop Wiring Diagram:	N/A'	
		Spec:	28 3233	Line / Vessel Number:	N/A	
Asset No:		P&ID:	P-6007	Line ID:	Size: 3/8 in	Schedule: Tubing
Service Description:	Facility Air Samplers			Manufacturer:	Brooks	
				Model:	1358F-1A4GC2B1C	
Safety Level:	NS			Quality Level:	ML-4	

PROCESS CONDITIONS

Fluid:	Air				Liquid:	Units:	Vapor:	Units:	Differential:	Units:
Fluid State Present:	N/A		Flow:	Min:	N/A	N/A		l/hr	N/A	N/A
Compressibility (Z):	N/A	Units:		Normal (Operating)	N/A		4500		N/A	
Temperature @ Operating:	75	deg F		Max (Full Scale):	N/A		6300		N/A	
Pressure @ Operating:	11.7	in Hg	SG/Density @ Operating:		Air			N/A		
Vapor Pressure:	N/A		Viscosity @ Operating:		Air			N/A		
Base Pressure:	N/A		Specific Heat Ratio (C_p/C_v):		N/A		% Solids:	N/A		
Base Temperature:	N/A		Steam % Quality or °Superheat:		N/A		Pipe Material:	N/A		
Flange Material:	N/A		Flange Rating:		N/A					

METER

Tube Material:	Borosilicate Glass	Float Material:	316 SS
Process Conn:	3/8" NPT		
Process Conn Material:	316 Stainless Steel		
Holder Material:	316 Stainless Steel		
Scale Range:	3.4 scfm	Rangeability:	10:1
Rated Accuracy:	±10% (full scale)	Meter Length:	75 mm
Max Temp:	250 deg F	Max Press:	200 psig
Fitting Material:	316 SS	O-ring Material:	Viton
SS Tag:	Yes	Mounting:	Panel Install

VALVE

Valve Location:	Inlet	Valve Size:	N/A
Tube packing	Viton		

NOTES

1358F-1A4GC2B1C
1358F - Size 8 SHO-RATE "50" Flow Indicator
1 - TUBE: R-8M-75-1 (Cut-Off)
A - FLOAT (316 STAINLESS STEEL): 8-RV-8
4 - SCALE TYPE / SIDE PLATE ARRANGEMENT: Stainless Steel Detachable Scale Mounted to Right Side Plate
G - SCALE INSCRIPTION: Special Calibration, 10% Full Scale Air
C - TUBE PACKING AND O-RING MATERIALS FOR METER / VALVE: Viton Tube Packing, Viton O-ring
2 - FITTING AND ADAPTER MATERIAL / PROCESS CONNECTION SIZE AND TYPE: 3/8" NPT Connection, 316 Stainless Steel Fitting and Adapter
B - VALVE CONFIGURATION: Standard Stainless Steel Needle Valve on Inlet
1 - CONNECTION ORIENTATION: Inlet Port Back, Outlet Port Back
C - ACCESSORIES: Stainless Steel Side Plates
Filter Holder: F&J Model FJ-46P - Diameter: 47 mm; Connection: 3/8" FPT
Critical Flow Venturi: Flow Systems Part No. SN-06-NPT-0.XXX-SS - 3/8" MNPT Hex Body,

AECOM

Flow Instrument
Rotameter

DATA SHEET NO.			REV.
FI-5021			A
SHEET	OF	DATE	
1	1	1-17-13	

NO.	BY	DATE	REVISION

BY	CHK'D	PROC.	APPR.
NCC	AME		

P.O.	
REQ.	

Project:	RLWTF

TAG NO:	FAC-FI-5021	Hookup Drawings:	N/A	Loop Wiring Diagram:	N/A'	<-
		Spec:	28 3233	Line / Vessel Number:	N/A	
Asset No:		P&ID:	P-6006	Line ID:	Size: 3/8 in Schedule: Tubing	<-
Service Description:	Facility Air Samplers			Manufacturer:	Brooks	<-
				Model:	1358F-1A4GC2B1C	<-
Safety Level:	NS			Quality Level:	ML-4	<-

PROCESS CONDITIONS

					Liquid:	Units:	Vapor:	Units:	Differential:	Units:	
Fluid:	Air		Flow:	Min:	N/A	N/A		l/hr	N/A	N/A	<-
Fluid State Present:	N/A			Normal (Operating)	N/A		4500		N/A		<-
Compressibility (Z):	N/A	Units:		Max (Full Scale):	N/A		6300		N/A		<-
Temperature @ Operating:	75	deg F									<-
Pressure @ Operating:	11.7	in Hg	SG/Density @ Operating:		Air			N/A			<-
Vapor Pressure:	N/A		Viscosity @ Operating:		Air			N/A			<-
Base Pressure:	N/A		Specific Heat Ratio ($^{Cp}/_{Cv}$):		N/A		% Solids:		N/A		<-
Base Temperature:	N/A		Steam % Quality or °Superheat:		N/A		Pipe Material:		N/A		<-
Flange Material:	N/A		Flange Rating		N/A						<-

METER

Tube Material:	Borosilicate Glass	Float Material:	316 SS
Process Conn:	3/8" NPT		
Process Conn Material:	316 Stainless Steel		
Holder Material:	316 Stainless Steel		
Scale Range:	3.4 scfm	Rangeability:	10:1
Rated Accuracy:	±10% (full scale)	Meter Length:	75 mm
Max Temp:	250 deg F	Max Press:	200 psig
Fitting Material:	316 SS	O-ring Material:	Viton
SS Tag:	Yes	Mounting:	Panel Install

VALVE

Valve Location:	Inlet	Valve Size:	N/A
Tube packing	Viton		

NOTES

1358F-1A4GC2B1C
1358F - Size 8 SHO-RATE "50" Flow Indicator
1 - TUBE: R-8M-75-1 (Cut-Off)
A - FLOAT (316 STAINLESS STEEL): 8-RV-8
4 - SCALE TYPE / SIDE PLATE ARRANGEMENT: Stainless Steel Detachable Scale Mounted to Right Side Plate
G - SCALE INSCRIPTION: Special Calibration, 10% Full Scale Air
C - TUBE PACKING AND O-RING MATERIALS FOR METER / VALVE: Viton Tube Packing, Viton O-ring
2 - FITTING AND ADAPTER MATERIAL / PROCESS CONNECTION SIZE AND TYPE: 3/8" NPT Connection, 316 Stainless Steel Fitting and Adapter
B - VALVE CONFIGURATION: Standard Stainless Steel Needle Valve on Inlet
1 - CONNECTION ORIENTATION: Inlet Port Back, Outlet Port Back
C - ACCESSORIES: Stainless Steel Side Plates
Filter Holder: F&J Model FJ-46P - Diameter: 47 mm; Connection: 3/8" FPT
Critical Flow Venturi: Flow Systems Part No. SN-06-NPT-0.XXX-SS - 3/8" MNPT Hex Body,

AECOM

Flow Instrument
Rotameter

DATA SHEET NO.			REV.
FI-5022			A
SHEET	OF	DATE	
1	1	1-17-13	

NO.	BY	DATE	REVISION

BY	CHK'D	PROC.	APPR.
NCC	AME		

P.O.	
REQ.	

Project:	RLWTF									
TAG NO:	FAC-FI-5022	Hookup Drawings:	N/A	Loop Wiring Diagram:	N/A'					<-
		Spec:	28 3233	Line / Vessel Number:	N/A					
Asset No:		P&ID:	P-6006	Line ID:		Size:	3/8 in	Schedule:	Tubing	<-
Service Description:	Facility Air Samplers			Manufacturer:	Brooks					<-
				Model:	1358F-1A4GC2B1C					<-
Safety Level:	NS			Quality Level:	ML-4					<-

PROCESS CONDITIONS

Fluid:	Air		Flow:		Liquid:	Units:	Vapor:	Units:	Differential:	Units:
Fluid State Present:	N/A			Min:	N/A	N/A		l/hr	N/A	N/A
Compressibility (Z):	N/A	Units:		Normal (Operating):	N/A		4500		N/A	
Temperature @ Operating:	75	deg F		Max (Full Scale):	N/A		6300		N/A	
Pressure @ Operating:	11.7	in Hg	SG/Density @ Operating:	Air				N/A		
Vapor Pressure:	N/A		Viscosity @ Operating:	Air				N/A		
Base Pressure:	N/A		Specific Heat Ratio (C_p/C_v):	N/A		% Solids:	N/A			
Base Temperature:	N/A		Steam % Quality or °Superheat:	N/A		Pipe Material:	N/A			
Flange Material:	N/A		Flange Rating	N/A						

METER

Tube Material:	Borosilicate Glass	Float Material:	316 SS
Process Conn:	3/8" NPT		
Process Conn Material:	316 Stainless Steel		
Holder Material:	316 Stainless Steel		
Scale Range:	3.4 scfm	Rangeability:	10:1
Rated Accuracy:	±10% (full scale)	Meter Length:	75 mm
Max Temp:	250 deg F	Max Press:	200 psig
Fitting Material:	316 SS	O-ring Material:	Viton
SS Tag:	Yes	Mounting:	Panel Install

VALVE

Valve Location:	Inlet	Valve Size:	N/A
Tube packing	Viton		

NOTES

1358F-1A4GC2B1C
1358F - Size 8 SHO-RATE "50" Flow Indicator
1 - TUBE: R-8M-75-1 (Cut-Off)
A - FLOAT (316 STAINLESS STEEL): 8-RV-8
4 - SCALE TYPE / SIDE PLATE ARRANGEMENT: Stainless Steel Detachable Scale Mounted to Right Side Plate
G - SCALE INSCRIPTION: Special Calibration, 10% Full Scale Air
C - TUBE PACKING AND O-RING MATERIALS FOR METER / VALVE: Viton Tube Packing, Viton O-ring
2 - FITTING AND ADAPTER MATERIAL / PROCESS CONNECTION SIZE AND TYPE: 3/8" NPT Connection, 316 Stainless Steel Fitting and Adapter
B - VALVE CONFIGURATION: Standard Stainless Steel Needle Valve on Inlet
1 - CONNECTION ORIENTATION: Inlet Port Back, Outlet Port Back
C - ACCESSORIES: Stainless Steel Side Plates
Filter Holder: F&J Model FJ-46P - Diameter: 47 mm; Connection: 3/8" FPT
Critical Flow Venturi: Flow Systems Part No. SN-06-NPT-0.XXX-SS - 3/8" MNPT Hex Body,

AECOM

Flow Instrument
Rotameter

DATA SHEET NO.			REV.
FI-5023			A
SHEET	OF	DATE	
1	1	1-17-13	

NO.	BY	DATE	REVISION

BY	CHK'D	PROC.	APPR.
NCC	AME		

P.O.:
REQ.:

Project: RLWTF

TAG NO: FAC-FI-5023

Hookup Drawings: N/A
Spec: 28 3233
P&ID: P-6006
Loop Wiring Diagram: N/A'
Line / Vessel Number: N/A
Asset No:
Line ID: Size: 3/8 in Schedule: Tubing
Service Description: Facility Air Samplers
Manufacturer: Brooks
Model: 1358F-1A4GC2B1C
Safety Level: NS
Quality Level: ML-4

PROCESS CONDITIONS

Fluid:	Air		Flow:		Liquid:	Units:	Vapor:	Units:	Differential:	Units:	
Fluid State Present:	N/A			Min:	N/A	N/A		l/hr	N/A	N/A	
Compressibility (Z):	N/A	Units:		Normal (Operating)	N/A		4500		N/A		
Temperature @ Operating:	75	deg F		Max (Full Scale):	N/A		6300		N/A		
Pressure @ Operating:	11.7	in Hg	SG/Density @ Operating:		Air			N/A			
Vapor Pressure:	N/A		Viscosity @ Operating:		Air			N/A			
Base Pressure:	N/A		Specific Heat Ratio ($^{Cp}/_{Cv}$):		N/A		% Solids:		N/A		
Base Temperature:	N/A		Steam % Quality or °Superheat:		N/A		Pipe Material:		N/A		
Flange Material:	N/A		Flange Rating		N/A						

METER

Tube Material:	Borosilicate Glass	Float Material:	316 SS
Process Conn:	3/8" NPT		
Process Conn Material:	316 Stainless Steel		
Holder Material:	316 Stainless Steel		
Scale Range:	3.4 scfm	Rangeability:	10:1
Rated Accuracy:	±10% (full scale)	Meter Length:	75 mm
Max Temp:	250 deg F	Max Press:	200 psig
Fitting Material:	316 SS	O-ring Material:	Viton
SS Tag:	Yes	Mounting:	Panel Install

VALVE

Valve Location:	Inlet	Valve Size:	N/A
Tube packing	Viton		

NOTES

1358F-1A4GC2B1C
1358F - Size 8 SHO-RATE "50" Flow Indicator
1 - TUBE: R-8M-75-1 (Cut-Off)
A - FLOAT (316 STAINLESS STEEL): 8-RV-8
4 - SCALE TYPE / SIDE PLATE ARRANGEMENT: Stainless Steel Detachable Scale Mounted to Right Side Plate
G - SCALE INSCRIPTION: Special Calibration, 10% Full Scale Air
C - TUBE PACKING AND O-RING MATERIALS FOR METER / VALVE: Viton Tube Packing, Viton O-ring
2 - FITTING AND ADAPTER MATERIAL / PROCESS CONNECTION SIZE AND TYPE: 3/8" NPT Connection, 316 Stainless Steel Fitting and Adapter
B - VALVE CONFIGURATION: Standard Stainless Steel Needle Valve on Inlet
1 - CONNECTION ORIENTATION: Inlet Port Back, Outlet Port Back
C - ACCESSORIES: Stainless Steel Side Plates
Filter Holder: F&J Model FJ-46P - Diameter: 47 mm; Connection: 3/8" FPT
Critical Flow Venturi: Flow Systems Part No. SN-06-NPT-0.XXX-SS - 3/8" MNPT Hex Body,

AECOM

Flow Instrument
Rotameter

DATA SHEET NO.			REV.
FI-5024			A
SHEET	OF	DATE	
1	1	1-17-13	

NO.	BY	DATE	REVISION

BY	CHK'D	PROC.	APPR.
NCC	AME		

P.O.:
REQ.:

Project: RLWTF

TAG NO: FAC-FI-5024

Hookup Drawings: N/A
Spec: 28 3233
P&ID: P-6006
Loop Wiring Diagram: N/A'
Line / Vessel Number: N/A
Asset No:
Line ID: Size: 3/8 in Schedule: Tubing
Service Description: Facility Air Samplers
Manufacturer: Brooks
Model: 1358F-1A4GC2B1C
Safety Level: NS
Quality Level: ML-4

PROCESS CONDITIONS

					Liquid:	Units:	Vapor:	Units:	Differential:	Units:
Fluid:	Air		Flow:	Min:	N/A	N/A		l/hr	N/A	N/A
Fluid State Present:	N/A			Normal (Operating):	N/A		4500		N/A	
Compressibility (Z):	N/A	Units:		Max (Full Scale):	N/A		6300		N/A	
Temperature @ Operating:	75	deg F								
Pressure @ Operating:	11.7	in Hg	SG/Density @ Operating:		Air			N/A		
Vapor Pressure:	N/A		Viscosity @ Operating:		Air			N/A		
Base Pressure:	N/A		Specific Heat Ratio ($^{Cp}/_{Cv}$):		N/A		% Solids:	N/A		
Base Temperature:	N/A		Steam % Quality or °Superheat:		N/A		Pipe Material:	N/A		
Flange Material:	N/A		Flange Rating:		N/A					

METER

Tube Material:	Borosilicate Glass	Float Material:	316 SS
Process Conn:	3/8" NPT		
Process Conn Material:	316 Stainless Steel		
Holder Material:	316 Stainless Steel		
Scale Range:	3.4 scfm	Rangeability:	10:1
Rated Accuracy:	±10% (full scale)	Meter Length:	75 mm
Max Temp:	250 deg F	Max Press:	200 psig
Fitting Material:	316 SS	O-ring Material:	Viton
SS Tag:	Yes	Mounting:	Panel Install

VALVE

Valve Location:	Inlet	Valve Size:	N/A
Tube packing	Viton		

NOTES

1358F-1A4GC2B1C
1358F - Size 8 SHO-RATE "50" Flow Indicator
1 - TUBE: R-8M-75-1 (Cut-Off)
A - FLOAT (316 STAINLESS STEEL): 8-RV-8
4 - SCALE TYPE / SIDE PLATE ARRANGEMENT: Stainless Steel Detachable Scale Mounted to Right Side Plate
G - SCALE INSCRIPTION: Special Calibration, 10% Full Scale Air
C - TUBE PACKING AND O-RING MATERIALS FOR METER / VALVE: Viton Tube Packing, Viton O-ring
2 - FITTING AND ADAPTER MATERIAL / PROCESS CONNECTION SIZE AND TYPE: 3/8" NPT Connection, 316 Stainless Steel Fitting and Adapter
B - VALVE CONFIGURATION: Standard Stainless Steel Needle Valve on Inlet
1 - CONNECTION ORIENTATION: Inlet Port Back, Outlet Port Back
C - ACCESSORIES: Stainless Steel Side Plates
Filter Holder: F&J Model FJ-46P - Diameter: 47 mm; Connection: 3/8" FPT
Critical Flow Venturi: Flow Systems Part No. SN-06-NPT-0.XXX-SS - 3/8" MNPT Hex Body,

AECOM

Flow Instrument
Rotameter

DATA SHEET NO.			REV.
FI-5025			A
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BY	CHK'D	PROC.	APPR.
NCC	AME		

P.O.	
REQ.	

Project: RLWTF

TAG NO:	FAC-FI-5025	Hookup Drawings:	N/A	Loop Wiring Diagram:	N/A'			<-
		Spec:	28 3233	Line / Vessel Number:	N/A			
Asset No:		P&ID:	P-6006	Line ID:		Size: 3/8 in	Schedule: Tubing	<-
Service Description:	Facility Air Samplers			Manufacturer:	Brooks			<-
				Model:	1358F-1A4GC2B1C			<-
Safety Level:	NS			Quality Level:	ML-4			<-

PROCESS CONDITIONS

Fluid:	Air			Flow:		Liquid:	Units:	Vapor:	Units:	Differential:	Units:
Fluid State Present:	N/A				Min:	N/A	N/A		l/hr	N/A	N/A
Compressibility (Z):	N/A	Units:			Normal (Operating)	N/A		4500		N/A	
Temperature @ Operating:	75	deg F			Max (Full Scale):	N/A		6300		N/A	
Pressure @ Operating:	11.7	in Hg		SG/Density @ Operating:		Air			N/A		
Vapor Pressure:	N/A			Viscosity @ Operating:		Air			N/A		
Base Pressure:	N/A			Specific Heat Ratio (C_P/C_V):		N/A		% Solids:	N/A		
Base Temperature:	N/A			Steam % Quality or °Superheat:		N/A		Pipe Material:	N/A		
Flange Material:	N/A			Flange Rating		N/A					

METER

Tube Material:	Borosilicate Glass	Float Material:	316 SS
Process Conn:	3/8" NPT		
Process Conn Material:	316 Stainless Steel		
Holder Material:	316 Stainless Steel		
Scale Range:	3.4 scfm	Rangeability:	10:1
Rated Accuracy:	±10% (full scale)	Meter Length:	75 mm
Max Temp:	250 deg F	Max Press:	200 psig
Fitting Material:	316 SS	O-ring Material:	Viton
SS Tag:	Yes	Mounting:	Panel Install

VALVE

Valve Location:	Inlet	Valve Size:	N/A
Tube packing	Viton		

NOTES

1358F-1A4GC2B1C
1358F - Size 8 SHO-RATE "50" Flow Indicator
1 - TUBE: R-8M-75-1 (Cut-Off)
A - FLOAT (316 STAINLESS STEEL): 8-RV-8
4 - SCALE TYPE / SIDE PLATE ARRANGEMENT: Stainless Steel Detachable Scale Mounted to Right Side Plate
G - SCALE INSCRIPTION: Special Calibration, 10% Full Scale Air
C - TUBE PACKING AND O-RING MATERIALS FOR METER / VALVE: Viton Tube Packing, Viton O-ring
2 - FITTING AND ADAPTER MATERIAL / PROCESS CONNECTION SIZE AND TYPE: 3/8" NPT Connection, 316 Stainless Steel Fitting and Adapter
B - VALVE CONFIGURATION: Standard Stainless Steel Needle Valve on Inlet
1 - CONNECTION ORIENTATION: Inlet Port Back, Outlet Port Back
C - ACCESSORIES: Stainless Steel Side Plates
Filter Holder: F&J Model FJ-46P - Diameter: 47 mm; Connection: 3/8" FPT
Critical Flow Venturi: Flow Systems Part No. SN-06-NPT-0.XXX-SS - 3/8" MNPT Hex Body,

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Flow Instrument
Rotameter

DATA SHEET NO.			REV.
FI-5026			A
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1	1	1-17-13	

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NCC	AME		

P.O.:
REQ.:

Project: RLWTF

TAG NO: FAC-FI-5026

Hookup Drawings: N/A
Spec: 28 3233
P&ID: P-6006
Loop Wiring Diagram: N/A'
Line / Vessel Number: N/A
Asset No:
Line ID: Size: 3/8 in Schedule: Tubing
Service Description: Facility Air Samplers
Manufacturer: Brooks
Model: 1358F-1A4GC2B1C
Safety Level: NS
Quality Level: ML-4

PROCESS CONDITIONS

					Liquid:	Units:	Vapor:	Units:	Differential:	Units:
Fluid:	Air		Flow:	Min:	N/A	N/A		l/hr	N/A	N/A
Fluid State Present:	N/A			Normal (Operating):	N/A		4500		N/A	
Compressibility (Z):	N/A	Units:		Max (Full Scale):	N/A		6300		N/A	
Temperature @ Operating:	75	deg F								
Pressure @ Operating:	11.7	in Hg	SG/Density @ Operating:		Air			N/A		
Vapor Pressure:	N/A		Viscosity @ Operating:		Air			N/A		
Base Pressure:	N/A		Specific Heat Ratio (C_P/C_V):		N/A		% Solids:	N/A		
Base Temperature:	N/A		Steam % Quality or °Superheat:		N/A		Pipe Material:	N/A		
Flange Material:	N/A		Flange Rating		N/A					

METER

Tube Material:	Borosilicate Glass	Float Material:	316 SS
Process Conn:	3/8" NPT		
Process Conn Material:	316 Stainless Steel		
Holder Material:	316 Stainless Steel		
Scale Range:	3.4 scfm	Rangeability:	10:1
Rated Accuracy:	±10% (full scale)	Meter Length:	75 mm
Max Temp:	250 deg F	Max Press:	200 psig
Fitting Material:	316 SS	O-ring Material:	Viton
SS Tag:	Yes	Mounting:	Panel Install

VALVE

Valve Location:	Inlet	Valve Size:	N/A
Tube packing	Viton		

NOTES

1358F-1A4GC2B1C
1358F - Size 8 SHO-RATE "50" Flow Indicator
1 - TUBE: R-8M-75-1 (Cut-Off)
A - FLOAT (316 STAINLESS STEEL): 8-RV-8
4 - SCALE TYPE / SIDE PLATE ARRANGEMENT: Stainless Steel Detachable Scale Mounted to Right Side Plate
G - SCALE INSCRIPTION: Special Calibration, 10% Full Scale Air
C - TUBE PACKING AND O-RING MATERIALS FOR METER / VALVE: Viton Tube Packing, Viton O-ring
2 - FITTING AND ADAPTER MATERIAL / PROCESS CONNECTION SIZE AND TYPE: 3/8" NPT Connection, 316 Stainless Steel Fitting and Adapter
B - VALVE CONFIGURATION: Standard Stainless Steel Needle Valve on Inlet
1 - CONNECTION ORIENTATION: Inlet Port Back, Outlet Port Back
C - ACCESSORIES: Stainless Steel Side Plates
Filter Holder: F&J Model FJ-46P - Diameter: 47 mm; Connection: 3/8" FPT
Critical Flow Venturi: Flow Systems Part No. SN-06-NPT-0.XXX-SS - 3/8" MNPT Hex Body,

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Flow Instrument
Rotameter

DATA SHEET NO.			REV.
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1	1	1-17-13	

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NCC	AME		

P.O.	
REQ.	

Project:	RLWTF

TAG NO:	FAC-FI-5027	Hookup Drawings:	N/A	Loop Wiring Diagram:	N/A'	<-
		Spec:	28 3233	Line / Vessel Number:	N/A	
Asset No:		P&ID:	P-6006	Line ID:	Size: 3/8 in Schedule: Tubing	<-
Service Description:	Facility Air Samplers			Manufacturer:	Brooks	<-
				Model:	1358F-1A4GC2B1C	<-
Safety Level:	NS			Quality Level:	ML-4	<-

PROCESS CONDITIONS

					Liquid:	Units:	Vapor:	Units:	Differential:	Units:
Fluid:	Air		Flow:	Min:	N/A	N/A		l/hr	N/A	N/A
Fluid State Present:	N/A			Normal (Operating):	N/A		4500		N/A	
Compressibility (Z):	N/A	Units:		Max (Full Scale):	N/A		6300		N/A	
Temperature @ Operating:	75	deg F								
Pressure @ Operating:	11.7	in Hg	SG/Density @ Operating:		Air			N/A		
Vapor Pressure:	N/A		Viscosity @ Operating:		Air			N/A		
Base Pressure:	N/A		Specific Heat Ratio ($^{Cp}/_{Cv}$):		N/A		% Solids:	N/A		
Base Temperature:	N/A		Steam % Quality or °Superheat:		N/A		Pipe Material:	N/A		
Flange Material:	N/A		Flange Rating		N/A					

METER

Tube Material:	Borosilicate Glass	Float Material:	316 SS
Process Conn:	3/8" NPT		
Process Conn Material:	316 Stainless Steel		
Holder Material:	316 Stainless Steel		
Scale Range:	3.4 scfm	Rangeability:	10:1
Rated Accuracy:	±10% (full scale)	Meter Length:	75 mm
Max Temp:	250 deg F	Max Press:	200 psig
Fitting Material:	316 SS	O-ring Material:	Viton
SS Tag:	Yes	Mounting:	Panel Install

VALVE

Valve Location:	Inlet	Valve Size:	N/A
Tube packing	Viton		

NOTES

1358F-1A4GC2B1C
1358F - Size 8 SHO-RATE "50" Flow Indicator
1 - TUBE: R-8M-75-1 (Cut-Off)
A - FLOAT (316 STAINLESS STEEL): 8-RV-8
4 - SCALE TYPE / SIDE PLATE ARRANGEMENT: Stainless Steel Detachable Scale Mounted to Right Side Plate
G - SCALE INSCRIPTION: Special Calibration, 10% Full Scale Air
C - TUBE PACKING AND O-RING MATERIALS FOR METER / VALVE: Viton Tube Packing, Viton O-ring
2 - FITTING AND ADAPTER MATERIAL / PROCESS CONNECTION SIZE AND TYPE: 3/8" NPT Connection, 316 Stainless Steel Fitting and Adapter
B - VALVE CONFIGURATION: Standard Stainless Steel Needle Valve on Inlet
1 - CONNECTION ORIENTATION: Inlet Port Back, Outlet Port Back
C - ACCESSORIES: Stainless Steel Side Plates
Filter Holder: F&J Model FJ-46P - Diameter: 47 mm; Connection: 3/8" FPT
Critical Flow Venturi: Flow Systems Part No. SN-06-NPT-0.XXX-SS - 3/8" MNPT Hex Body,

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Flow Instrument
Rotameter

DATA SHEET NO.			REV.
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NCC	AME		

P.O.
REQ.

Project: RLWTF

TAG NO: FAC-FI-5028

Hookup Drawings: N/A
Spec: 28 3233
P&ID: P-6006
Loop Wiring Diagram: N/A'
Line / Vessel Number: N/A
Asset No:
Line ID: Size: 3/8 in Schedule: Tubing
Service Description: Facility Air Samplers
Manufacturer: Brooks
Model: 1358F-1A4GC2B1C
Safety Level: NS
Quality Level: ML-4

PROCESS CONDITIONS

Fluid:	Air		Flow:		Liquid:	Units:	Vapor:	Units:	Differential:	Units:	
Fluid State Present:	N/A			Min:	N/A	N/A		l/hr	N/A	N/A	
Compressibility (Z):	N/A	Units:		Normal (Operating)	N/A		4500		N/A		
Temperature @ Operating:	75	deg F		Max (Full Scale):	N/A		6300		N/A		
Pressure @ Operating:	11.7	in Hg	SG/Density @ Operating:		Air			N/A			
Vapor Pressure:	N/A		Viscosity @ Operating:		Air			N/A			
Base Pressure:	N/A		Specific Heat Ratio (C_P/C_V):		N/A		% Solids:		N/A		
Base Temperature	N/A		Steam % Quality or °Superheat:		N/A		Pipe Material:		N/A		
Flange Material:	N/A		Flange Rating		N/A						

METER

Tube Material:	Borosilicate Glass	Float Material:	316 SS
Process Conn:	3/8" NPT		
Process Conn Material:	316 Stainless Steel		
Holder Material:	316 Stainless Steel		
Scale Range:	3.4 scfm	Rangeability:	10:1
Rated Accuracy:	±10% (full scale)	Meter Length:	75 mm
Max Temp:	250 deg F	Max Press:	200 psig
Fitting Material:	316 SS	O-ring Material:	Viton
SS Tag:	Yes	Mounting:	Panel Install

VALVE

Valve Location:	Inlet	Valve Size:	N/A
Tube packing	Viton		

NOTES

1358F-1A4GC2B1C
1358F - Size 8 SHO-RATE "50" Flow Indicator
1 - TUBE: R-8M-75-1 (Cut-Off)
A - FLOAT (316 STAINLESS STEEL): 8-RV-8
4 - SCALE TYPE / SIDE PLATE ARRANGEMENT: Stainless Steel Detachable Scale Mounted to Right Side Plate
G - SCALE INSCRIPTION: Special Calibration, 10% Full Scale Air
C - TUBE PACKING AND O-RING MATERIALS FOR METER / VALVE: Viton Tube Packing, Viton O-ring
2 - FITTING AND ADAPTER MATERIAL / PROCESS CONNECTION SIZE AND TYPE: 3/8" NPT Connection, 316 Stainless Steel Fitting and Adapter
B - VALVE CONFIGURATION: Standard Stainless Steel Needle Valve on Inlet
1 - CONNECTION ORIENTATION: Inlet Port Back, Outlet Port Back
C - ACCESSORIES: Stainless Steel Side Plates
Filter Holder: F&J Model FJ-46P - Diameter: 47 mm; Connection: 3/8" FPT
Critical Flow Venturi: Flow Systems Part No. SN-06-NPT-0.XXX-SS - 3/8" MNPT Hex Body,

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Flow Instrument
Rotameter

DATA SHEET NO.			REV.
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NCC	AME		

P.O.	
REQ.	

Project:	RLWTF

TAG NO:	FAC-FI-5029	Hookup Drawings:	N/A	Loop Wiring Diagram:	N/A'	<-
		Spec:	28 3233	Line / Vessel Number:	N/A	
Asset No:		P&ID:	P-6006	Line ID:	Size: 3/8 in Schedule: Tubing	<-
Service Description:	Facility Air Samplers			Manufacturer:	Brooks	<-
				Model:	1358F-1A4GC2B1C	<-
Safety Level:	NS			Quality Level:	ML-4	<-

PROCESS CONDITIONS

					Liquid:	Units:	Vapor:	Units:	Differential:	Units:
Fluid:	Air		Flow:	Min:	N/A	N/A		l/hr	N/A	N/A
Fluid State Present:	N/A			Normal (Operating):	N/A		4500		N/A	
Compressibility (Z):	N/A	Units:		Max (Full Scale):	N/A		6300		N/A	
Temperature @ Operating:	75	deg F								
Pressure @ Operating:	11.7	in Hg		SG/Density @ Operating:	Air			N/A		
Vapor Pressure:	N/A			Viscosity @ Operating:	Air			N/A		
Base Pressure:	N/A			Specific Heat Ratio ($^{C_P}/_{C_V}$):	N/A		% Solids:	N/A		
Base Temperature:	N/A			Steam % Quality or °Superheat:	N/A		Pipe Material:	N/A		
Flange Material:	N/A			Flange Rating	N/A					

METER

Tube Material:	Borosilicate Glass	Float Material:	316 SS
Process Conn:	3/8" NPT		
Process Conn Material:	316 Stainless Steel		
Holder Material:	316 Stainless Steel		
Scale Range:	3.4 scfm	Rangeability:	10:1
Rated Accuracy:	±10% (full scale)	Meter Length:	75 mm
Max Temp:	250 deg F	Max Press:	200 psig
Fitting Material:	316 SS	O-ring Material:	Viton
SS Tag:	Yes	Mounting:	Panel Install

VALVE

Valve Location:	Inlet	Valve Size:	N/A
Tube packing	Viton		

NOTES

1358F-1A4GC2B1C
1358F - Size 8 SHO-RATE "50" Flow Indicator
1 - TUBE: R-8M-75-1 (Cut-Off)
A - FLOAT (316 STAINLESS STEEL): 8-RV-8
4 - SCALE TYPE / SIDE PLATE ARRANGEMENT: Stainless Steel Detachable Scale Mounted to Right Side Plate
G - SCALE INSCRIPTION: Special Calibration, 10% Full Scale Air
C - TUBE PACKING AND O-RING MATERIALS FOR METER / VALVE: Viton Tube Packing, Viton O-ring
2 - FITTING AND ADAPTER MATERIAL / PROCESS CONNECTION SIZE AND TYPE: 3/8" NPT Connection, 316 Stainless Steel Fitting and Adapter
B - VALVE CONFIGURATION: Standard Stainless Steel Needle Valve on Inlet
1 - CONNECTION ORIENTATION: Inlet Port Back, Outlet Port Back
C - ACCESSORIES: Stainless Steel Side Plates
Filter Holder: F&J Model FJ-46P - Diameter: 47 mm; Connection: 3/8" FPT
Critical Flow Venturi: Flow Systems Part No. SN-06-NPT-0.XXX-SS - 3/8" MNPT Hex Body,

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Flow Instrument
Rotameter

DATA SHEET NO.			REV.
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P.O.
REQ.

Project: RLWTF

TAG NO: FAC-FI-5030

Hookup Drawings: N/A
Spec: 28 3233
P&ID: P-6006
Loop Wiring Diagram: N/A'
Line / Vessel Number: N/A
Asset No:
Line ID: Size: 3/8 in Schedule: Tubing
Service Description: Facility Air Samplers
Manufacturer: Brooks
Model: 1358F-1A4GC2B1C
Safety Level: NS
Quality Level: ML-4

PROCESS CONDITIONS

					Liquid:	Units:	Vapor:	Units:	Differential:	Units:
Fluid:	Air		Flow:	Min:	N/A	N/A		l/hr	N/A	N/A
Fluid State Present:	N/A			Normal (Operating)	N/A		4500		N/A	
Compressibility (Z):	N/A	Units:		Max (Full Scale):	N/A		6300		N/A	
Temperature @ Operating:	75	deg F		SG/Density @ Operating:	Air			N/A		
Pressure @ Operating:	11.7	in Hg		Viscosity @ Operating:	Air			N/A		
Vapor Pressure:	N/A			Specific Heat Ratio ($^{Cp}/_{Cv}$):	N/A		% Solids:	N/A		
Base Pressure:	N/A			Steam % Quality or °Superheat:	N/A		Pipe Material:	N/A		
Base Temperature	N/A									
Flange Material:	N/A			Flange Rating	N/A					

METER

Tube Material:	Borosilicate Glass	Float Material:	316 SS
Process Conn:	3/8" NPT		
Process Conn Material:	316 Stainless Steel		
Holder Material:	316 Stainless Steel		
Scale Range:	3.4 scfm	Rangeability:	10:1
Rated Accuracy:	±10% (full scale)	Meter Length:	75 mm
Max Temp:	250 deg F	Max Press:	200 psig
Fitting Material:	316 SS	O-ring Material:	Viton
SS Tag:	Yes	Mounting:	Panel Install

VALVE

Valve Location:	Inlet	Valve Size:	N/A
Tube packing	Viton		

NOTES

1358F-1A4GC2B1C
1358F - Size 8 SHO-RATE "50" Flow Indicator
1 - TUBE: R-8M-75-1 (Cut-Off)
A - FLOAT (316 STAINLESS STEEL): 8-RV-8
4 - SCALE TYPE / SIDE PLATE ARRANGEMENT: Stainless Steel Detachable Scale Mounted to Right Side Plate
G - SCALE INSCRIPTION: Special Calibration, 10% Full Scale Air
C - TUBE PACKING AND O-RING MATERIALS FOR METER / VALVE: Viton Tube Packing, Viton O-ring
2 - FITTING AND ADAPTER MATERIAL / PROCESS CONNECTION SIZE AND TYPE: 3/8" NPT Connection, 316 Stainless Steel Fitting and Adapter
B - VALVE CONFIGURATION: Standard Stainless Steel Needle Valve on Inlet
1 - CONNECTION ORIENTATION: Inlet Port Back, Outlet Port Back
C - ACCESSORIES: Stainless Steel Side Plates
Filter Holder: F&J Model FJ-46P - Diameter: 47 mm; Connection: 3/8" FPT
Critical Flow Venturi: Flow Systems Part No. SN-06-NPT-0.XXX-SS - 3/8" MNPT Hex Body,

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Flow Instrument
Rotameter

DATA SHEET NO.			REV.
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NCC	AME		

P.O.	
REQ.	

Project: RLWTF

TAG NO: FAC-FI-5031

Hookup Drawings:	N/A			Loop Wiring Diagram:	N/A'			<-
Spec:	28 3233			Line / Vessel Number:	N/A			
P&ID:	P-6006			Line ID:		Size: 3/8 in	Schedule: Tubing	<-
Asset No:				Manufacturer:	Brooks			<-
Service Description:	Facility Air Samplers			Model:	1358F-1A4GC2B1C			<-
Safety Level:	NS			Quality Level:	ML-4			<-

PROCESS CONDITIONS

Fluid:	Air			Flow:		Liquid:	Units:	Vapor:	Units:	Differential:	Units:
Fluid State Present:	N/A				Min:	N/A	N/A		l/hr	N/A	N/A
Compressibility (Z):	N/A	Units:			Normal (Operating)	N/A		4500		N/A	
Temperature @ Operating:	75	deg F			Max (Full Scale):	N/A		6300		N/A	
Pressure @ Operating:	11.7	in Hg		SG/Density @ Operating:		Air			N/A		
Vapor Pressure:	N/A			Viscosity @ Operating:		Air			N/A		
Base Pressure:	N/A			Specific Heat Ratio (C_P/C_V):		N/A		% Solids:		N/A	
Base Temperature:	N/A			Steam % Quality or °Superheat:		N/A		Pipe Material:		N/A	
Flange Material:	N/A			Flange Rating		N/A					

METER

Tube Material:	Borosilicate Glass	Float Material:	316 SS
Process Conn:	3/8" NPT		
Process Conn Material:	316 Stainless Steel		
Holder Material:	316 Stainless Steel		
Scale Range:	3.4 scfm	Rangeability:	10:1
Rated Accuracy:	±10% (full scale)	Meter Length:	75 mm
Max Temp:	250 deg F	Max Press:	200 psig
Fitting Material:	316 SS	O-ring Material:	Viton
SS Tag:	Yes	Mounting:	Panel Install

VALVE

Valve Location:	Inlet	Valve Size:	N/A
Tube packing	Viton		

NOTES

1358F-1A4GC2B1C
1358F - Size 8 SHO-RATE "50" Flow Indicator
1 - TUBE: R-8M-75-1 (Cut-Off)
A - FLOAT (316 STAINLESS STEEL): 8-RV-8
4 - SCALE TYPE / SIDE PLATE ARRANGEMENT: Stainless Steel Detachable Scale Mounted to Right Side Plate
G - SCALE INSCRIPTION: Special Calibration, 10% Full Scale Air
C - TUBE PACKING AND O-RING MATERIALS FOR METER / VALVE: Viton Tube Packing, Viton O-ring
2 - FITTING AND ADAPTER MATERIAL / PROCESS CONNECTION SIZE AND TYPE: 3/8" NPT Connection, 316 Stainless Steel Fitting and Adapter
B - VALVE CONFIGURATION: Standard Stainless Steel Needle Valve on Inlet
1 - CONNECTION ORIENTATION: Inlet Port Back, Outlet Port Back
C - ACCESSORIES: Stainless Steel Side Plates
Filter Holder: F&J Model FJ-46P - Diameter: 47 mm; Connection: 3/8" FPT
Critical Flow Venturi: Flow Systems Part No. SN-06-NPT-0.XXX-SS - 3/8" MNPT Hex Body,

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Flow Instrument
Rotameter

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NCC	AME		

P.O. REQ.

Project: RLWTF

TAG NO: FAC-FI-5032

Hookup Drawings:	N/A			Loop Wiring Diagram:	N/A'				<-
Spec:	28 3233			Line / Vessel Number:	N/A				
Asset No:		P&ID:	P-6006	Line ID:		Size:	3/8 in	Schedule:	Tubing <-
Service Description:	Facility Air Samplers			Manufacturer:	Brooks				<-
				Model:	1358F-1A4GC2B1C				<-
Safety Level:	NS			Quality Level:	ML-4				<-

PROCESS CONDITIONS

Fluid:	Air				Liquid:	Units:	Vapor:	Units:	Differential:	Units:	<-
Fluid State Present:	N/A		Flow:	Min:	N/A	N/A		l/hr	N/A	N/A	<-
Compressibility (Z):	N/A	Units:		Normal (Operating)	N/A		4500		N/A		<-
Temperature @ Operating:	75	deg F		Max (Full Scale):	N/A		6300		N/A		<-
Pressure @ Operating:	11.7	in Hg	SG/Density @ Operating:	Air			N/A				<-
Vapor Pressure:	N/A		Viscosity @ Operating:	Air			N/A				<-
Base Pressure:	N/A		Specific Heat Ratio (C_p/C_v):	N/A		% Solids:	N/A				<-
Base Temperature:	N/A		Steam % Quality or °Superheat:	N/A		Pipe Material:	N/A				<-
Flange Material:	N/A		Flange Rating	N/A							<-

METER

Tube Material:	Borosilicate Glass	Float Material:	316 SS
Process Conn:	3/8" NPT		
Process Conn Material:	316 Stainless Steel		
Holder Material:	316 Stainless Steel		
Scale Range:	3.4 scfm	Rangeability:	10:1
Rated Accuracy:	±10% (full scale)	Meter Length:	75 mm
Max Temp:	250 deg F	Max Press:	200 psig
Fitting Material:	316 SS	O-ring Material:	Viton
SS Tag:	Yes	Mounting:	Panel Install

VALVE

Valve Location:	Inlet	Valve Size:	N/A
Tube packing	Viton		

NOTES

1358F-1A4GC2B1C
1358F - Size 8 SHO-RATE "50" Flow Indicator
1 - TUBE: R-8M-75-1 (Cut-Off)
A - FLOAT (316 STAINLESS STEEL): 8-RV-8
4 - SCALE TYPE / SIDE PLATE ARRANGEMENT: Stainless Steel Detachable Scale Mounted to Right Side Plate
G - SCALE INSCRIPTION: Special Calibration, 10% Full Scale Air
C - TUBE PACKING AND O-RING MATERIALS FOR METER / VALVE: Viton Tube Packing, Viton O-ring
2 - FITTING AND ADAPTER MATERIAL / PROCESS CONNECTION SIZE AND TYPE: 3/8" NPT Connection, 316 Stainless Steel Fitting and Adapter
B - VALVE CONFIGURATION: Standard Stainless Steel Needle Valve on Inlet
1 - CONNECTION ORIENTATION: Inlet Port Back, Outlet Port Back
C - ACCESSORIES: Stainless Steel Side Plates
Filter Holder: F&J Model FJ-46P - Diameter: 47 mm; Connection: 3/8" FPT
Critical Flow Venturi: Flow Systems Part No. SN-06-NPT-0.XXX-SS - 3/8" MNPT Hex Body,

AECOM

Flow Instrument
Rotameter

DATA SHEET NO.			REV.
FI-5033			A
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NO.	BY	DATE	REVISION

BY	CHK'D	PROC.	APPR.
NCC	AME		

P.O.
REQ.

Project: RLWTF

TAG NO: FAC-FI-5033

Hookup Drawings: N/A
Spec: 28 3233
P&ID: P-6006
Loop Wiring Diagram: N/A'
Line / Vessel Number: N/A
Asset No:
Line ID: Size: 3/8 in Schedule: Tubing
Service Description: Facility Air Samplers
Manufacturer: Brooks
Model: 1358F-1A4GC2B1C
Safety Level: NS
Quality Level: ML-4

PROCESS CONDITIONS

					Liquid:	Units:	Vapor:	Units:	Differential:	Units:
Fluid:	Air		Flow:	Min:	N/A	N/A		l/hr	N/A	N/A
Fluid State Present:	N/A			Normal (Operating):	N/A		4500		N/A	
Compressibility (Z):	N/A	Units:		Max (Full Scale):	N/A		6300		N/A	
Temperature @ Operating:	75	deg F								
Pressure @ Operating:	11.7	in Hg	SG/Density @ Operating:		Air			N/A		
Vapor Pressure:	N/A		Viscosity @ Operating:		Air			N/A		
Base Pressure:	N/A		Specific Heat Ratio ($^{Cp}/_{Cv}$):		N/A		% Solids:		N/A	
Base Temperature:	N/A		Steam % Quality or °Superheat:		N/A		Pipe Material:		N/A	
Flange Material:	N/A		Flange Rating		N/A					

METER

Tube Material:	Borosilicate Glass	Float Material:	316 SS
Process Conn:	3/8" NPT		
Process Conn Material:	316 Stainless Steel		
Holder Material:	316 Stainless Steel		
Scale Range:	3.4 scfm	Rangeability:	10:1
Rated Accuracy:	±10% (full scale)	Meter Length:	75 mm
Max Temp:	250 deg F	Max Press:	200 psig
Fitting Material:	316 SS	O-ring Material:	Viton
SS Tag:	Yes	Mounting:	Panel Install

VALVE

Valve Location:	Inlet	Valve Size:	N/A
Tube packing	Viton		

NOTES

1358F-1A4GC2B1C
1358F - Size 8 SHO-RATE "50" Flow Indicator
1 - TUBE: R-8M-75-1 (Cut-Off)
A - FLOAT (316 STAINLESS STEEL): 8-RV-8
4 - SCALE TYPE / SIDE PLATE ARRANGEMENT: Stainless Steel Detachable Scale Mounted to Right Side Plate
G - SCALE INSCRIPTION: Special Calibration, 10% Full Scale Air
C - TUBE PACKING AND O-RING MATERIALS FOR METER / VALVE: Viton Tube Packing, Viton O-ring
2 - FITTING AND ADAPTER MATERIAL / PROCESS CONNECTION SIZE AND TYPE: 3/8" NPT Connection, 316 Stainless Steel Fitting and Adapter
B - VALVE CONFIGURATION: Standard Stainless Steel Needle Valve on Inlet
1 - CONNECTION ORIENTATION: Inlet Port Back, Outlet Port Back
C - ACCESSORIES: Stainless Steel Side Plates
Filter Holder: F&J Model FJ-46P - Diameter: 47 mm; Connection: 3/8" FPT
Critical Flow Venturi: Flow Systems Part No. SN-06-NPT-0.XXX-SS - 3/8" MNPT Hex Body,

AECOM

Flow Instrument
Rotameter

DATA SHEET NO.			REV.
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NO.	BY	DATE	REVISION

BY	CHK'D	PROC.	APPR.
NCC	AME		

P.O.
REQ.

Project: RLWTF

TAG NO: FAC-FI-5034

Hookup Drawings: N/A
Spec: 28 3233
P&ID: P-6006
Loop Wiring Diagram: N/A'
Line / Vessel Number: N/A
Asset No:
Line ID: Size: 3/8 in Schedule: Tubing
Service Description: Facility Air Samplers
Manufacturer: Brooks
Model: 1358F-1A4GC2B1C
Safety Level: NS
Quality Level: ML-4

PROCESS CONDITIONS

Fluid:	Air		Flow:		Liquid:	Units:	Vapor:	Units:	Differential:	Units:	
Fluid State Present:	N/A			Min:	N/A	N/A		l/hr	N/A	N/A	
Compressibility (Z):	N/A	Units:		Normal (Operating):	N/A		4500		N/A		
Temperature @ Operating:	75	deg F		Max (Full Scale):	N/A		6300		N/A		
Pressure @ Operating:	11.7	in Hg	SG/Density @ Operating:		Air			N/A			
Vapor Pressure:	N/A		Viscosity @ Operating:		Air			N/A			
Base Pressure:	N/A		Specific Heat Ratio ($^{Cp}/_{Cv}$):		N/A		% Solids:		N/A		
Base Temperature:	N/A		Steam % Quality or °Superheat:		N/A		Pipe Material:		N/A		
Flange Material:	N/A		Flange Rating		N/A						

METER

Tube Material:	Borosilicate Glass	Float Material:	316 SS
Process Conn:	3/8" NPT		
Process Conn Material:	316 Stainless Steel		
Holder Material:	316 Stainless Steel		
Scale Range:	3.4 scfm	Rangeability:	10:1
Rated Accuracy:	±10% (full scale)	Meter Length:	75 mm
Max Temp:	250 deg F	Max Press:	200 psig
Fitting Material:	316 SS	O-ring Material:	Viton
SS Tag:	Yes	Mounting:	Panel Install

VALVE

Valve Location:	Inlet	Valve Size:	N/A
Tube packing	Viton		

NOTES

1358F-1A4GC2B1C
1358F - Size 8 SHO-RATE "50" Flow Indicator
1 - TUBE: R-8M-75-1 (Cut-Off)
A - FLOAT (316 STAINLESS STEEL): 8-RV-8
4 - SCALE TYPE / SIDE PLATE ARRANGEMENT: Stainless Steel Detachable Scale Mounted to Right Side Plate
G - SCALE INSCRIPTION: Special Calibration, 10% Full Scale Air
C - TUBE PACKING AND O-RING MATERIALS FOR METER / VALVE: Viton Tube Packing, Viton O-ring
2 - FITTING AND ADAPTER MATERIAL / PROCESS CONNECTION SIZE AND TYPE: 3/8" NPT Connection, 316 Stainless Steel Fitting and Adapter
B - VALVE CONFIGURATION: Standard Stainless Steel Needle Valve on Inlet
1 - CONNECTION ORIENTATION: Inlet Port Back, Outlet Port Back
C - ACCESSORIES: Stainless Steel Side Plates
Filter Holder: F&J Model FJ-46P - Diameter: 47 mm; Connection: 3/8" FPT
Critical Flow Venturi: Flow Systems Part No. SN-06-NPT-0.XXX-SS - 3/8" MNPT Hex Body,

AECOM

Flow Instrument
Rotameter

DATA SHEET NO.			REV.
FI-5035			A
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1	1	1-17-13	

NO.	BY	DATE	REVISION

BY	CHK'D	PROC.	APPR.
NCC	AME		

P.O. / REQ.:

Project: RLWTF

TAG NO: FAC-FI-5035

Hookup Drawings: N/A
Spec: 28 3233
P&ID: P-6006
Loop Wiring Diagram: N/A'
Line / Vessel Number: N/A
Asset No:
Line ID: Size: 3/8 in Schedule: Tubing
Service Description: Facility Air Samplers
Manufacturer: Brooks
Model: 1358F-1A4GC2B1C
Safety Level: NS
Quality Level: ML-4

PROCESS CONDITIONS

					Liquid:	Units:	Vapor:	Units:	Differential:	Units:
Fluid:	Air		Flow:	Min:	N/A	N/A		l/hr	N/A	N/A
Fluid State Present:	N/A			Normal (Operating):	N/A		4500		N/A	
Compressibility (Z):	N/A	Units:		Max (Full Scale):	N/A		6300		N/A	
Temperature @ Operating:	75	deg F		SG/Density @ Operating:	Air			N/A		
Pressure @ Operating:	11.7	in Hg		Viscosity @ Operating:	Air			N/A		
Vapor Pressure:	N/A			Specific Heat Ratio ($^{Cp}/_{Cv}$):	N/A		% Solids:	N/A		
Base Pressure:	N/A			Steam % Quality or °Superheat:	N/A		Pipe Material:	N/A		
Base Temperature:	N/A			Flange Rating	N/A					
Flange Material:	N/A									

METER

Tube Material:	Borosilicate Glass	Float Material:	316 SS
Process Conn:	3/8" NPT		
Process Conn Material:	316 Stainless Steel		
Holder Material:	316 Stainless Steel		
Scale Range:	3.4 scfm	Rangeability:	10:1
Rated Accuracy:	±10% (full scale)	Meter Length:	75 mm
Max Temp:	250 deg F	Max Press:	200 psig
Fitting Material:	316 SS	O-ring Material:	Viton
SS Tag:	Yes	Mounting:	Panel Install

VALVE

Valve Location:	Inlet	Valve Size:	N/A
Tube packing	Viton		

NOTES

1358F-1A4GC2B1C
1358F - Size 8 SHO-RATE "50" Flow Indicator
1 - TUBE: R-8M-75-1 (Cut-Off)
A - FLOAT (316 STAINLESS STEEL): 8-RV-8
4 - SCALE TYPE / SIDE PLATE ARRANGEMENT: Stainless Steel Detachable Scale Mounted to Right Side Plate
G - SCALE INSCRIPTION: Special Calibration, 10% Full Scale Air
C - TUBE PACKING AND O-RING MATERIALS FOR METER / VALVE: Viton Tube Packing, Viton O-ring
2 - FITTING AND ADAPTER MATERIAL / PROCESS CONNECTION SIZE AND TYPE: 3/8" NPT Connection, 316 Stainless Steel Fitting and Adapter
B - VALVE CONFIGURATION: Standard Stainless Steel Needle Valve on Inlet
1 - CONNECTION ORIENTATION: Inlet Port Back, Outlet Port Back
C - ACCESSORIES: Stainless Steel Side Plates
Filter Holder: F&J Model FJ-46P - Diameter: 47 mm; Connection: 3/8" FPT
Critical Flow Venturi: Flow Systems Part No. SN-06-NPT-0.XXX-SS - 3/8" MNPT Hex Body,

AECOM

Flow Instrument
Rotameter

DATA SHEET NO.			REV.
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NO.	BY	DATE	REVISION

BY	CHK'D	PROC.	APPR.
NCC	AME		

P.O.
REQ.

Project: RLWTF

TAG NO:	FAC-FI-5036	Hookup Drawings:	N/A	Loop Wiring Diagram:	N/A'			
		Spec:	28 3233	Line / Vessel Number:	N/A			
Asset No:		P&ID:	P-6006	Line ID:		Size: 3/8 in	Schedule:	Tubing
Service Description:	Facility Air Samplers			Manufacturer:	Brooks			
				Model:	1358F-1A4GC2B1C			
Safety Level:	NS			Quality Level:	ML-4			

PROCESS CONDITIONS

Fluid:	Air			Flow:		Liquid:	Units:	Vapor:	Units:	Differential:	Units:
Fluid State Present:	N/A				Min:	N/A	N/A		l/hr	N/A	N/A
Compressibility (Z):	N/A	Units:			Normal (Operating)	N/A		4500		N/A	
Temperature @ Operating:	75	deg F			Max (Full Scale):	N/A		6300		N/A	
Pressure @ Operating:	11.7	in Hg		SG/Density @ Operating:		Air			N/A		
Vapor Pressure:	N/A			Viscosity @ Operating:		Air			N/A		
Base Pressure:	N/A			Specific Heat Ratio (C_p/C_v):		N/A		% Solids:	N/A		
Base Temperature:	N/A			Steam % Quality or °Superheat:		N/A		Pipe Material:	N/A		
Flange Material:	N/A			Flange Rating		N/A					

METER

Tube Material:	Borosilicate Glass	Float Material:	316 SS
Process Conn:	3/8" NPT		
Process Conn Material:	316 Stainless Steel		
Holder Material:	316 Stainless Steel		
Scale Range:	3.4 scfm	Rangeability:	10:1
Rated Accuracy:	±10% (full scale)	Meter Length:	75 mm
Max Temp:	250 deg F	Max Press:	200 psig
Fitting Material:	316 SS	O-ring Material:	Viton
SS Tag:	Yes	Mounting:	Panel Install

VALVE

Valve Location:	Inlet	Valve Size:	N/A
Tube packing	Viton		

NOTES

1358F-1A4GC2B1C
1358F - Size 8 SHO-RATE "50" Flow Indicator
1 - TUBE: R-8M-75-1 (Cut-Off)
A - FLOAT (316 STAINLESS STEEL): 8-RV-8
4 - SCALE TYPE / SIDE PLATE ARRANGEMENT: Stainless Steel Detachable Scale Mounted to Right Side Plate
G - SCALE INSCRIPTION: Special Calibration, 10% Full Scale Air
C - TUBE PACKING AND O-RING MATERIALS FOR METER / VALVE: Viton Tube Packing, Viton O-ring
2 - FITTING AND ADAPTER MATERIAL / PROCESS CONNECTION SIZE AND TYPE: 3/8" NPT Connection, 316 Stainless Steel Fitting and Adapter
B - VALVE CONFIGURATION: Standard Stainless Steel Needle Valve on Inlet
1 - CONNECTION ORIENTATION: Inlet Port Back, Outlet Port Back
C - ACCESSORIES: Stainless Steel Side Plates
Filter Holder: F&J Model FJ-46P - Diameter: 47 mm; Connection: 3/8" FPT
Critical Flow Venturi: Flow Systems Part No. SN-06-NPT-0.XXX-SS - 3/8" MNPT Hex Body,

AECOM

Flow Instrument
Rotameter

DATA SHEET NO.			REV.
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NO.	BY	DATE	REVISION

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NCC	AME		

P.O.	
REQ.	

Project: RLWTF

TAG NO:	FAC-FI-5037	Hookup Drawings:	N/A	Loop Wiring Diagram:	N/A'			
		Spec:	28 3233	Line / Vessel Number:	N/A			
Asset No:		P&ID:	P-6006	Line ID:		Size:	3/8 in	Schedule: Tubing
Service Description:	Facility Air Samplers			Manufacturer:	Brooks			
				Model:	1358F-1A4GC2B1C			
Safety Level:	NS			Quality Level:	ML-4			

PROCESS CONDITIONS

Fluid:	Air			Flow:		Liquid:	Units:	Vapor:	Units:	Differential:	Units:
Fluid State Present:	N/A				Min:	N/A	N/A		l/hr	N/A	N/A
Compressibility (Z):	N/A	Units:			Normal (Operating)	N/A		4500		N/A	
Temperature @ Operating:	75	deg F			Max (Full Scale):	N/A		6300		N/A	
Pressure @ Operating:	11.7	in Hg		SG/Density @ Operating:		Air			N/A		
Vapor Pressure:	N/A			Viscosity @ Operating:		Air			N/A		
Base Pressure:	N/A			Specific Heat Ratio (C_p/C_v):		N/A		% Solids:		N/A	
Base Temperature:	N/A			Steam % Quality or °Superheat:		N/A		Pipe Material:		N/A	
Flange Material:	N/A			Flange Rating		N/A					

METER

Tube Material:	Borosilicate Glass	Float Material:	316 SS
Process Conn:	3/8" NPT		
Process Conn Material:	316 Stainless Steel		
Holder Material:	316 Stainless Steel		
Scale Range:	3.4 scfm	Rangeability:	10:1
Rated Accuracy:	±10% (full scale)	Meter Length:	75 mm
Max Temp:	250 deg F	Max Press:	200 psig
Fitting Material:	316 SS	O-ring Material:	Viton
SS Tag:	Yes	Mounting:	Panel Install

VALVE

Valve Location:	Inlet	Valve Size:	N/A
Tube packing	Viton		

NOTES

1358F-1A4GC2B1C
1358F - Size 8 SHO-RATE "50" Flow Indicator
1 - TUBE: R-8M-75-1 (Cut-Off)
A - FLOAT (316 STAINLESS STEEL): 8-RV-8
4 - SCALE TYPE / SIDE PLATE ARRANGEMENT: Stainless Steel Detachable Scale Mounted to Right Side Plate
G - SCALE INSCRIPTION: Special Calibration, 10% Full Scale Air
C - TUBE PACKING AND O-RING MATERIALS FOR METER / VALVE: Viton Tube Packing, Viton O-ring
2 - FITTING AND ADAPTER MATERIAL / PROCESS CONNECTION SIZE AND TYPE: 3/8" NPT Connection, 316 Stainless Steel Fitting and Adapter
B - VALVE CONFIGURATION: Standard Stainless Steel Needle Valve on Inlet
1 - CONNECTION ORIENTATION: Inlet Port Back, Outlet Port Back
C - ACCESSORIES: Stainless Steel Side Plates
Filter Holder: F&J Model FJ-46P - Diameter: 47 mm; Connection: 3/8" FPT
Critical Flow Venturi: Flow Systems Part No. SN-06-NPT-0.XXX-SS - 3/8" MNPT Hex Body,

AECOM

Flow Instrument
Rotameter

DATA SHEET NO.	REV.
FI-5038	A

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1	1	1-17-13

NO.	BY	DATE	REVISION

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NCC	AME		

P.O.:
REQ.:

Project: RLWTF

TAG NO: FAC-FI-5038

Hookup Drawings: N/A
Spec: 28 3233
P&ID: P-6006
Loop Wiring Diagram: N/A'
Line / Vessel Number: N/A
Asset No:
Line ID: Size: 3/8 in Schedule: Tubing
Service Description: Facility Air Samplers
Manufacturer: Brooks
Model: 1358F-1A4GC2B1C
Safety Level: NS
Quality Level: ML-4

PROCESS CONDITIONS

					Liquid:	Units:	Vapor:	Units:	Differential:	Units:
Fluid:	Air		Flow:	Min:	N/A	N/A		l/hr	N/A	N/A
Fluid State Present:	N/A			Normal (Operating)	N/A		4500		N/A	
Compressibility (Z):	N/A	Units:		Max (Full Scale):	N/A		6300		N/A	
Temperature @ Operating:	75	deg F								
Pressure @ Operating:	11.7	in Hg	SG/Density @ Operating:		Air			N/A		
Vapor Pressure:	N/A		Viscosity @ Operating:		Air			N/A		
Base Pressure:	N/A		Specific Heat Ratio (C_p/C_v):		N/A		% Solids:	N/A		
Base Temperature:	N/A		Steam % Quality or °Superheat:		N/A		Pipe Material:	N/A		
Flange Material:	N/A		Flange Rating		N/A					

METER

Tube Material:	Borosilicate Glass	Float Material:	316 SS
Process Conn:	3/8" NPT		
Process Conn Material:	316 Stainless Steel		
Holder Material:	316 Stainless Steel		
Scale Range:	3.4 scfm	Rangeability:	10:1
Rated Accuracy:	±10% (full scale)	Meter Length:	75 mm
Max Temp:	250 deg F	Max Press:	200 psig
Fitting Material:	316 SS	O-ring Material:	Viton
SS Tag:	Yes	Mounting:	Panel Install

VALVE

Valve Location:	Inlet	Valve Size:	N/A
Tube packing	Viton		

NOTES

1358F-1A4GC2B1C
1358F - Size 8 SHO-RATE "50" Flow Indicator
1 - TUBE: R-8M-75-1 (Cut-Off)
A - FLOAT (316 STAINLESS STEEL): 8-RV-8
4 - SCALE TYPE / SIDE PLATE ARRANGEMENT: Stainless Steel Detachable Scale Mounted to Right Side Plate
G - SCALE INSCRIPTION: Special Calibration, 10% Full Scale Air
C - TUBE PACKING AND O-RING MATERIALS FOR METER / VALVE: Viton Tube Packing, Viton O-ring
2 - FITTING AND ADAPTER MATERIAL / PROCESS CONNECTION SIZE AND TYPE: 3/8" NPT Connection, 316 Stainless Steel Fitting and Adapter
B - VALVE CONFIGURATION: Standard Stainless Steel Needle Valve on Inlet
1 - CONNECTION ORIENTATION: Inlet Port Back, Outlet Port Back
C - ACCESSORIES: Stainless Steel Side Plates
Filter Holder: F&J Model FJ-46P - Diameter: 47 mm; Connection: 3/8" FPT
Critical Flow Venturi: Flow Systems Part No. SN-06-NPT-0.XXX-SS - 3/8" MNPT Hex Body,

AECOM

Flow Instrument
Rotameter

DATA SHEET NO.			REV.
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NO.	BY	DATE	REVISION

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NCC	AME		

P.O.

REQ.

Project: RLWTF

TAG NO: FAC-FI-5039

Hookup Drawings: N/A
Spec: 28 3233
P&ID: P-6006
Loop Wiring Diagram: N/A'
Line / Vessel Number: N/A
Asset No:
Line ID: Size: 3/8 in Schedule: Tubing
Service Description: Facility Air Samplers
Manufacturer: Brooks
Model: 1358F-1A4GC2B1C
Safety Level: NS
Quality Level: ML-4

PROCESS CONDITIONS

					Liquid:	Units:	Vapor:	Units:	Differential:	Units:
Fluid:	Air		Flow:	Min:	N/A	N/A		l/hr	N/A	N/A
Fluid State Present:	N/A			Normal (Operating)	N/A		4500		N/A	
Compressibility (Z):	N/A	Units:		Max (Full Scale):	N/A		6300		N/A	
Temperature @ Operating:	75	deg F		SG/Density @ Operating:	Air			N/A		
Pressure @ Operating:	11.7	in Hg		Viscosity @ Operating:	Air			N/A		
Vapor Pressure:	N/A			Specific Heat Ratio (C_p/C_v):	N/A		% Solids:	N/A		
Base Pressure:	N/A			Steam % Quality or °Superheat:	N/A		Pipe Material:	N/A		
Base Temperature:	N/A									
Flange Material:	N/A			Flange Rating	N/A					

METER

Tube Material:	Borosilicate Glass	Float Material:	316 SS
Process Conn:	3/8" NPT		
Process Conn Material:	316 Stainless Steel		
Holder Material:	316 Stainless Steel		
Scale Range:	3.4 scfm	Rangeability:	10:1
Rated Accuracy:	±10% (full scale)	Meter Length:	75 mm
Max Temp:	250 deg F	Max Press:	200 psig
Fitting Material:	316 SS	O-ring Material:	Viton
SS Tag:	Yes	Mounting:	Panel Install

VALVE

Valve Location:	Inlet	Valve Size:	N/A
Tube packing	Viton		

NOTES

1358F-1A4GC2B1C
1358F - Size 8 SHO-RATE "50" Flow Indicator
1 - TUBE: R-8M-75-1 (Cut-Off)
A - FLOAT (316 STAINLESS STEEL): 8-RV-8
4 - SCALE TYPE / SIDE PLATE ARRANGEMENT: Stainless Steel Detachable Scale Mounted to Right Side Plate
G - SCALE INSCRIPTION: Special Calibration, 10% Full Scale Air
C - TUBE PACKING AND O-RING MATERIALS FOR METER / VALVE: Viton Tube Packing, Viton O-ring
2 - FITTING AND ADAPTER MATERIAL / PROCESS CONNECTION SIZE AND TYPE: 3/8" NPT Connection, 316 Stainless Steel Fitting and Adapter
B - VALVE CONFIGURATION: Standard Stainless Steel Needle Valve on Inlet
1 - CONNECTION ORIENTATION: Inlet Port Back, Outlet Port Back
C - ACCESSORIES: Stainless Steel Side Plates
Filter Holder: F&J Model FJ-46P - Diameter: 47 mm; Connection: 3/8" FPT
Critical Flow Venturi: Flow Systems Part No. SN-06-NPT-0.XXX-SS - 3/8" MNPT Hex Body.

AECOM

Flow Transmitter
Magnetic Flow Meter

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
FIT-1102			A
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1	1	1-17-13	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project:	RLWTF								
TAG NO:	LLW-FIT-1102	Hookup Drawings:	N/A	Loop Wiring Diagram:	M-6150				
		Spec:	40 9100	Line / Vessel Number:	LLW-101-SS150				
Asset No:		P&ID:	D-6010	Line ID:	1.61"	Size:	1.1/2"	Schedule:	40
Service Description:	LLW Influent Filter System			Manufacturer:	Yokogawa				
				Model:	AXF040G-NNAH2H-AA112NB/SCT/GC/M01T01L3/SC				
Safety Class	NS			Quality Assurance Level	ML-4				

PROCESS CONDITIONS

Fluid:	LLW Influent					Liquid:	Units:	Vapor:	Units:	Differential:	Units:
Fluid State Present:	Liquid			Flow:	Min:	N/A	gpm	N/A	N/A	N/A	N/A
Compressibility (Z):	Water based	Units:			Normal (Operating)	50		N/A		N/A	
Temperature @ Operating:	75	deg F			Max (Full Scale):	N/A		N/A		N/A	
Pressure @ Operating:	45	psig		SG/Density @ Operating:		.0368	lbm / in^3	N/A	N/A		
Vapor Pressure:	No			Viscosity @ Operating:		1.05			cP		
Base Pressure:	N/A			Specific Heat Ratio (C_P/C_V):		N/A		% Solids:		N/A	
Base Temperature:	N/A			Steam % Quality or °Superheat:		N/A		Pipe Material:		Halar lined SS	
Flange Material:	SS			Flange Rating:		Class 150					

FLOW TUBE

Process Conenction	CL150 Flange				
Tube Material	316SS	Liner Material	PFA		
Electrode Type	Removable	Electrode Material	Hastelloy C276		
Meter Casing	N/A				
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group: N/A	Enclosure Protection IP1	6	IP2:	7	
Grounding Type:	Ring	Grounding Material:	Hastelloy C276		
Voltage:	N/A				
Power Wiring:	See notes	Signal Type:	4 - 20 mA		
Communication Protocol:	HART	Location:	Remote		
Max Flow (gpm)	321.2	Normal:	100	Minimum	0
Max Temp (deg F)	140	Minimum	-40		
Max Press (psi)	14.5	Minimum	-14.5		
Max velocity (ft/s)		Min Cond (uS/cm)	>= 1		
Vacuum Possibility	No				

CONVERTER

Voltage:	120VAC		
Power Wiring:	Self Powered	Signal Type:	4 - 20 mA
Communication Protocol:	HART	Location:	Remote
Electrical Protection:	N/A	Temperature Category:	N/A
Gas Group: N/A	Enclosure Protection IP1	6	IP2: 7
Pulse Frequency (pps)	0.0001 to 10,000		
Operating temp (deg F)	68 - 86		
Calibrated Span (gpm):	0-500		
Factory Calibration:	Yes		
Body Material:	Aluminum		
SS Tag:	Yes		
Accuracy:	0.35% span		
Alarms	qty 1 dry contact	Rating	30VDC or 0.2A
Status	qty 2 dry contact	Rating	30VDC or 0.2A
Mounting	Flush Panel		

NOTES

Power originates from converter using dedicated signal cable AXFC-4-L200
Model Code AXF040 Standard (Wafer Type) Submersible Type / Explosion Proof, PFA Lining, 50 mm (1.5 in) integral Flow meter / Remote Flow tube
G - General Purpose Use [Available only with Electrode suffix code 2]
N - Remote Flow tube for Combined use with AXFA11
N - Remote Flow tube
A - Fluorocarbon PFA
H - Electrode Material; Hastelloy C276 equivalent
2 - Electrode Structure; Replaceable [Only for suffix code G "General Purpose Use"]
H - Grounding Ring and Electrode Material Hastelloy C276 equivalent
AA1 - Process Connection ANSI Class 150 Flange (Carbon Steel)
1 - Lay Length (Standard)
2 - Electrical Connection ANSI 1/2 NPT female
N - Indicator (Integral Flow meter without indicator - Must be used for Remote Flow tube)
B - Standard Calibration
SCT - Stainless Steel Tag Plate
GC - Acid-resistant Viton Gaskets
M01 - Material Certificate for: PFA / Polyurethane Pipe, Electrodes, Grounding rings/electrodes, Flanges
T01/L3/SC - Hydrostatic Tests / Calibration Certificate - Declaration & the Primary Standard List / Flow Test 5 points of user-specified span

AECOM

Flow Transmitter
Magnetic Flow Meter

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
FIT-1311			A
SHEET	OF	DATE	
1	1	1-17-13	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project:	RLWTF								
TAG NO:	LLW-FIT-1311	Hookup Drawings:	N/A	Loop Wiring Diagram:	M-6234				
		Spec:	40 9100	Line / Vessel Number:	LLW-220-SS150				
Asset No:		P&ID:	D-6017	Line ID:	0.67"	Size:	1/2"	Schedule:	40
Service Description:	RO Feed Recycle			Manufacturer:	Yokogawa				
				Model:	AXF015G-NNAH2H-AA11-2NB/SCT/GC/M01/T01/L3/SC				
Safety Class	NS			Quality Assurance Level	ML-4				

PROCESS CONDITIONS

Fluid:	LLW Influent				Liquid:	Units:	Vapor:	Units:	Differential:	Units:	
Fluid State Present:	Liquid		Flow:	Min:	N/A	gpm	N/A	N/A	N/A	N/A	
Compressibility (Z):	Water based	Units:		Normal (Operating)	5		N/A		N/A		
Temperature @ Operating:	75	deg F		Max (Full Scale):	N/A		N/A		N/A		
Pressure @ Operating:	45	psig		SG/Density @ Operating:	.0368	lbm / in^3	N/A	N/A			
Vapor Pressure:	No			Viscosity @ Operating:	1.05			cP			
Base Pressure:	N/A			Specific Heat Ratio (C_P/C_V):	N/A		% Solids:	N/A			
Base Temperature:	N/A			Steam % Quality or °Superheat:	N/A		Pipe Material:	Halar lined SS			
Flange Material:	SS			Flange Rating:	Class 150						

FLOW TUBE

Process Conenction	CL150 Flange				
Tube Material	316SS	Liner Material	PFA		
Electrode Type	Removable	Electrode Material	Hastelloy C276		
Meter Casing	N/A				
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group: N/A	Enclosure Protection IP1	6	IP2:	7	
Grounding Type:	Ring	Grounding Material:	Hastelloy C276		
Voltage:	N/A				
Power Wiring:	See notes	Signal Type:	4 - 20 mA		
Communication Protocol:	HART	Location:	Remote		
Max Flow (gpm)	321.2	Normal:	100	Minimum	0
Max Temp (deg F)	140	Minimum	-40		
Max Press (psi)	14.5	Minimum	-14.5		
Max velocity (ft/s)		Min Cond (uS/cm)	>= 1		
Vacuum Possibility	No				

CONVERTER

Voltage:	120VAC			
Power Wiring:	Self Powered	Signal Type:	4 - 20 mA	
Communication Protocol:	HART	Location:	Remote	
Electrical Protection:	N/A	Temperature Category:	N/A	
Gas Group: N/A	Enclosure Protection IP1	6	IP2:	7
Pulse Frequency (pps)	0.0001 to 10,000			
Operating temp (deg F)	68 - 86			
Calibrated Span (gpm):	0-500			
Factory Calibration:	Yes			
Body Material:	Aluminum			
SS Tag:	Yes			
Accuracy:	0.35% span			
Alarms	qty 1 dry contact	Rating	30VDC or 0.2A	
Status	qty 2 dry contact	Rating	30VDC or 0.2A	
Mounting	Flush Panel			

NOTES

Power originates from converter using dedicated signal cable AXFC-4-L200
Model Code AXF015 Standard Wafer Type) Submersible Type / Explosion Proof, PFA Lining, 50 mm (0.5 in) integral Flowmeter / Remote Flow tube
G - General Purpose Use [Available only with Electrode suffix code 2]
N - Remote Flow tube for Combined use with AXFA11
N - Remote Flow tube
A - Fluorocarbon PFA
H - Electrode Material; Hastelloy C276 equivalent
2 - Electrode Structure; Replaceable [Only for suffix code G "General Purpose Use"]
H - Grounding Ring and Electrode Material Hastelloy C276 equivalent
AA1 - Process Connection ANSI Class 150 Flange (Carbon Steel)
1 - Lay Length (Standard)
2 - Electrical Connection ANSI 1/2 NPT female
N - Indicator (Integral Flowmeter without indicator - Must be used for Remote Flow tube)
B - Standard Calibration
SCT - Stainless Steel Tag Plate
GC - Acid-resistant Viton Gaskets
M01 - Material Certificate for: PFA / Polyurethane Pipe, Electrodes, Grounding rings/electrodes, Flanges
T01/L3/SC - Hydrostatic Tests / Calibration Certificate - Declaration & the Primary Standard List / Flow Test 5 points of user-specified span

AECOM

Flow Transmitter
Magnetic Flow Meter

DATA SHEET NO.	REV.
FIT-1315	A

SHEET	OF	DATE
1	1	1-17-13

NO.	BY	DATE	REVISION

BY	CHK'D	PROC.	APPR.
NCC	AME		

P.O.	
REQ.	

Project:	RLWTF								
TAG NO:	LLW-FIT-1315	Hookup Drawings:	N/A	Loop Wiring Diagram:	M-6230				
		Spec:	40 9100	Line / Vessel Number:	LLW-228-SS150				
Asset No:		P&ID:	D-6017	Line ID:	1.61"	Size:	1 1/2"	Schedule:	40
Service Description:	RO Inlet Feed			Manufacturer:	Yokogawa				
				Model:	AXF040G-NNAH2H-AA11-2NB/SCT/GC/M01/T01/L3/SC				
Safety Class	NS			Quality Assurance Level	ML-4				

PROCESS CONDITIONS

					Liquid:	Units:	Vapor:	Units:	Differential:	Units:
Fluid:	LLW Influent		Flow:	Min:	N/A	gpm	N/A	N/A	N/A	N/A
Fluid State Present:	Liquid			Normal (Operating)	40		N/A		N/A	
Compressibility (Z):	Water based	Units:		Max (Full Scale):	N/A		N/A		N/A	
Temperature @ Operating:	75	deg F								
Pressure @ Operating:	45	psig	SG/Density @ Operating:		.0368	lbm / in^3	N/A	N/A		
Vapor Pressure:	No		Viscosity @ Operating:		1.05			cP		
Base Pressure:	N/A		Specific Heat Ratio (C_p/C_v):		N/A		% Solids:	N/A		
Base Temperature:	N/A		Steam % Quality or °Superheat:		N/A		Pipe Material:	Halar lined SS		
Flange Material:	SS		Flange Rating:		Class 150					

FLOW TUBE

Process Conenction	CL150 Flange				
Tube Material	316SS	Liner Material	PFA		
Electrode Type	Removable	Electrode Material	Hastelloy C276		
Meter Casing	N/A				
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1	6	IP2:	7
Grounding Type:	Ring	Grounding Material:	Hastelloy C276		
Voltage:	N/A				
Power Wiring:	See notes	Signal Type:	4 - 20 mA		
Communication Protocol:	HART	Location:	Remote		
Max Flow (gpm)	321.2	Normal:	100	Minimum	0
Max Temp (deg F)	140	Minimum	-40		
Max Press (psi)	14.5	Minimum	-14.5		
Max velocity (ft/s)		Min Cond (uS/cm)	>= 1		
Vacuum Possibility	No				

CONVERTER

Voltage:	120VAC				
Power Wiring:	Self Powered	Signal Type:	4 - 20 mA		
Communication Protocol:	HART	Location:	Remote		
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1	6	IP2:	7
Pulse Frequency (pps)	0.0001 to 10,000				
Operating temp (deg F)	68 - 86				
Calibrated Span (gpm):	0-500				
Factory Calibration:	Yes				
Body Material:	Aluminum				
SS Tag:	Yes				
Accuracy:	0.35% span				
Alarms	qty 1 dry contact	Rating	30VDC or 0.2A		
Status	qty 2 dry contact	Rating	30VDC or 0.2A		
Mounting	Flush Panel				

NOTES

Power originates from converter using dedicated signal cable AXFC-4-L200
Model Code AXF040 Standard (Wafer Type) Submersible Type / Explosion Proof, PFA Lining, 50 mm (1.5 in) integral Flowmeter / Remote Flowtube
G - General Purpose Use [Available only with Electrode suffix code 2]
N - Remote Flowtube for Combined use with AXFA11
N - Remote Flowtube
A - Fluorocarbon PFA
H - Electrode Material; Hastelloy C276 equivalent
2 - Electrode Structure; Replaceable [Only for suffix code G "General Purpose Use"]
H - Grounding Ring and Electrode Material Hastelloy C276 equivalent
AA1 - Process Connection ANSI Class 150 Flange (Carbon Steel)
1 - Lay Length (Standard)
2 - Electrical Connection ANSI 1/2 NPT female
N - Indicator (Integral Flowmeter without indicator - Must be used for Remote Flowtube)
B - Standard Calibration
SCT - Stainless Steel Tag Plate
GC - Acid-resistant Viton Gaskets
M01 - Material Certificate for: PFA / Polyurethane Pipe, Electrodes, Grounding rings/electrodes, Flanges
T01/L3/SC - Hydrostatic Tests / Calibration Certificate - Declaration & the Primary Standard List / Flow Test 5 points of user-specified span

AECOM

Flow Transmitter
Magnetic Flow Meter

DATA SHEET NO.			REV.
FIT-1352			A
SHEET	OF	DATE	
1	1	1-17-13	

NO.	BY	DATE	REVISION

BY	CHK'D	PROC.	APPR.
NCC	AME		

P.O.	
REQ.	

Project:	RLWTF								
TAG NO:	LLW-FIT-1352	Hookup Drawings:	N/A	Loop Wiring Diagram:	M-6246				
		Spec:	40 9100	Line / Vessel Number:	LLW-245-SS150				
Asset No:		P&ID:	D-6018	Line ID:	1.61"	Size:	1 1/2"	Schedule:	40
Service Description:	RO Permeate			Manufacturer:	Yokogawa				
				Model:	AXF040G-NNAH2H-AA11-2NB/SCT/GC/M01/T01/L3/SC				
Safety Class	NS			Quality Assurance Level	ML-4				

PROCESS CONDITIONS

Fluid:	LLW Influent				Liquid:	Units:	Vapor:	Units:	Differential:	Units:
Fluid State Present:	Liquid		Flow:	Min:	N/A	gpm	N/A	N/A	N/A	N/A
Compressibility (Z):	Water based	Units:		Normal (Operating)	40		N/A		N/A	
Temperature @ Operating:	75	deg F		Max (Full Scale):	N/A		N/A		N/A	
Pressure @ Operating:	45	psig	SG/Density @ Operating:		.0368	lbm / in^3	N/A	N/A		
Vapor Pressure:	No		Viscosity @ Operating:		1.05			cP		
Base Pressure:	N/A		Specific Heat Ratio (C_P/C_V):		N/A		% Solids:	N/A		
Base Temperature:	N/A		Steam % Quality or °Superheat:		N/A		Pipe Material:	Halar lined SS		
Flange Material:	SS		Flange Rating:		Class 150					

FLOW TUBE

Process Conenction	CL150 Flange				
Tube Material	316SS	Liner Material	PFA		
Electrode Type	Removable	Electrode Material	Hastelloy C276		
Meter Casing	N/A				
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group: N/A	Enclosure Protection IP1	6	IP2:	7	
Grounding Type:	Ring	Grounding Material:	Hastelloy C276		
Voltage:	N/A				
Power Wiring:	See notes	Signal Type:	4 - 20 mA		
Communication Protocol:	HART	Location:	Remote		
Max Flow (gpm)	321.2	Normal:	100	Minimum	0
Max Temp (deg F)	140	Minimum	-40		
Max Press (psi)	14.5	Minimum	-14.5		
Max velocity (ft/s)		Min Cond (uS/cm)	>= 1		
Vacuum Possibility	No				

CONVERTER

Voltage:	120VAC				
Power Wiring:	Self Powered	Signal Type:	4 - 20 mA		
Communication Protocol:	HART	Location:	Remote		
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group: N/A	Enclosure Protection IP1	6	IP2:	7	
Pulse Frequency (pps)	0.0001 to 10,000				
Operating temp (deg F)	68 - 86				
Calibrated Span (gpm):	0-500				
Factory Calibration:	Yes				
Body Material:	Aluminum				
SS Tag:	Yes				
Accuracy:	0.35% span				
Alarms	qty 1 dry contact	Rating	30VDC or 0.2A		
Status	qty 2 dry contact	Rating	30VDC or 0.2A		
Mounting	Flush Panel				

NOTES

Power originates from converter using dedicated signal cable AXFC-4-L200
Model Code AXF040 Standard (Wafer Type) Submersible Type / Explosion Proof, PFA Lining, 50 mm (1.5 in) integral Flowmeter / Remote Flowtube
G - General Purpose Use [Available only with Electrode suffix code 2]
N - Remote Flowtube for Combined use with AXFA11
N - Remote Flowtube
A - Fluorocarbon PFA
H - Electrode Material; Hastelloy C276 equivalent
2 - Electrode Structure; Replaceable [Only for suffix code G "General Purpose Use"]
H - Grounding Ring and Electrode Material Hastelloy C276 equivalent
AA1 - Process Connection ANSI Class 150 Flange (Carbon Steel)
1 - Lay Length (Standard)
2 - Electrical Connection ANSI 1/2 NPT female
N - Indicator (Integral Flowmeter without indicator - Must be used for Remote Flowtube)
B - Standard Calibration
SCT - Stainless Steel Tag Plate
GC - Acid-resistant Viton Gaskets
M01 - Material Certificate for: PFA / Polyurethane Pipe, Electrodes, Grounding rings/electrodes, Flanges
T01/L3/SC - Hydrostatic Tests / Calibration Certificate - Declaration & the Primary Standard List / Flow Test 5 points of user-specified span

AECOM

Flow Transmitter
Magnetic Flow Meter

DATA SHEET NO.	REV.
FIT-1403	A

SHEET	OF	DATE
1	1	1-17-13

NO.	BY	DATE	REVISION

BY	CHK'D	PROC.	APPR.
NCC	AME		

P.O.:
REQ.:

Project: RLWTF

TAG NO:	LLW-FIT-1403	Hookup Drawings:	N/A	Loop Wiring Diagram:	M-6276				
		Spec:	40 9100	Line / Vessel Number:	LLW-449-SS150				
Asset No:		P&ID:	D-6021	Line ID:	1.61"	Size:	1 1/2"	Schedule:	40
Service Description:	RO Permeate Recycle			Manufacturer:	Yokogawa				
				Model:	AXF040G-NNAH2H-AA11-2NB/SCT/GC/M01/T01/L3/SC				
Safety Class	NS			Quality Assurance Level	ML-4				

PROCESS CONDITIONS

					Liquid:	Units:	Vapor:	Units:	Differential:	Units:
Fluid:	LLW Influent		Flow:	Min:	N/A	gpm	N/A	N/A	N/A	N/A
Fluid State Present:	Liquid			Normal (Operating)	40		N/A		N/A	
Compressibility (Z):	Water based	Units:		Max (Full Scale):	N/A		N/A		N/A	
Temperature @ Operating:	75	deg F								
Pressure @ Operating:	45	psig	SG/Density @ Operating:		.0368	lbm / in^3	N/A	N/A		
Vapor Pressure:	No		Viscosity @ Operating:		1.05			cP		
Base Pressure:	N/A		Specific Heat Ratio (C_P/C_V):		N/A		% Solids:		N/A	
Base Temperature:	N/A		Steam % Quality or °Superheat:		N/A		Pipe Material:		Halar lined SS	
Flange Material:	SS		Flange Rating:		Class 150					

FLOW TUBE

Process Conenction	CL150 Flange				
Tube Material	316SS	Liner Material	PFA		
Electrode Type	Removable	Electrode Material	Hastelloy C276		
Meter Casing	N/A				
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group: N/A	Enclosure Protection IP1	6	IP2:	7	
Grounding Type:	Ring	Grounding Material:	Hastelloy C276		
Voltage:	N/A				
Power Wiring:	See notes	Signal Type:	4 - 20 mA		
Communication Protocol:	HART	Location:	Remote		
Max Flow (gpm)	321.2	Normal:	100	Minimum	0
Max Temp (deg F)	140	Minimum	-40		
Max Press (psi)	14.5	Minimum	-14.5		
Max velocity (ft/s)		Min Cond (uS/cm)	>= 1		
Vacuum Possibility	No				

CONVERTER

Voltage:	120VAC				
Power Wiring:	Self Powered	Signal Type:	4 - 20 mA		
Communication Protocol:	HART	Location:	Remote		
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group: N/A	Enclosure Protection IP1	6	IP2:	7	
Pulse Frequency (pps)	0.0001 to 10,000				
Operating temp (deg F)	68 - 86				
Calibrated Span (gpm):	0-500				
Factory Calibration:	Yes				
Body Material:	Aluminum				
SS Tag:	Yes				
Accuracy:	0.35% span				
Alarms	qty 1 dry contact	Rating	30VDC or 0.2A		
Status	qty 2 dry contact	Rating	30VDC or 0.2A		
Mounting	Flush Panel				

NOTES

Power originates from converter using dedicated signal cable AXFC-4-L200
Model Code AXF040 Standard (Wafer Type) Submersible Type / Explosion Proof, PFA Lining, 50 mm (1.5 in) integral Flowmeter / Remote Flowtube
G - General Purpose Use [Available only with Electrode suffix code 2]
N - Remote Flowtube for Combined use with AXFA11
N - Remote Flowtube
A - Fluorocarbon PFA
H - Electrode Material; Hastelloy C276 equivalent
2 - Electrode Structure; Replaceable [Only for suffix code G "General Purpose Use"]
H - Grounding Ring and Electrode Material Hastelloy C276 equivalent
AA1 - Process Connection ANSI Class 150 Flange (Carbon Steel)
1 - Lay Length (Standard)
2 - Electrical Connection ANSI 1/2 NPT female
N - Indicator (Integral Flowmeter without indicator - Must be used for Remote Flowtube)
B - Standard Calibration
SCT - Stainless Steel Tag Plate
GC - Acid-resistant Viton Gaskets
M01 - Material Certificate for: PFA / Polyurethane Pipe, Electrodes, Grounding rings/electrodes, Flanges
T01/L3/SC - Hydrostatic Tests / Calibration Certificate - Declaration & the Primary Standard List / Flow Test 5 points of user-specified span

AECOM

Flow Transmitter
Magnetic Flow Meter

DATA SHEET NO.	REV.
FIT-1405	A

NO.	BY	DATE	REVISION

SHEET	OF	DATE
1	1	1-17-13

BY	CHK'D	PROC.	APPR.
NCC	AME		

P.O.
REQ.

Project: RLWTF

TAG NO:	LLW-FIT-1405	Hookup Drawings:	N/A	Loop Wiring Diagram:	M-6277				
		Spec:	40 9100	Line / Vessel Number:	LLW-449-SS150				
Asset No:		P&ID:	D-6021	Line ID:	1.61"	Size:	1 1/2"	Schedule:	40
Service Description:	Treated Effluent			Manufacturer:	Yokogawa				
				Model:	AXF040G-NNAH2H-AA11-2NB/SCT/GC/M01/T01/L3/SC				
Safety Class	NS			Quality Assurance Level	ML-4				

PROCESS CONDITIONS

					Liquid:	Units:	Vapor:	Units:	Differential:	Units:
Fluid:	LLW Influent			Flow: Min:	N/A	gpm	N/A	N/A	N/A	N/A
Fluid State Present:	Liquid			Normal (Operating)	40		N/A		N/A	
Compressibility (Z):	Water based	Units:		Max (Full Scale):	N/A		N/A		N/A	
Temperature @ Operating:	75	deg F		SG/Density @ Operating:	.0368	lbm / in^3	N/A	N/A		
Pressure @ Operating:	45	psig		Viscosity @ Operating:	1.05			cP		
Vapor Pressure:	No			Specific Heat Ratio (C_P/C_V):	N/A		% Solids:	N/A		
Base Pressure:	N/A			Steam % Quality or °Superheat:	N/A		Pipe Material:	Halar lined SS		
Base Temperature:	N/A			Flange Rating:	Class 150					
Flange Material:	SS									

FLOW TUBE

Process Conenction	CL150 Flange				
Tube Material	316SS	Liner Material	PFA		
Electrode Type	Removable	Electrode Material	Hastelloy C276		
Meter Casing	N/A				
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group: N/A	Enclosure Protection IP1	6	IP2:	7	
Grounding Type:	Ring	Grounding Material:	Hastelloy C276		
Voltage:	N/A				
Power Wiring:	See notes	Signal Type:	4 - 20 mA		
Communication Protocol:	HART	Location:	Remote		
Max Flow (gpm)	321.2	Normal:	100	Minimum	0
Max Temp (deg F)	140	Minimum	-40		
Max Press (psi)	14.5	Minimum	-14.5		
Max velocity (ft/s)		Min Cond (uS/cm)	>= 1		
Vacuum Possibility	No				

CONVERTER

Voltage:	120VAC		
Power Wiring:	Self Powered	Signal Type:	4 - 20 mA
Communication Protocol:	HART	Location:	Remote
Electrical Protection:	N/A	Temperature Category:	N/A
Gas Group: N/A	Enclosure Protection IP1	6	IP2: 7
Pulse Frequency (pps)	0.0001 to 10,000		
Operating temp (deg F)	68 - 86		
Calibrated Span (gpm):	0-500		
Factory Calibration:	Yes		
Body Material:	Aluminum		
SS Tag:	Yes		
Accuracy:	0.35% span		
Alarms	qty 1 dry contact	Rating	30VDC or 0.2A
Status	qty 2 dry contact	Rating	30VDC or 0.2A
Mounting	Flush Panel		

NOTES

Power originates from converter using dedicated signal cable AXFC-4-L200
Model Code AXF040 Standard (Wafer Type) Submersible Type / Explosion Proof, PFA Lining, 50 mm (1.5 in) integral Flowmeter / Remote Flowtube
G - General Purpose Use [Available only with Electrode suffix code 2]
N - Remote Flowtube for Combined use with AXFA11
N - Remote Flowtube
A - Fluorocarbon PFA
H - Electrode Material; Hastelloy C276 equivalent
2 - Electrode Structure; Replaceable [Only for suffix code G "General Purpose Use"]
H - Grounding Ring and Electrode Material Hastelloy C276 equivalent
AA1 - Process Connection ANSI Class 150 Flange (Carbon Steel)
1 - Lay Length (Standard)
2 - Electrical Connection ANSI 1/2 NPT female
N - Indicator (Integral Flowmeter without indicator - Must be used for Remote Flowtube)
B - Standard Calibration
SCT - Stainless Steel Tag Plate
GC - Acid-resistant Viton Gaskets
M01 - Material Certificate for: PFA / Polyurethane Pipe, Electrodes, Grounding rings/electrodes, Flanges
T01/L3/SC - Hydrostatic Tests / Calibration Certificate - Declaration & the Primary Standard List / Flow Test 5 points of user-specified span

AECOM

Flow Instrument
Rotometer

DATA SHEET NO.			REV.
FIT-1515			A
SHEET	OF	DATE	
1	1	1-17-13	

NO.	BY	DATE	REVISION

BY	CHK'D	PROC.	APPR.
NCC	AME		

P.O.	
REQ.	

Project: RLWTF

TAG NO:	LLW-FIT-1515	Hookup Drawings:	N/A	Loop Wiring Diagram:	E-6398			
		Spec:	40 9100	Line / Vessel Number:	LLW-303-SS150			
Asset No:		P&ID:	D-6412	Line ID:	3.07"	Size:	3"	Schedule: 40
Service Description:	LLW Effluent Sampling and pH adjustment			Manufacturer:	Krohne			
				Model:	H250H/RR/M9/ESK-Z/K2			
Safety Class	NS			Quality Assurance Level	ML-4			

PROCESS CONDITIONS

Fluid:	LLW Effluent				Liquid:	Units:	Vapor:	Units:	Differential:	Units:
Fluid State Present:	Liquid		Flow:	Min:	0	gpm	N/A	N/A	N/A	N/A
Compressibility (Z):	Water based	Units:		Normal (Operating)	100		N/A		N/A	
Temperature @ Operating:	75	deg F		Max (Full Scale):	200		N/A		N/A	
Pressure @ Operating:	45	psig		SG/Density @ Operating:	1.02	g/mL	N/A	N/A		
Vapor Pressure:	No			Viscosity @ Operating:	N/A			N/A		
Base Pressure:	N/A			Nominal pH	7		% Solids:	0		
Base Temperature:	N/A			Steam % Quality or °Superheat:	0		Pipe Material:	SS		
Flange Material:	SS			Flange Rating	Class 150					

FLOW TUBE

Process Conenction	DN80 3" Flange						
Tube Material	316SS	Liner Material	N/A				
Element Type	Variable Area	Electrode Material	Hastelloy C(equiv)				
Meter Casing	N/A						
Electrical Protection:	N/A	Temperature Category:	N/A				
Max Flow(gpm)	264	Normal:	100	Minimum	0		
Max Temp (deg F)	572	Minimum	-321				
Max Press (psi)	Flange Rating	Minimum	2 x Pressure Loss				
Max velocity (ft/s)	N/A	Min Cond (uS/cm)	N/A				
Vacuum Possibility	No						

Inlet Run: > 5 Diameters
Outlet Run: > 3 Diameters

TRANSMITTER

Voltage:	24 VDC						
Power Wiring:	Loop Powered	Signal Type:	4 - 20 mA				
Communication Protocc	HART	Location:	Local				
Electrical Protection:	N/A	Temperature Category:	N/A				
Gas Group:	N/A	Enclosure Protection IP	6	IP2:	7		
Pulse Frequency (pps)	N/A						
Operating temp (deg F)	-13 - 104F						
Calibrated Span (gpm):	0 - 50						
Factory Calibration	Yes						
Body Material:	SS						
SS Tag:	LIT-1515						
Accuracy:	1.6% reading						
Alarms	qty 2 NAMUR	Rating	8 VDC				
		≥3mA pointer detected, ≤1mA open					
Mounting							

NOTES

Provide with K85.2 Float for 15851GPH flow range and 4.26psig loss

H250H Model (H) horizontal (U) top to bottom
RR Tube material: Stainless Steel
M9 Standard Indicator
ESK-Z Current output and totalizer
K2 Two limit switches (NAMUR)

AECOM

Flow Transmitter

Magnetic Flow Meter

DATA SHEET NO.	REV.
FIT-1700	A

NO.	BY	DATE	REVISION

SHEET	OF	DATE
1	1	1-17-13

BY	CHK'D	PROC.	APPR.
NCC	AME		

P.O.	
REQ.	

Project: RLWTF

TAG NO:	LLW-FIT-1700	Hookup Drawings:	N/A	Loop Wiring Diagram:	M-6368			
		Spec:	40 9100	Line / Vessel Number:	LLW-397-SS150			
Asset No:		P&ID:	D-6030	Line ID:	0.67"	Size:	1/2"	Schedule: 40
Service Description:	LLW Evaporator Condensate			Manufacturer:	Yokogawa			
				Model:	AXF015G-NNAH2H-AA11-2NB/SCT/GC/M01/T01/L3/SC			
Safety Class	NS	Quality Assurance Level		ML-4				

PROCESS CONDITIONS

Fluid:	LLW Influent				Liquid:	Units:	Vapor:	Units:	Differential:	Units:
Fluid State Present:	Liquid		Flow:	Min:	N/A	gpm	N/A	N/A	N/A	N/A
Compressibility (Z):	Water based	Units:		Normal (Operating)	40		N/A		N/A	
Temperature @ Operating:	75	deg F		Max (Full Scale):	N/A		N/A		N/A	
Pressure @ Operating:	45	psig		SG/Density @ Operating:	.0368	lbm / in^3	N/A	N/A		
Vapor Pressure:	No			Viscosity @ Operating:	1.05			cP		
Base Pressure:	N/A			Specific Heat Ratio (C_P/C_V):	N/A		% Solids:	N/A		
Base Temperature:	N/A			Steam % Quality or °Superheat:	N/A		Pipe Material:	Halar lined SS		
Flange Material:	SS			Flange Rating:	Class 150					

FLOW TUBE

Process Conenction	CL150 Flange						
Tube Material	316SS	Liner Material	PFA				
Electrode Type	Removable	Electrode Material	Hastelloy C276				
Meter Casing	N/A						
Electrical Protection:	N/A	Temperature Category:	N/A				
Gas Group: N/A	Enclosure Protection IP1	6	IP2:	7			
Grounding Type:	Ring	Grounding Material:	Hastelloy C276				
Voltage:	N/A						
Power Wiring:	See notes	Signal Type:	4 - 20 mA				
Communication Protocol:	HART	Location:	Remote				
Max Flow (gpm)	321.2	Normal:	100	Minimum	0		
Max Temp (deg F)	140	Minimum	-40				
Max Press (psi)	14.5	Minimum	-14.5				
Max velocity (ft/s)		Min Cond (uS/cm)	>= 1				
Vacuum Possibility	No						

CONVERTER

Voltage:	120VAC						
Power Wiring:	Self Powered	Signal Type:	4 - 20 mA				
Communication Protocol:	HART	Location:	Remote				
Electrical Protection:	N/A	Temperature Category:	N/A				
Gas Group: N/A	Enclosure Protection IP1	6	IP2:	7			
Pulse Frequency (pps)	0.0001 to 10,000						
Operating temp (deg F)	68 - 86						
Calibrated Span (gpm):	0-500						
Factory Calibration:	Yes						
Body Material:	Aluminum						
SS Tag:	Yes						
Accuracy:	0.35% span						
Alarms	qty 1 dry contact	Rating	30VDC or 0.2A				
Status	qty 2 dry contact	Rating	30VDC or 0.2A				
Mounting	Flush Panel						

NOTES

Power originates from converter using dedicated signal cable AXFC-4-L200

Model Code AXF015 Standard (Wafer Type) Submersible Type / Explosion Proof, PFA Lining, 50 mm (0.5 in) integral Flowmeter / Remote Flowtube

G - General Purpose Use [Available only with Electrode suffix code 2]

N - Remote Flowtube for Combined use with AXFA11

N - Remote Flowtube

A - Fluorocarbon PFA

H - Electrode Material; Hastelloy C276 equivalent

2 - Electrode Structure; Replaceable [Only for suffix code G "General Purpose Use"]

H - Grounding Ring and Electrode Material Hastelloy C276 equivalent

AA1 - Process Connection ANSI Class 150 Flange (Carbon Steel)

1 - Lay Length (Standard)

2 - Electrical Connection ANSI 1/2 NPT female

N - Indicator (Integral Flowmeter without indicator - Must be used for Remote Flowtube)

B - Standard Calibration

SCT - Stainless Steel Tag Plate

GC - Acid-resistant Viton Gaskets

M01 - Material Certificate for: PFA / Polyurethane Pipe, Electrodes, Grounding rings/electrodes, Flanges

T01/L3/SC - Hydrostatic Tests / Calibration Certificate - Declaration & the Primary Standard List / Flow Test 5 points of user-specified span

AECOM

Flow Transmitter
Magnetic Flow Meter

DATA SHEET NO.	REV.
FIT-1701	A

SHEET	OF	DATE
1	1	1-17-13

NO.	BY	DATE	REVISION

BY	CHK'D	PROC.	APPR.
NCC	AME		

P.O.	
REQ.	

Project: RLWTF

TAG NO:	LLW-FIT-1701	Hookup Drawings:	N/A	Loop Wiring Diagram:	M-6369				
		Spec:	40 9100	Line / Vessel Number:	LLW-234-SS150				
Asset No:		P&ID:	D-6030	Line ID:	0.67"	Size:	1/2"	Schedule:	40
Service Description:	LLW Evaporator Condensate Recirculate			Manufacturer:	Yokogawa				
				Model:	AXF015G-NNAH2H-AA11-2NB/SCT/GC/M01/T01/L3/SC				
Safety Class	NS			Quality Assurance Level	ML-4				

PROCESS CONDITIONS

Fluid:	LLW Influent				Liquid:	Units:	Vapor:	Units:	Differential:	Units:
Fluid State Present:	Liquid		Flow:	Min:	N/A	gpm	N/A	N/A	N/A	N/A
Compressibility (Z):	Water based	Units:		Normal (Operating)	5		N/A		N/A	
Temperature @ Operating:	75	deg F		Max (Full Scale):	N/A		N/A		N/A	
Pressure @ Operating:	45	psig		SG/Density @ Operating:	.0368	lbm / in^3	N/A	N/A		
Vapor Pressure:	No			Viscosity @ Operating:	1.05			cP		
Base Pressure:	N/A			Specific Heat Ratio (C_P/C_V):	N/A		% Solids:	N/A		
Base Temperature:	N/A			Steam % Quality or °Superheat:	N/A		Pipe Material:	Halar lined SS		
Flange Material:	SS			Flange Rating:	Class 150					

FLOW TUBE

Process Conenction	CL150 Flange				
Tube Material	316SS	Liner Material	PFA		
Electrode Type	Removable	Electrode Material	Hastelloy C276		
Meter Casing	N/A				
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1	6	IP2:	7
Grounding Type:	Ring	Grounding Material:	Hastelloy C276		
Voltage:	N/A				
Power Wiring:	See notes	Signal Type:	4 - 20 mA		
Communication Protocol:	HART	Location:	Remote		
Max Flow (gpm)	321.2	Normal:	100	Minimum	0
Max Temp (deg F)	140	Minimum	-40		
Max Press (psi)	14.5	Minimum	-14.5		
Max velocity (ft/s)		Min Cond (uS/cm)	>= 1		
Vacuum Possibility	No				

CONVERTER

Voltage:	120VAC				
Power Wiring:	Self Powered	Signal Type:	4 - 20 mA		
Communication Protocol:	HART	Location:	Remote		
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1	6	IP2:	7
Pulse Frequency (pps)	0.0001 to 10,000				
Operating temp (deg F)	68 - 86				
Calibrated Span (gpm):	0-500				
Factory Calibration:	Yes				
Body Material:	Aluminum				
SS Tag:	Yes				
Accuracy:	0.35% span				
Alarms	qty 1 dry contact	Rating	30VDC or 0.2A		
Status	qty 2 dry contact	Rating	30VDC or 0.2A		
Mounting	Flush Panel				

NOTES

Power originates from converter using dedicated signal cable AXFC-4-L200
Model Code AXF015 Standard (Wafer Type) Submersible Type / Explosion Proof, PFA Lining, 50 mm (0.5 in) integral Flow meter / Remote Flow tube
G - General Purpose Use [Available only with Electrode suffix code 2]
N - Remote Flow tube for Combined use with AXFA11
N - Remote Flow tube
A - Fluorocarbon PFA
H - Electrode Material; Hastelloy C276 equivalent
2 - Electrode Structure; Replaceable [Only for suffix code G "General Purpose Use"]
H - Grounding Ring and Electrode Material Hastelloy C276 equivalent
AA1 - Process Connection ANSI Class 150 Flange (Carbon Steel)
1 - Lay Length (Standard)
2 - Electrical Connection ANSI 1/2 NPT female
N - Indicator (Integral Flow meter without indicator - Must be used for Remote Flow tube)
B - Standard Calibration
SCT - Stainless Steel Tag Plate
GC - Acid-resistant Viton Gaskets
M01 - Material Certificate for: PFA / Polyurethane Pipe, Electrodes, Grounding rings/electrodes, Flanges
T01/L3/SC - Hydrostatic Tests / Calibration Certificate - Declaration & the Primary Standard List / Flow Test 5 points of user-specified span

AECOM

Flow Transmitter
Magnetic Flow Meter

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
FIT-1705			A
SHEET	OF	DATE	
1	1	1-17-13	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project:	RLWTF						
TAG NO:	LLW-FIT-1705	Hookup Drawings:	N/A	Loop Wiring Diagram:	M-6306		
		Spec:	40 9100	Line / Vessel Number:	LLW-153-SS150		
Asset No:		P&ID:	D-6024	Line ID: 0.67"	Size: 1/2"	Schedule:	40
Service Description:	MicroFilter Sludge			Manufacturer:	Yokogawa		
				Model:	AXF015G-NNAH2H-AA11-2NB/SCT/GC/M01/T01/L3/SC		
Safety Class	NS			Quality Assurance Level	ML-4		

PROCESS CONDITIONS

Fluid:	LLW Influent			Flow:		Liquid:	Units:	Vapor:	Units:	Differential:	Units:
Fluid State Present:	Liquid				Min:	N/A	gpm	N/A	N/A	N/A	N/A
Compressibility (Z):	Water based	Units:			Normal (Operating)	5		N/A		N/A	
Temperature @ Operating:	75	deg F			Max (Full Scale):	N/A		N/A		N/A	
Pressure @ Operating:	45	psig		SG/Density @ Operating:		.0368	lbm / in^3	N/A	N/A		
Vapor Pressure:	No			Viscosity @ Operating:		1.05			cP		
Base Pressure:	N/A			Specific Heat Ratio (C_P/C_V):		N/A		% Solids:	N/A		
Base Temperature:	N/A			Steam % Quality or °Superheat:		N/A		Pipe Material:	Halar lined SS		
Flange Material:	SS			Flange Rating:		Class 150					

FLOW TUBE

Process Conenction	CL150 Flange				
Tube Material	316SS	Liner Material	PFA		
Electrode Type	Removable	Electrode Material	Hastelloy C276		
Meter Casing	N/A				
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group: N/A	Enclosure Protection IP1	6	IP2:	7	
Grounding Type:	Ring	Grounding Material:	Hastelloy C276		
Voltage:	N/A				
Power Wiring:	See notes	Signal Type:	4 - 20 mA		
Communication Protocol:	HART	Location:	Remote		
Max Flow (gpm)	321.2	Normal:	100	Minimum	0
Max Temp (deg F)	140	Minimum	-40		
Max Press (psi)	14.5	Minimum	-14.5		
Max velocity (ft/s)		Min Cond (uS/cm)	>= 1		
Vacuum Possibility	No				

CONVERTER

Voltage:	120VAC				
Power Wiring:	Self Powered	Signal Type:	4 - 20 mA		
Communication Protocol:	HART	Location:	Remote		
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group: N/A	Enclosure Protection IP1	6	IP2:	7	
Pulse Frequency (pps)	0.0001 to 10,000				
Operating temp (deg F)	68 - 86				
Calibrated Span (gpm):	0-500				
Factory Calibration:	Yes				
Body Material:	Aluminum				
SS Tag:	Yes				
Accuracy:	0.35% span				
Alarms	qty 1 dry contact	Rating	30VDC or 0.2A		
Status	qty 2 dry contact	Rating	30VDC or 0.2A		
Mounting	Flush Panel				

NOTES

Power originates from converter using dedicated signal cable AXFC-4-L200

Model Code AXF015 Standard (Wafer Type) Submersible Type / Explosion Proof, PFA Lining, 50 mm (0.5 in) integral Flow meter / Remote Flow tube

G - General Purpose Use [Available only with Electrode suffix code 2]

N - Remote Flow tube for Combined use with AXFA11

N - Remote Flow tube

A - Fluorocarbon PFA

H - Electrode Material; Hastelloy C276 equivalent

2 - Electrode Structure; Replaceable [Only for suffix code G "General Purpose Use"]

H - Grounding Ring and Electrode Material Hastelloy C276 equivalent

AA1 - Process Connection ANSI Class 150 Flange (Carbon Steel)

1 - Lay Length (Standard)

2 - Electrical Connection ANSI 1/2 NPT female

N - Indicator (Integral Flow meter without indicator - Must be used for Remote Flow tube)

B - Standard Calibration

SCT - Stainless Steel Tag Plate

GC - Acid-resistant Viton Gaskets

M01 - Material Certificate for: PFA / Polyurethane Pipe, Electrodes, Grounding rings/electrodes, Flanges

T01/L3/SC - Hydrostatic Tests / Calibration Certificate - Declaration & the Primary Standard List / Flow Test 5 points of user-specified span

AECOM

Flow Transmitter
Magnetic Flow Meter

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
FIT-1707			A
SHEET	OF	DATE	
1	1	1-17-13	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project:	RLWTF						
TAG NO:	LLW-FIT-1707	Hookup Drawings:	N/A	Loop Wiring Diagram:	M-6295		
		Spec:	40 9100	Line / Vessel Number:	LLW-089-SS150		
Asset No:		P&ID:	D-6023	Line ID: 1.05"	Size: 1"	Schedule:	40
Service Description:	Rotary Press Filtrate Recirculate			Manufacturer:	Yokogawa		
				Model:	AXF025G-NNAH2H-AA1!2NB/SCT/GC/M01T01L3/SC		
Safety Class	NS			Quality Assurance Level	ML-4		

PROCESS CONDITIONS

Fluid:	LLW Influent				Liquid:	Units:	Vapor:	Units:	Differential:	Units:
Fluid State Present:	Liquid		Flow:	Min:	N/A	gpm	N/A	N/A	N/A	N/A
Compressibility (Z):	Water based	Units:		Normal (Operating)	12		N/A		N/A	
Temperature @ Operating:	75	deg F		Max (Full Scale):	N/A		N/A		N/A	
Pressure @ Operating:	45	psig		SG/Density @ Operating:	.0368	lbm / in^3	N/A	N/A		
Vapor Pressure:	No			Viscosity @ Operating:	1.05			cP		
Base Pressure:	N/A			Specific Heat Ratio (C_P/C_V):	N/A		% Solids:	N/A		
Base Temperature:	N/A			Steam % Quality or °Superheat:	N/A		Pipe Material:	Halar lined SS		
Flange Material:	SS			Flange Rating:	Class 150					

FLOW TUBE

Process Conenction	CL150 Flange					
Tube Material	316SS	Liner Material	PFA			
Electrode Type	Removable	Electrode Material	Hastelloy C276			
Meter Casing	N/A					
Electrical Protection:	N/A	Temperature Category:	N/A			
Gas Group: N/A	Enclosure Protection IP1	6	IP2:	7		
Grounding Type:	Ring	Grounding Material:	Hastelloy C276			
Voltage:	N/A					
Power Wiring:	See notes	Signal Type:	4 - 20 mA			
Communication Protocol:	HART	Location:	Remote			
Max Flow (gpm)	321.2	Normal:	100	Minimum	0	
Max Temp (deg F)	140	Minimum	-40			
Max Press (psi)	14.5	Minimum	-14.5			
Max velocity (ft/s)		Min Cond (uS/cm)	>= 1			
Vacuum Possibility	No					

CONVERTER

Voltage:	120VAC				
Power Wiring:	Self Powered	Signal Type:	4 - 20 mA		
Communication Protocol:	HART	Location:	Remote		
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group: N/A	Enclosure Protection IP1	6	IP2:	7	
Pulse Frequency (pps)	0.0001 to 10,000				
Operating temp (deg F)	68 - 86				
Calibrated Span (gpm):	0-500				
Factory Calibration:	Yes				
Body Material:	Aluminum				
SS Tag:	Yes				
Accuracy:	0.35% span				
Alarms	qty 1 dry contact	Rating	30VDC or 0.2A		
Status	qty 2 dry contact	Rating	30VDC or 0.2A		
Mounting	Flush Panel				

NOTES

Power originates from converter using dedicated signal cable AXFC-4-L200
Model Code AXF025 Standard (Wafer Type) Submersible Type / Explosion Proof, PFA Lining, 50 mm (1.0 in) integral Flowmeter / Remote Flow tube
G - General Purpose Use [Available only with Electrode suffix code 2]
N - Remote Flow tube for Combined use with AXFA11
N - Remote Flow tube
A - Fluorocarbon PFA
H - Electrode Material; Hastelloy C276 equivalent
2 - Electrode Structure; Replaceable [Only for suffix code G "General Purpose Use"]
H - Grounding Ring and Electrode Material Hastelloy C276 equivalent
AA1 - Process Connection ANSI Class 150 Flange (Carbon Steel)
1 - Lay Length (Standard)
2 - Electrical Connection ANSI 1/2 NPT female
N - Indicator (Integral Flowmeter without indicator - Must be used for Remote Flow tube)
B - Standard Calibration
SCT - Stainless Steel Tag Plate
GC - Acid-resistant Viton Gaskets
M01 - Material Certificate for: PFA / Polyurethane Pipe, Electrodes, Grounding rings/electrodes, Flanges
T01/L3/SC - Hydrostatic Tests / Calibration Certificate - Declaration & the Primary Standard List / Flow Test 5 points of user-specified span

AECOM

Flow Transmitter
Magnetic Flow Meter

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
FIT-1708			A
SHEET	OF	DATE	
1	1	1-17-13	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project:	RLWTF						
TAG NO:	LLW-FIT-1708	Hookup Drawings:	N/A	Loop Wiring Diagram:	M-6297		
		Spec:	40 9100	Line / Vessel Number:	LLW-088-SS150		
Asset No:		P&ID:	D-6023	Line ID: 0.67"	Size: 1/2"	Schedule:	40
Service Description:	Rotary Press Filtrate Recycle			Manufacturer:	Yokogawa		
				Model:	AXF015G-NNAH2H-AA11-2NB/SCT/GC/M01/T01/L3/SC		
Safety Class	NS			Quality Assurance Level	ML-4		

PROCESS CONDITIONS

Fluid:	LLW Influent			Flow:		Liquid:	Units:	Vapor:	Units:	Differential:	Units:
Fluid State Present:	Liquid				Min:	N/A	gpm	N/A	N/A	N/A	N/A
Compressibility (Z):	Water based	Units:			Normal (Operating)	5		N/A		N/A	
Temperature @ Operating:	75	deg F			Max (Full Scale):	N/A		N/A		N/A	
Pressure @ Operating:	45	psig		SG/Density @ Operating:		.0368	lbm / in^3	N/A	N/A		
Vapor Pressure:	No			Viscosity @ Operating:		1.05			cP		
Base Pressure:	N/A			Specific Heat Ratio (C_p/C_v):		N/A		% Solids:	N/A		
Base Temperature:	N/A			Steam % Quality or °Superheat:		N/A		Pipe Material:	Halar lined SS		
Flange Material:	SS			Flange Rating:		Class 150					

FLOW TUBE

Process Conenction	CL150 Flange				
Tube Material	316SS	Liner Material	PFA		
Electrode Type	Removable	Electrode Material	Hastelloy C276		
Meter Casing	N/A				
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group: N/A	Enclosure Protection IP1	6	IP2:	7	
Grounding Type:	Ring	Grounding Material:	Hastelloy C276		
Voltage:	N/A				
Power Wiring:	See notes	Signal Type:	4 - 20 mA		
Communication Protocol:	HART	Location:	Remote		
Max Flow (gpm)	321.2	Normal:	100	Minimum	0
Max Temp (deg F)	140	Minimum	-40		
Max Press (psi)	14.5	Minimum	-14.5		
Max velocity (ft/s)		Min Cond (uS/cm)	>= 1		
Vacuum Possibility	No				

CONVERTER

Voltage:	120VAC				
Power Wiring:	Self Powered	Signal Type:	4 - 20 mA		
Communication Protocol:	HART	Location:	Remote		
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group: N/A	Enclosure Protection IP1	6	IP2:	7	
Pulse Frequency (pps)	0.0001 to 10,000				
Operating temp (deg F)	68 - 86				
Calibrated Span (gpm):	0-500				
Factory Calibration:	Yes				
Body Material:	Aluminum				
SS Tag:	Yes				
Accuracy:	0.35% span				
Alarms	qty 1 dry contact	Rating	30VDC or 0.2A		
Status	qty 2 dry contact	Rating	30VDC or 0.2A		
Mounting	Flush Panel				

NOTES

Power originates from converter using dedicated signal cable AXFC-4-L200
Model Code AXF015 Standard (Wafer Type) Submersible Type / Explosion Proof, PFA Lining, 50 mm (0.5 in) integral Flow meter / Remote Flow tube
G - General Purpose Use [Available only with Electrode suffix code 2]
N - Remote Flow tube for Combined use with AXFA11
N - Remote Flow tube
A - Fluorocarbon PFA
H - Electrode Material; Hastelloy C276 equivalent
2 - Electrode Structure; Replaceable [Only for suffix code G "General Purpose Use"]
H - Grounding Ring and Electrode Material Hastelloy C276 equivalent
AA1 - Process Connection ANSI Class 150 Flange (Carbon Steel)
1 - Lay Length (Standard)
2 - Electrical Connection ANSI 1/2 NPT female
N - Indicator (Integral Flow meter without indicator - Must be used for Remote Flow tube)
B - Standard Calibration
SCT - Stainless Steel Tag Plate
GC - Acid-resistant Viton Gaskets
M01 - Material Certificate for: PFA / Polyurethane Pipe, Electrodes, Grounding rings/electrodes, Flanges
T01/L3/SC - Hydrostatic Tests / Calibration Certificate - Declaration & the Primary Standard List / Flow Test 5 points of user-specified span

AECOM

Flow Transmitter
Magnetic Flow Meter

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
FIT-1711			A
SHEET	OF	DATE	
1	1	1-17-13	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project:	RLWTF							
TAG NO:	LLW-FIT-1711	Hookup Drawings:	N/A	Loop Wiring Diagram:	M-6317			
		Spec:	40 9100	Line / Vessel Number:	LLW-165-SS150			
Asset No:		P&ID:	D-6025	Line ID:	0.67"	Size:	1/2"	Schedule: 40
Service Description:	Thickened Sludge			Manufacturer:	Yokogawa			
				Model:	AXF015G-NNAH2H-AA11-2NB/SCT/GC/M01/T01/L3/SC			
Safety Class	NS			Quality Assurance Level	ML-4			

PROCESS CONDITIONS

Fluid:	LLW Influent			Flow:		Liquid:	Units:	Vapor:	Units:	Differential:	Units:
Fluid State Present:	Liquid				Min:	N/A	gpm	N/A	N/A	N/A	N/A
Compressibility (Z):	Water based	Units:			Normal (Operating)	7		N/A		N/A	
Temperature @ Operating:	75	deg F			Max (Full Scale):	N/A		N/A		N/A	
Pressure @ Operating:	45	psig		SG/Density @ Operating:		.0368	lbm / in^3	N/A	N/A		
Vapor Pressure:	No			Viscosity @ Operating:		1.05			cP		
Base Pressure:	N/A			Specific Heat Ratio (C_P/C_V):		N/A		% Solids:	N/A		
Base Temperature:	N/A			Steam % Quality or °Superheat:		N/A		Pipe Material:	Halar lined SS		
Flange Material:	SS			Flange Rating:		Class 150					

FLOW TUBE

Process Conenction	CL150 Flange				
Tube Material	316SS	Liner Material	PFA		
Electrode Type	Removable	Electrode Material	Hastelloy C276		
Meter Casing	N/A				
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group: N/A	Enclosure Protection IP1	6	IP2:	7	
Grounding Type:	Ring	Grounding Material:	Hastelloy C276		
Voltage:	N/A				
Power Wiring:	See notes	Signal Type:	4 - 20 mA		
Communication Protocol:	HART	Location:	Remote		
Max Flow (gpm)	321.2	Normal:	100	Minimum	0
Max Temp (deg F)	140	Minimum	-40		
Max Press (psi)	14.5	Minimum	-14.5		
Max velocity (ft/s)		Min Cond (uS/cm)	>= 1		
Vacuum Possibility	No				

CONVERTER

Voltage:	120VAC			
Power Wiring:	Self Powered	Signal Type:	4 - 20 mA	
Communication Protocol:	HART	Location:	Remote	
Electrical Protection:	N/A	Temperature Category:	N/A	
Gas Group: N/A	Enclosure Protection IP1	6	IP2:	7
Pulse Frequency (pps)	0.0001 to 10,000			
Operating temp (deg F)	68 - 86			
Calibrated Span (gpm):	0-500			
Factory Calibration:	Yes			
Body Material:	Aluminum			
SS Tag:	Yes			
Accuracy:	0.35% span			
Alarms	qty 1 dry contact	Rating	30VDC or 0.2A	
Status	qty 2 dry contact	Rating	30VDC or 0.2A	
Mounting	Flush Panel			

NOTES

Power originates from converter using dedicated signal cable AXFC-4-L200
Model Code AXF015 Standard (Wafer Type) Submersible Type / Explosion Proof, PFA Lining, 50 mm (0.5 in) integral Flowmeter / Remote Flow tube
G - General Purpose Use [Available only with Electrode suffix code 2]
N - Remote Flow tube for Combined use with AXFA11
N - Remote Flow tube
A - Fluorocarbon PFA
H - Electrode Material; Hastelloy C276 equivalent
2 - Electrode Structure; Replaceable [Only for suffix code G "General Purpose Use"]
H - Grounding Ring and Electrode Material Hastelloy C276 equivalent
AA1 - Process Connection ANSI Class 150 Flange (Carbon Steel)
1 - Lay Length (Standard)
2 - Electrical Connection ANSI 1/2 NPT female
N - Indicator (Integral Flowmeter without indicator - Must be used for Remote Flow tube)
B - Standard Calibration
SCT - Stainless Steel Tag Plate
GC - Acid-resistant Viton Gaskets
M01 - Material Certificate for: PFA / Polyurethane Pipe, Electrodes, Grounding rings/electrodes, Flanges
T01/L3/SC - Hydrostatic Tests / Calibration Certificate - Declaration & the Primary Standard List / Flow Test 5 points of user-specified span

AECOM

Flow Transmitter
Magnetic Flow Meter

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
FIT-1719			A
SHEET	OF	DATE	
1	1	1-17-13	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project:	RLWTF							
TAG NO:	LLW-FIT-1719	Hookup Drawings:	N/A	Loop Wiring Diagram:	M-6333			
		Spec:	40 9100	Line / Vessel Number:	LLW-179-SS150			
Asset No:		P&ID:	D-6027	Line ID:	1.05"	Size:	1"	Schedule: 40
Service Description:	Thickener Decant Recirculate			Manufacturer:	Yokogawa			
				Model:	AXF025G-NNAH2H-AA11-2NB/SCT/GC/M01/T01/L3/SC			
Safety Class	NS			Quality Assurance Level	ML-4			

PROCESS CONDITIONS

Fluid:	LLW Influent				Liquid:	Units:	Vapor:	Units:	Differential:	Units:	
Fluid State Present:	Liquid		Flow:	Min:	N/A	gpm	N/A	N/A	N/A	N/A	
Compressibility (Z):	Water based	Units:		Normal (Operating)	12		N/A		N/A		
Temperature @ Operating:	75	deg F		Max (Full Scale):	N/A		N/A		N/A		
Pressure @ Operating:	45	psig	SG/Density @ Operating:		.0368	lbm / in^3	N/A	N/A			
Vapor Pressure:	No		Viscosity @ Operating:		1.05			cP			
Base Pressure:	N/A		Specific Heat Ratio (C_p/C_v):		N/A		% Solids:	N/A			
Base Temperature:	N/A		Steam % Quality or °Superheat:		N/A		Pipe Material:	Halar lined SS			
Flange Material:	SS		Flange Rating:		Class 150						

FLOW TUBE

Process Conenction	CL150 Flange				
Tube Material	316SS	Liner Material	PFA		
Electrode Type	Removable	Electrode Material	Hastelloy C276		
Meter Casing	N/A				
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group: N/A	Enclosure Protection IP1	6	IP2:	7	
Grounding Type:	Ring	Grounding Material:	Hastelloy C276		
Voltage:	N/A				
Power Wiring:	See notes	Signal Type:	4 - 20 mA		
Communication Protocol:	HART	Location:	Remote		
Max Flow (gpm)	321.2	Normal:	100	Minimum	0
Max Temp (deg F)	140	Minimum	-40		
Max Press (psi)	14.5	Minimum	-14.5		
Max velocity (ft/s)		Min Cond (uS/cm)	>= 1		
Vacuum Possibility	No				

CONVERTER

Voltage:	120VAC			
Power Wiring:	Self Powered	Signal Type:	4 - 20 mA	
Communication Protocol:	HART	Location:	Remote	
Electrical Protection:	N/A	Temperature Category:	N/A	
Gas Group: N/A	Enclosure Protection IP1	6	IP2:	7
Pulse Frequency (pps)	0.0001 to 10,000			
Operating temp (deg F)	68 - 86			
Calibrated Span (gpm):	0-500			
Factory Calibration:	Yes			
Body Material:	Aluminum			
SS Tag:	Yes			
Accuracy:	0.35% span			
Alarms	qty 1 dry contact	Rating	30VDC or 0.2A	
Status	qty 2 dry contact	Rating	30VDC or 0.2A	
Mounting	Flush Panel			

NOTES

Power originates from converter using dedicated signal cable AXFC-4-L200
Model Code AXF025 Standard (Wafer Type) Submersible Type / Explosion Proof, PFA Lining, 50 mm (1.0 in) integral Flow meter / Remote Flow tube
G - General Purpose Use [Available only with Electrode suffix code 2]
N - Remote Flow tube for Combined use with AXFA11
N - Remote Flow tube
A - Fluorocarbon PFA
H - Electrode Material; Hastelloy C276 equivalent
2 - Electrode Structure; Replaceable [Only for suffix code G "General Purpose Use"]
H - Grounding Ring and Electrode Material Hastelloy C276 equivalent
AA1 - Process Connection ANSI Class 150 Flange (Carbon Steel)
1 - Lay Length (Standard)
2 - Electrical Connection ANSI 1/2 NPT female
N - Indicator (Integral Flow meter without indicator - Must be used for Remote Flow tube)
B - Standard Calibration
SCT - Stainless Steel Tag Plate
GC - Acid-resistant Viton Gaskets
M01 - Material Certificate for: PFA / Polyurethane Pipe, Electrodes, Grounding rings/electrodes, Flanges
T01/L3/SC - Hydrostatic Tests / Calibration Certificate - Declaration & the Primary Standard List / Flow Test 5 points of user-specified span

AECOM

Flow Transmitter

Magnetic Flow Meter

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
FIT-1721			A
SHEET	OF	DATE	
1	1	1-17-13	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project:	RLWTF							
TAG NO:	LLW-FIT-1721	Hookup Drawings:	N/A	Loop Wiring Diagram:	M-6331			
		Spec:	40 9100	Line / Vessel Number:	LLW-179-SS150			
Asset No:		P&ID:	D-6027	Line ID:	0.67"	Size:	1/2"	Schedule: 40
Service Description:	Thickener Decant Recycle			Manufacturer:	Yokogawa			
				Model:	AXF015G-NNAH2H-AA112NB/SCT/GC/M01/T01/L3/SC			
Safety Class	NS			Quality Assurance Level	ML-4			

PROCESS CONDITIONS

Fluid:	LLW Influent			Flow:		Liquid:	Units:	Vapor:	Units:	Differential:	Units:
Fluid State Present:	Liquid				Min:	N/A	gpm	N/A	N/A	N/A	N/A
Compressibility (Z):	Water based	Units:			Normal (Operating)	5		N/A		N/A	
Temperature @ Operating:	75	deg F			Max (Full Scale):	N/A		N/A		N/A	
Pressure @ Operating:	45	psig		SG/Density @ Operating:		.0368	lbm / in^3	N/A	N/A		
Vapor Pressure:	No			Viscosity @ Operating:		1.05			cP		
Base Pressure:	N/A			Specific Heat Ratio (C_P/C_v):		N/A		% Solids:	N/A		
Base Temperature:	N/A			Steam % Quality or °Superheat:		N/A		Pipe Material:	Halar lined SS		
Flange Material:	SS			Flange Rating:		Class 150					

FLOW TUBE

Process Conenction	CL150 Flange				
Tube Material	316SS	Liner Material	PFA		
Electrode Type	Removable	Electrode Material	Hastelloy C276		
Meter Casing	N/A				
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group: N/A	Enclosure Protection IP1	6	IP2:	7	
Grounding Type:	Ring	Grounding Material:	Hastelloy C276		
Voltage:	N/A				
Power Wiring:	See notes	Signal Type:	4 - 20 mA		
Communication Protocol:	HART	Location:	Remote		
Max Flow (gpm)	321.2	Normal:	100	Minimum	0
Max Temp (deg F)	140	Minimum	-40		
Max Press (psi)	14.5	Minimum	-14.5		
Max velocity (ft/s)		Min Cond (uS/cm)	>= 1		
Vacuum Possibility	No				

CONVERTER

Voltage:	120VAC				
Power Wiring:	Self Powered	Signal Type:	4 - 20 mA		
Communication Protocol:	HART	Location:	Remote		
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group: N/A	Enclosure Protection IP1	6	IP2:	7	
Pulse Frequency (pps)	0.0001 to 10,000				
Operating temp (deg F)	68 - 86				
Calibrated Span (gpm):	0-500				
Factory Calibration:	Yes				
Body Material:	Aluminum				
SS Tag:	Yes				
Accuracy:	0.35% span				
Alarms	qty 1 dry contact	Rating	30VDC or 0.2A		
Status	qty 2 dry contact	Rating	30VDC or 0.2A		
Mounting	Flush Panel				

NOTES

Power originates from converter using dedicated signal cable AXFC-4-L200

Model Code AXF015 Standard (Wafer Type) Submersible Type / Explosion Proof, PFA Lining, 50 mm (0.5 in) integral Flow meter / Remote Flow tube

G - General Purpose Use [Available only with Electrode suffix code 2]

N - Remote Flow tube for Combined use with AXFA11

N - Remote Flow tube

A - Fluorocarbon PFA

H - Electrode Material; Hastelloy C276 equivalent

2 - Electrode Structure; Replaceable [Only for suffix code G "General Purpose Use"]

H - Grounding Ring and Electrode Material Hastelloy C276 equivalent

AA1 - Process Connection ANSI Class 150 Flange (Carbon Steel)

1 - Lay Length (Standard)

2 - Electrical Connection ANSI 1/2 NPT female

N - Indicator (Integral Flow meter without indicator - Must be used for Remote Flow tube)

B - Standard Calibration

SCT - Stainless Steel Tag Plate

GC - Acid-resistant Viton Gaskets

M01 - Material Certificate for: PFA / Polyurethane Pipe, Electrodes, Grounding rings/electrodes, Flanges

T01/L3/SC - Hydrostatic Tests / Calibration Certificate - Declaration & the Primary Standard List / Flow Test 5 points of user-specified span

AECOM

Vortex
Flow Instrument

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
FIT-5600			A
SHEET	OF	DATE	
1	1	1-17-13	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project:	RLWTF								
TAG NO:	PWC-FIT-5600	Hookup Drawings:	N/A	Loop Wiring Diagram:	M-6455				
		Spec:	40 9100	Line / Vessel Number:	PWC-225-CS				
Asset No:		P&ID:	P-6201	Line ID:	4.03"	Size:	4"	Schedule:	40
Service Description:	Potable Water Supply			Manufacturer:	Yokogawa				
				Model:	DY100EBLAA12D/MY				
Safety Class	GS			Quality Assurance Level	ML-4				

PROCESS CONDITIONS

Fluid:	Potable Water			Flow:		Liquid:	Units:	Vapor:	Units:	Differential:	Units:
Fluid State Present:	Liquid				Min:	N/A	gpm	N/A	N/A	N/A	N/A
Compressibility (Z):	Water based	Units:			Normal (Operating)	75		N/A		N/A	
Temperature @ Operating:	70	deg F			Max (Full Scale):	N/A		N/A		N/A	
Pressure @ Operating:	60	psig		SG/Density @ Operating:		.0361	lbm / in^3	N/A	N/A		
Vapor Pressure:	No			Viscosity @ Operating:		N/A			N/A		
Design Pressure:	125 psig			Specific Heat Ratio (C_P/C_V):		N/A		% Solids:		N/A	
Design Temperature:	150 (deg F.)			Steam % Quality or °Superheat:		N/A		Pipe Material:		CS	

FLOW TUBE

Process Connection	CL150 Flange				
Process Tube	SS JIS SCS14A	Gasket	Teflon Coated SS		
Shedder Bar Material	Duplex SS	Electrode Material	N/A		
Meter Casing	Alluminum Alloy JIS ADC12				
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP	6	IP2:	7
Grounding Type:	N/A	Grounding Material	N/A		
Voltage:	10.5 - 42 VDC				
Power Wiring:	See notes	Signal Type:	4 - 20 mA		
Communication Protocc	HART	Location:	Remote		
Max Flow(gpm)	625	Normal:	N/A	Minimum	18.9
Max Temp (deg F)	482	Minimum	-20		
Max Press (psi)	Flange Rating	Minimum	-14.5		
Max velocity (ft/s)	33	Min Cond (uS/cm)	N/A		
Vacuum Possibility	No				

CONVERTER

Voltage:	N/A				
Power Wiring:	N/A	Signal Type:	N/A		
Communication Protocc	N/A	Location:	N/A		
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP	N/A	IP2:	N/A
Pulse Frequency (pps)	N/A				
Operating temp (deg F)	N/A				
Calibrated Span (gpm):	N/A				
Factory Calibration	N/A				
Body Material:	N/A				
SS Tag:	N/A				
Accuracy:	N/A				
Alarms	N/A	Rating	N/A		
Status	N/A	Rating	N/A		
Mounting	N/A				

NOTES

Model Code DY100EBLAA12D/MY
100 - 4" (100 mm)
E - Output Signal 4-20mA DC, Pulse, HART
B - Body Material: ASTM CF8M
L - Shedder Bar Material: Duplex Stainless Steel
AA1 - Process Connection ANSI Class 150 Wafer
2 - Electrical Connection ANSI 1/2 NPT female
D - Indicator: With Local Indicator
MV - Build in Temperature sensor (Pt 1000) in vortex shedder bar.
Ensure the upstream straight pipe length is 5D or more, & the downstream straight pipe length is 5D or more per reducer pipe. (5D refers to upstream pipe Dia.)

Pulse, alarm, status output use a common terminal, therefore these functions are not used simultaneously.

27-Dec-12

AECOM

Vortex
Flow Instrument

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
FIT-5811			A
SHEET	OF	DATE	
1	1	1-17-13	
BY	CHK'D	PROC.	APPR.
NCC	AME		
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REQ.			

Project:	RLWTF						
TAG NO:	NGL-FIT-5811	Hookup Drawings:	N/A	Loop Wiring Diagram:	M-6447		
		Spec:	40 9100	Line / Vessel Number:	NGL-003-CS		
Asset No:		P&ID:	P-6200	Line ID: 3.07"	Size: 3"	Schedule:	40
Service Description:	Low Pressure Natural Gas			Manufacturer:	Yokogawa		
				Model:	DY080EBLAA12D/MY		
Safety Class	GS			Quality Assurance Level	ML-4		

PROCESS CONDITIONS

Fluid:	Natural Gas (Methane)			Flow:		Liquid:	Units:	Vapor:	Units:	Differential:	Units:
Fluid State Present:	Gas				Min:	N/A	gpm	N/A		N/A	N/A
Compressibility (Z):	Water based	Units:			Normal (Operating)	N/A		N/A		N/A	
Temperature @ Operating:	75	deg F			Max (Full Scale):	N/A		2800	CFH	N/A	
Pressure @ Operating:	14	in wc		Specific Gravity		N/A	N/A	0.554	N/A		
Vapor Pressure:	No			Viscosity @ Operating:		7.39 x 10^{-6}			$lb_m/ft\ s$		
Base Pressure:	N/A			Specific Heat Ratio ($^{Cp}/_{Cv}$):		1.31		% Solids:		N/A	
Base Temperature	N/A			Steam % Quality or °Superheat:		N/A		Pipe Material:		CS	

FLOW TUBE

Process Connection	CL150 Flange				
Process Tube	SS JIS SCS14A	Gasket	Teflon Coated SS		
Shedder Bar Material	Duplex SS	Electrode Material	N/A		
Meter Casing	Alluminum Alloy JIS ADC12				
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group: N/A	Enclosure Protection IP	6	IP2:	7	
Grounding Type:	N/A	Grounding Material	N/A		
Voltage:	10.5 - 42 VDC				
Power Wiring:	See notes	Signal Type:	4 - 20 mA		
Communication Protocc	HART	Location:	Remote		
Max Flow(gpm)	625	Normal:	N/A	Minimum	18.9
Max Temp (deg F)	482	Minimum	-20		
Max Press (psi)	Flange Rating	Minimum	-14.5		
Max velocity (ft/s)	33	Min Cond (uS/cm)	N/A		
Vacuum Possibility	No				

CONVERTER

Voltage:	N/A		
Power Wiring:	N/A	Signal Type:	N/A
Communication Protocc	N/A	Location:	N/A
Electrical Protection:	N/A	Temperature Category:	N/A
Gas Group: N/A	Enclosure Protection IP	N/A	IP2: N/A
Pulse Frequency (pps)	N/A		
Operating temp (deg F)	N/A		
Calibrated Span (gpm):	N/A		
Factory Calibration	N/A		
Body Material:	N/A		
SS Tag:	N/A		
Accuracy:	N/A		
Alarms	N/A	Rating	N/A
Status	N/A	Rating	N/A
Mounting	N/A		

NOTES

Model Code DY080EBLAA12D/MY
080 - 3" (80 mm)
E - Output Signal 4-20mA DC, Pulse, HART
B - Body Material: ASTM CF8M
L - Shedder Bar Material: Duplex Stainless Steel
AA1 - Process Connection ANSI Class 150 Wafer
2 - Electrical Connection ANSI 1/2 NPT female
D - Indicator: With Local Indicator
MV - Build in Temperature sensor (Pt 1000) in vortex shedder bar.
Ensure the upstream straight pipe length is 5D or more, & the downstream straight pipe length is 5D or more per reducer pipe. (5D refers to upstream pipe Dia.)

Pulse, alarm, status output use a common terminal, therefore these functions are not used simultaneously.

27-Dec-12

AECOM

Flow Switch

DATA SHEET NO.			REV.
CS-FSL-4003			A
SHEET	OF	DATE	
1	1	1-17-13	

NO.	BY	DATE	REVISION

BY	CHK'D	PROC.	APPR.
NCC	AME		

P.O.	
REQ.	

Project:	RLWTF				
TAG NO:	CS-FSL-4003	Hookup Drawing No:		Loop Wiring Diagram:	M-6181
		Spec:	40 9100	Vessel Number:	TK-1101
Asset No:		P&ID:	D-6012		
Service Description:	Sodium Hydroxide addition to LLW Reaction/Precipitation Tank 1101			Manufacturer:	GEMS Sensors
				Model:	FS-380P 0.15GPM
Safety Class:	NS			User 3:	
Quality Assurance Level:	ML-4			User 4:	

PROCESS CONDITIONS

Fluid						
Fluid:	Sodium Hydroxide					
Fluid Density @ Operating Temperature:	2.13	g/cm³				
Viscosity @ Operating Temperature:	N/A					
% Solids:	N/A	Dielectric Constant:	57.5 @ 77F			
Service:	LLW	Critical:	N/A			
Temperature Min:	N/A	Normal:	75	Max:	125	deg F
Pressure Min:	N/A	Normal:	N/A	Max:	60	psig
Area Classification	N/A	Ambient Temperature:	50 - 95 F			

SWITCHES

RELAY 1	Tag No:	CS-FSL-4003		
	Power Rating:	10V/A	Type:	N/O @ no flow
	Alarm Setting:	N/A		
RELAY 2	Tag No:	N/A		
	Power Rating:	N/A	Type:	N/A
	Alarm Setting:	N/A		
Contact Rating:		10V/A	Switch Form:	SPST
Conduit Connection:		Spade Terminals	Fluid Temp:	0 - 212 F
Process Connection:		3/8 in MNPT	Max Pressure	125 psig
Materials:		Polypropylene, Ryton -R4, 316 SS, Viton		
Manufacturer:		GEMS Sensors		
Model No.		FS-380P 0.15GPM		
Electrical Protection:		N/A	Enclosure Type:	NEMA 4

TRANSMITTER

Voltage:	N/A				
Power Wiring:	N/A		Signal Type:	N/A	
Communication Protocal:	N/A		Location:	N/A	
Smart:	N/A	Indicate:	N/A	Isolate:	N/A
Electrical Protection:	None		Temperature Category:	N/A	
Gas Group:	N/A	Encl Protection IP1:	N/A	IP2:	N/A
Factory Calibration:	N/A				
Accuracy:	N/A				
Sensor Connection:	N/A				
Conduit Connection:	N/A				
Body Material:	N/A				
Calibrated Range:	N/A		Full Range:	N/A	
Gasket Material:	N/A		SS Tag:	N/A	

NOTES

Element Tag	CS-FSL-4003		
Remote Indicator Tag	N/A		

19-Dec-12

AECOM

Flow Switch

DATA SHEET NO.			REV.
CS-FSL-4006			A
SHEET	OF	DATE	
1	1	1-17-13	

NO.	BY	DATE	REVISION

BY	CHK'D	PROC.	APPR.
NCC	AME		

P.O.	
REQ.	

Project:	RLWTF				
TAG NO:	CS-FSL-4006	Hookup Drawing No:		Loop Wiring Diagram:	M-6226
		Spec:	40 9100	Vessel Number:	TK-1301
Asset No:		P&ID:	D-6016		
Service Description:	Sodium Hydroxide addition to RO pH Adjustment Tank 1301			Manufacturer:	GEMS Sensors
				Model:	FS-380P 0.15GPM
Safety Class:	NS			User 3:	
Quality Assurance Level:	ML-4			User 4:	

PROCESS CONDITIONS

Fluid						
Fluid:	Sodium Hydroxide					
Fluid Density @ Operating Temperature:	2.13	g/cm³				
Viscosity @ Operating Temperature:	N/A					
% Solids:	N/A	Dielectric Constant:	57.5 @ 77F			
Service:	LLW MF Filtrate	Critical:	N/A			
Temperature Min:	N/A	Normal:	75	Max:	125	deg F
Pressure Min:	N/A	Normal:	N/A	Max:	60	psig
Area Classification	N/A	Ambient Temperature:	50 - 95 F			

SWITCHES

RELAY 1	Tag No:	CS-FSL-4006		
	Power Rating:	10V/A	Type:	N/O @ no flow
	Alarm Setting:	N/A		
RELAY 2	Tag No:	N/A		
	Power Rating:	N/A	Type:	N/A
	Alarm Setting:	N/A		
Contact Rating:	10V/A	Switch Form:	SPST	
Conduit Connection:	Spade Terminals	Fluid Temp:	0 - 212 F	
Process Connection:	3/8 in MNPT	Max Pressure	125 psig	
Materials:	Polypropylene, Ryton -R4, 316 SS, Viton			
Manufacturer:	GEMS Sensors			
Model No.	FS-380P 0.15GPM			
Electrical Protection:	N/A	Enclosure Type:	NEMA 4	

TRANSMITTER

Voltage:	N/A				
Power Wiring:	N/A	Signal Type:	N/A		
Communication Protocal:	N/A	Location:	N/A		
Smart:	N/A	Indicate:	N/A	Isolate:	N/A
Electrical Protection:	None	Temperature Category:	N/A		
Gas Group:	N/A	Encl Protection IP1:	N/A	IP2:	N/A
Factory Calibration:	N/A				
Accuracy:	N/A				
Sensor Connection:	N/A				
Conduit Connection:	N/A				
Body Material:	N/A				
Calibrated Range:	N/A	Full Range:	N/A		
Gasket Material:	N/A	SS Tag:	N/A		

NOTES

Element Tag	CS-FSL-4006		
Remote Indicator Tag	N/A		

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AECOM

Flow Switch

DATA SHEET NO.			REV.
CS-FSL-4007			A
SHEET	OF	DATE	
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NO.	BY	DATE	REVISION

BY	CHK'D	PROC.	APPR.
NCC	AME		

P.O.	
REQ.	

Project:	RLWTF				
TAG NO:	CS-FSL-4007	Hookup Drawing No:		Loop Wiring Diagram:	M-6227
		Spec:	40 9100	Vessel Number:	TK-1301
Asset No:		P&ID:	D-6016		
Service Description:	Sulfuric Acid addition to RO pH Adjustment Tank 1301			Manufacturer:	GEMS Sensors
				Model:	FS-380P 0.15GPM
Safety Class:	NS			User 3:	
Quality Assurance Level:	ML-4			User 4:	

PROCESS CONDITIONS

Fluid						
Fluid:	Sulfuric Acid					
Fluid Density @ Operating Temperature:	1.84	g/cm³				
Viscosity @ Operating Temperature:	N/A					
% Solids:	N/A	Dielectric Constant:	84 @ 68F			
Service:	LLW MF Filtrate	Critical:	N/A			
Temperature Min:	N/A	Normal:	75	Max:	125	deg F
Pressure Min:	N/A	Normal:	N/A	Max:	60	psig
Area Classification	N/A	Ambient Temperature:	50 - 95 F			

SWITCHES

RELAY 1	Tag No:	CS-FSL-4007		
	Power Rating:	10V/A	Type:	N/O @ no flow
	Alarm Setting:	N/A		
RELAY 2	Tag No:	N/A		
	Power Rating:	N/A	Type:	N/A
	Alarm Setting:	N/A		
Contact Rating:	10V/A	Switch Form:	SPST	
Conduit Connection:	Spade Terminals	Fluid Temp:	0 - 212 F	
Process Connection:	3/8 in MNPT	Max Pressure	125 psig	
Materials:	Polypropylene, Ryton -R4, 316 SS, Viton			
Manufacturer:	GEMS Sensors			
Model No.	FS-380P 0.15GPM			
Electrical Protection:	N/A	Enclosure Type:	NEMA 4	

TRANSMITTER

Voltage:	N/A				
Power Wiring:	N/A		Signal Type:	N/A	
Communication Protocal:	N/A		Location:	N/A	
Smart:	N/A	Indicate:	N/A	Isolate:	N/A
Electrical Protection:	None		Temperature Category:	N/A	
Gas Group:	N/A	Encl Protection IP1:	N/A	IP2:	N/A
Factory Calibration:	N/A				
Accuracy:	N/A				
Sensor Connection:	N/A				
Conduit Connection:	N/A				
Body Material:	N/A				
Calibrated Range:	N/A		Full Range:	N/A	
Gasket Material:	N/A		SS Tag:	N/A	

NOTES

Element Tag	CS-FSL-4007		
Remote Indicator Tag	N/A		

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AECOM

Flow Switch

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CS-FSL-4010			A
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P.O.

REQ.

Project: RLWTF

TAG NO:	**CS-FSL-4010**	Hookup Drawing No:		Loop Wiring Diagram:	M-6270
		Spec:	40 9100	Vessel Number:	TK-1304
Asset No:		P&ID:	D-6020		
Service Description:	Sodium Hydroxide addition to RO Permeate Holding Tank 1304			Manufacturer:	GEMS Sensors
				Model:	FS-380P 0.15GPM
Safety Class:	NS			User 3:	
Quality Assurance Level:	ML-4			User 4:	

PROCESS CONDITIONS

Fluid						
Fluid:	Sodium Hydroxide					
Fluid Density @ Operating Temperature:	2.13	g/cm³				
Viscosity @ Operating Temperature:	N/A					
% Solids:	N/A	Dielectric Constant:	57.5 @ 25C			
Service:	LLW RO Permeate	Critical:	N/A			
Temperature Min:	N/A	Normal:	75	Max:	125	deg F
Pressure Min:	N/A	Normal:	N/A	Max:	60	psig
Area Classification	N/A	Ambient Temperature:	50 - 95 F			

SWITCHES

RELAY 1	Tag No:	CS-FSL-4010		
	Power Rating:	10V/A	Type:	N/O @ no flow
	Alarm Setting:	N/A		
RELAY 2	Tag No:	N/A		
	Power Rating:	N/A	Type:	N/A
	Alarm Setting:	N/A		
Contact Rating:	10V/A	Switch Form:	SPST	
Conduit Connection:	Spade Terminals	Fluid Temp:	0 - 212 F	
Process Connection:	3/8 in MNPT	Max Pressure	125 psig	
Materials:	Polypropylene, Ryton -R4, 316 SS, Viton			
Manufacturer:	GEMS Sensors			
Model No.	FS-380P 0.15GPM			
Electrical Protection:	N/A	Enclosure Type:	NEMA 4	

TRANSMITTER

Voltage:	N/A				
Power Wiring:	N/A		Signal Type:	N/A	
Communication Protocal:	N/A		Location:	N/A	
Smart:	N/A	Indicate:	N/A	Isolate:	N/A
Electrical Protection:	None	Temperature Category:		N/A	
Gas Group:	N/A	Encl Protection IP1:	N/A	IP2:	N/A
Factory Calibration:	N/A				
Accuracy:	N/A				
Sensor Connection:	N/A				
Conduit Connection:	N/A				
Body Material:	N/A				
Calibrated Range:	N/A		Full Range:	N/A	
Gasket Material:	N/A		SS Tag:	N/A	

NOTES

Element Tag	CS-FSL-4010		
Remote Indicator Tag	N/A		

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Flow Switch

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P.O.	
REQ.	

Project:	RLWTF				
TAG NO:	CS-FSL-4011	Hookup Drawing No:		Loop Wiring Diagram:	M-6271
		Spec:	40 9100	Vessel Number:	TK-1304
Asset No:		P&ID:	D-6020		
Service Description:	Sulfuric Acid addition to RO Permeate Holding Tank 1304			Manufacturer:	GEMS Sensors
				Model:	FS-380P 0.15GPM
Safety Class:	NS			User 3:	
Quality Assurance Level:	ML-4			User 4:	

PROCESS CONDITIONS

Fluid						
Fluid:	Sulfuric Acid					
Fluid Density @ Operating Temperature:	1.84	g/cm³				
Viscosity @ Operating Temperature:	N/A					
% Solids:	N/A	Dielectric Constant:	57.5 @ 25C			
Service:	LLW RO Permeate	Critical:	N/A			
Temperature Min:	N/A	Normal:	75	Max:	125	deg F
Pressure Min:	N/A	Normal:	N/A	Max:	60	psig
Area Classification	N/A	Ambient Temperature:	50 - 95 F			

SWITCHES

RELAY 1	Tag No:	CS-FSL-4011		
	Power Rating:	10V/A	Type:	N/O @ no flow
	Alarm Setting:	N/A		
RELAY 2	Tag No:	N/A		
	Power Rating:	N/A	Type:	N/A
	Alarm Setting:	N/A		
Contact Rating:	10V/A	Switch Form:	SPST	
Conduit Connection:	Spade Terminals	Fluid Temp:	0 - 212 F	
Process Connection:	3/8 in MNPT	Max Pressure	125 psig	
Materials:	Polypropylene, Ryton -R4, 316 SS, Viton			
Manufacturer:	GEMS Sensors			
Model No.	FS-380P 0.15GPM			
Electrical Protection:	N/A	Enclosure Type:	NEMA 4	

TRANSMITTER

Voltage:	N/A				
Power Wiring:	N/A	Signal Type:	N/A		
Communication Protocal:	N/A	Location:	N/A		
Smart:	N/A	Indicate:	N/A	Isolate:	N/A
Electrical Protection:	None	Temperature Category:	N/A		
Gas Group:	N/A	Encl Protection IP1:	N/A	IP2:	N/A
Factory Calibration:	N/A				
Accuracy:	N/A				
Sensor Connection:	N/A				
Conduit Connection:	N/A				
Body Material:	N/A				
Calibrated Range:	N/A	Full Range:	N/A		
Gasket Material:	N/A	SS Tag:	N/A		

NOTES

Element Tag	CS-FSL-4011		
Remote Indicator Tag	N/A		

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P.O.
REQ.

Project: RLWTF

TAG NO:	CS-FSL-4012	Hookup Drawing No:		Loop Wiring Diagram:	M-6399
		Spec:	40 9100	Vessel Number:	TAC-4012
Asset No:		P&ID:	D-6412		
Service Description:	Sulfuric Acid addition to Effluent Sample/pH Adjustment System			Manufacturer:	GEMS Sensors
				Model:	FS-380P 0.15GPM
Safety Class:	NS			User 3:	
Quality Assurance Level:	ML-4			User 4:	

PROCESS CONDITIONS

Fluid						
Fluid:	Sulfuric Acid					
Fluid Density @ Operating Temperature:	1.84	g/cm³				
Viscosity @ Operating Temperature:	N/A					
% Solids:	N/A	Dielectric Constant:	84 @ 68F			
Service:	LLW EFF	Critical:	N/A			
Temperature Min:	N/A	Normal:	75	Max:	125	deg F
Pressure Min:	N/A	Normal:	N/A	Max:	60	psig
Area Classification	N/A	Ambient Temperature:	50 - 95 F			

SWITCHES

RELAY 1	Tag No:	CS-FSL-4012		
	Power Rating:	10V/A	Type:	N/O @ no flow
	Alarm Setting:	N/A		
RELAY 2	Tag No:	N/A		
	Power Rating:	N/A	Type:	N/A
	Alarm Setting:	N/A		
Contact Rating:		10V/A	Switch Form:	SPST
Conduit Connection:		Spade Terminals	Fluid Temp:	0 - 212 F
Process Connection:		3/8 in MNPT	Max Pressure	125 psig
Materials:		Polypropylene, Ryton -R4, 316 SS, Viton		
Manufacturer:		GEMS Sensors		
Model No.		FS-380P 0.15GPM		
Electrical Protection:		N/A	Enclosure Type:	NEMA 4

TRANSMITTER

Voltage:	N/A						
Power Wiring:	N/A			Signal Type:	N/A		
Communication Protocal:	N/A			Location:	N/A		
Smart:	N/A	Indicate:	N/A			Isolate:	N/A
Electrical Protection:	None			Temperature Category:		N/A	
Gas Group:	N/A	Encl Protection IP1:	N/A	IP2:	N/A		
Factory Calibration:	N/A						
Accuracy:	N/A						
Sensor Connection:	N/A						
Conduit Connection:	N/A						
Body Material:	N/A						
Calibrated Range:	N/A			Full Range:	N/A		
Gasket Material:	N/A			SS Tag:	N/A		

NOTES

Element Tag	CS-FSL-4012		
Remote Indicator Tag	N/A		

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Flow Switch

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NO.	BY	DATE	REVISION

Project:	RLWTF				
TAG NO:	CS-FSL-4013	Hookup Drawing No:		Loop Wiring Diagram:	M-6401
		Spec:	40 9100	Vessel Number:	TAC-4013
Asset No:		P&ID:	D-6412		
Service Description:	Sodium Hydroxide addition to Effluent Sample/pH Adjustment			Manufacturer:	GEMS Sensors
				Model:	FS-380P 0.15GPM
Safety Class:	NS			User 3:	
Quality Assurance Level:	ML-4			User 4:	

PROCESS CONDITIONS

Fluid						
Fluid:	Sodium Hydroxide					
Fluid Density @ Operating Temperature:	2.13	g/cm³				
Viscosity @ Operating Temperature:	N/A					
% Solids:	N/A	Dielectric Constant:	57.5 @ 77F			
Service:	LLW EFF	Critical:	N/A			
Temperature Min:	N/A	Normal:	75	Max:	125	deg F
Pressure Min:	N/A	Normal:	N/A	Max:	60	psig
Area Classification:	N/A	Ambient Temperature:	50 - 95 F			

SWITCHES

RELAY 1	Tag No:	CS-FSL-4013		
	Power Rating:	10V/A	Type:	N/O @ no flow
	Alarm Setting:	N/A		
RELAY 2	Tag No:	N/A		
	Power Rating:	N/A	Type:	N/A
	Alarm Setting:	N/A		
Contact Rating:	10V/A	Switch Form:	SPST	
Conduit Connection:	Spade Terminals	Fluid Temp:	0 - 212 F	
Process Connection:	3/8 in MNPT	Max Pressure	125 psig	
Materials:	Polypropylene, Ryton -R4, 316 SS, Viton			
Manufacturer:	GEMS Sensors			
Model No.	FS-380P 0.15GPM			
Electrical Protection:	N/A	Enclosure Type:	NEMA 4	

TRANSMITTER

Voltage:	N/A				
Power Wiring:	N/A		Signal Type:	N/A	
Communication Protocal:	N/A		Location:	N/A	
Smart:	N/A	Indicate:	N/A	Isolate:	N/A
Electrical Protection:	None		Temperature Category:	N/A	
Gas Group:	N/A	Encl Protection IP1:	N/A	IP2:	N/A
Factory Calibration:	N/A				
Accuracy:	N/A				
Sensor Connection:	N/A				
Conduit Connection:	N/A				
Body Material:	N/A				
Calibrated Range:	N/A		Full Range:	N/A	
Gasket Material:	N/A		SS Tag:	N/A	

NOTES

Element Tag	CS-FSL-4013		
Remote Indicator Tag	N/A		

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AECOM

Level Instrument
Radar

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
LIT-1123			A
SHEET	OF	DATE	
1	1	1-17-13	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project:	RLWTF				
TAG NO:	LLW-LIT-1123	Hookup Drawing No:		Loop Wiring Diagram:	E-6174
		Spec:	40 9100	Vessel Number:	TK-1101
Asset No:		P&ID:	D-6012		
Service Description:	LLW Reaction			Manufacturer:	Ohmart / VEGA
				Model:	VEGAPULS 66, PS66.UXQBM2HVNX1
Safety Class:	NS			User 3:	
Quality Assurance Level:	ML-4			User 4:	

PROCESS CONDITIONS

	Lower Fluid			Upper Fluid			Units
Fluid:	LLW			N/A			
Fluid Density @ Operating Temperature:	0.0361			N/A			lbm/in^3
Viscosity @ Operating Temperature:	N/A			N/A			
% Solids:	N/A	Dielectric Constant:	Water Based	N/A	Dielectric Constant:	N/A	
Service:	TK-1102	Critical:	N/A	N/A	Critical:	N/A	
Temperature Min:	N/A	Normal:	75	Max:	125		deg F
Pressure Min:	N/A	Normal:	1	Max:	N/A		atm
Area Classification:	TBD	Ambient Temperature Requirements:		77 deg F			

REMOTE INDICATOR

Display Type:	VEGADIS 61 LC display in dot matrix		
Housing:	316L SS	WT.	0.772 lbs
Indicating and Adjusment Module			
Body / Cage Material:	ABS	Length	4.84"
Inspection Window	Polyester foil	Dia	3.35"
Ambient Conditions			
Temperature:	-4 - 156F	Storage	-40 - 176 F
Extension Length:	5 meters		
Sensor:	Plics®		
Mounting:	Wall, rail and tube mounting kits included.		
Model:	DIS61CIVNC		

TRANSMITTER

Voltage:	24V DC				
Power Wiring:	LOOP	Signal Type:	4 - 20 mA		
Communication Protocol:	HART	Location:	REMOTE		
Smart:	YES	Indicate:	SEE NOTES	Isolate:	SEE NOTES
Electrical Protection:	None	Temperature Category:	T6		
Gas Group:	N/A	Enclosure Protection IP:	6	IP2:	7
Factory Calibration:	Yes				
Accuracy:	0.039in				
Sensor Connection:	screened 4-wire cable				
Conduit Connection:	qty 1 M20x1.5; qty 1 M12x1				
Body Material:	Plastic PBT				
Calibrated Range:	18 ft	Full Range:	114.8 ft		
Gasket Material:	Silicon	SS Tag:	LLW-LIT-1123		

ELEMENT

Type:	Antenna Horn	Gauge:	VEGADIS 61
Gauge Material:	AL 316L, PBT	Gauge Dimensions	4.84" X 3.03"
Insertion Depth:	10.547 in		
Process Connection:	Flange 6" 150lb		
Transmitter Connection:	Remote		
Element Dimen.:	5.71 in diameter, 7.68 in height		
Element Material:	Alloy C22		
Radar Frequency:	C-band		
Displacer Extension:	N/A		
Displacer Spring / Tube Material:	N/A		
Float Well Clearance:	N/A	Float Shaft Clearance:	N/A

SWITCHES

RELAY 1	Tag No:	N/A			
	Power Rating:	N/A	Type:	N/A	
	Alarm Setting:	N/A			
RELAY 2	Tag No:	N/A			
	Power Rating:	N/A	Type:	N/A	
	Alarm Setting:	N/A			
Contact Rating:	N/A	Contact Form:	N/A		
Conduit Connection:	N/A				
Manufacturer:	N/A				
Model No.	N/A				
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP:	N/A	IP2:	N/A

NOTES

Furnish with 70 ft four wire cable w/screen
VEGAPULS 66 Model PS66
UX - FM(N)CL I, DIV2,GP ABCD (DIP)CL II, III, DIV1, GP EFG
Q - With horn antenna 145mm/2.4602 C22
BM - Flange: 6" 150lb RF 2.4602, alloy C22
2 - Seal: FKM (Viton) -40-150 deg C
H - Two wire 4-20 mA / Hart
V - Housing: StSt (Precision Casting) 316L / IP66 / IP68 (0.2 bar)
N - Cable Entry: 1/2 NPT without cable gland, Without plug connection
X - Without Indicating/adjustment module (PLICSCOM)
1 - Antenna extension / 316L or C-22 same as horn selected

DIS61. VEGADIS 61
CI Approval: IEC Ex ia IIC Ga, Gb
V Housing: Stainless Steel 316L
N Cable Entry: 1/2" NPT
C Mounting: Rail mounting (Plastic)

AECOM

Level Instrument
Radar

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
LIT-1124			A
SHEET	OF	DATE	
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BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project:	RLWTF				
TAG NO:	LLW-LIT-1124	Hookup Drawing No:		Loop Wiring Diagram:	E-6189
		Spec:	40 9100	Vessel Number:	TK-1102
Asset No:		P&ID:	D-6013		
Service Description:	LLW Reaction			Manufacturer:	Ohmart / VEGA
				Model:	VEGAPULS 66, PS66.UXQBM2HVNX1
Safety Class:	NS			User 3:	
Quality Assurance Level:	ML-4			User 4:	

PROCESS CONDITIONS

	Lower Fluid			Upper Fluid			Units
Fluid:	LLW			N/A			
Fluid Density @ Operating Temperature:	0.0361			N/A			lbm/in^3
Viscosity @ Operating Temperature:	N/A			N/A			
% Solids	N/A	Dielectric Constant:	Water Based	N/A	Dielectric Constant:	N/A	
Service:	TK-1102	Critical:	N/A	N/A	Critical:	N/A	
Temperature Min:	N/A	Normal:	75	Max:	125		deg F
Pressure Min:	N/A	Normal:	1	Max:	N/A		atm
Area Classification:	TBD	Ambient Temperature Requirements:		77 deg F			

REMOTE INDICATOR

Display Type:	VEGADIS 61 LC display in dot matrix		
Housing:	316L SS	WT.	0.772 lbs
Indicating and Adjusment Module			
Body / Cage Material:	ABS	Length	4.84"
Inspection Window	Polyester foil	Dia	3.35"
Ambient Conditions			
Temperature:	-4 - 156F	Storage	-40 - 176 F
Extension Length:	5 meters		
Sensor:	Plics®		
Mounting:	Wall, rail and tube mounting kits included.		
Model:	DIS61CIVNC		

TRANSMITTER

Voltage:	24V DC		
Power Wiring:	LOOP	Signal Type:	4 - 20 mA
Communication Protoca	HART	Location:	REMOTE
Smart: YES	Indicate:	SEE NOTES	Isolate: SEE NOTES
Electrical Protection:	None	Temperature Category:	T6
Gas Group: N/A	Enclosure Protection IP	6	IP2: 7
Factory Calibration:	Yes		
Accuracy:	0.039in		
Sensor Connection:	screened 4-wire cable		
Conduit Connection:	qty 1 M20x1.5; qty 1 M12x1		
Body Material:	Plastic PBT		
Calibrated Range:	18 ft	Full Range:	114.8 ft
Gasket Material:	Silicon	SS Tag:	LLW-LIT-1124

ELEMENT

Type:	Antenna Horn	Gauge:	VEGADIS 61
Gauge Material:	AL 316L, PBT	Gauge Dimensions	4.84" X 3.03"
Insertion Depth:	10.547 in		
Process Connection:	Flange 6" 150lb		
Transmitter Connection:	Remote		
Element Dimen.:	5.71 in diameter, 7.68 in height		
Element Material:	Alloy C22		
Radar Frequency:	C-band		
Displacer Extension:	N/A		
Displacer Spring / Tube Material:	N/A		
Float Well Clearance:	N/A	Float Shaft Clearance:	N/A

SWITCHES

RELAY 1	Tag No:	N/A		
	Power Rating:	N/A	Type:	N/A
	Alarm Setting:	N/A		
RELAY 2	Tag No:	N/A		
	Power Rating:	N/A	Type:	N/A
	Alarm Setting:	N/A		
Contact Rating:	N/A	Contact Form:	N/A	
Conduit Connection:	N/A			
Manufacturer:	N/A			
Model No.	N/A			
Electrical Protection:	N/A	Temperature Category:	N/A	
Gas Group: N/A	Enclosure Protection IP	N/A	IP2:	N/A

NOTES

Furnish with 70 ft four wire cable w/screen
VEGAPULS 66 Model PS66
UX - FM(N)CL I, DIV2,GP ABCD (DIP)CL II, III, DIV1, GP EFG
Q - With horn antenna 145mm/2.4602 C22
BM - Flange: 6" 150lb RF 2.4602, alloy C22
2 - Seal: FKM (Viton) -40-150 deg C
H - Two wire 4-20 mA / Hart
V - Housing: StSt (Precision Casting) 316L / IP66 / IP68 (0.2 bar)
N - Cable Entry: 1/2 NPT without cable gland, Without plug connection
X - Without Indicating/adjustment module (PLICSCOM)
1 - Antenna extension / 316L or C-22 same as horn selected

DIS61. VEGADIS 61
CI Approval: IEC Ex ia IIC Ga, Gb
V Housing: Stainless Steel 316L
N Cable Entry: 1/2" NPT
C Mounting: Rail mounting (Plastic)
Provide with 5 meter cable as required

AECOM

Level Instrument
Radar

DATA SHEET NO.			REV.
LIT-1302			A
SHEET	OF	DATE	
1	1	1-17-13	

NO.	BY	DATE	REVISION

BY	CHK'D	PROC.	APPR.
NCC	AME		

P.O. / REQ.

Project: RLWTF

TAG NO: LLW-LIT-1302

Hookup Drawing No:		Loop Wiring Diagram:	E-6219
Spec:	40 9100	Vessel Number:	TK-1302
P&ID:	D-6016		
Asset No:			
Service Description:	Reverse Osmosis pH Adjustment	Manufacturer:	Ohmart / VEGA
		Model:	VEGAPULS 66, PS66.UXQBM2HVNX1
Safety Class:	NS	User 3:	
Quality Assurance Level:	ML-4	User 4:	

PROCESS CONDITIONS

Lower Fluid				Upper Fluid				Units
Fluid:	LLW			Fluid:	N/A			
Fluid Density @ Operating Temperature:	0.0361			Fluid Density @ Operating Temperature:	N/A			lbm/in^3
Viscosity @ Operating Temperature:	N/A			Viscosity @ Operating Temperature:	N/A			
% Solids	N/A	Dielectric Constant:	Water Based	% Solids	N/A	Dielectric Constant:	N/A	
Service:	TK-1102	Critical:	N/A	Service:	N/A	Critical:	N/A	

Temperature Min:	N/A	Normal:	75	Max:	125	deg F
Pressure Min:	N/A	Normal:	1	Max:	N/A	atm
Area Classification:	TBD	Ambient Temperature Requirements:			77 deg F	

REMOTE INDICATOR

Display Type:	VEGADIS 61 LC display in dot matrix		
Housing:	316L SS	WT.	0.772 lbs
Indicating and Adjusment Module			
Body / Cage Material:	ABS	Length	4.84"
Inspection Window	Polyester foil	Dia	3.35"
Ambient Conditions			
Temperature:	-4 - 158F	Storage	-40 - 176 F
Extension Length:	5 meters		
Sensor:	Plics®		
Mounting:	Wall, rail and tube mounting kits included.		
Model:	DIS61CIVNC		

TRANSMITTER

Voltage:	24V DC				
Power Wiring:	LOOP	Signal Type:	4 - 20 mA		
Communication Protocol:	HART	Location:	REMOTE		
Smart:	YES	Indicate:	SEE NOTES	Isolate:	SEE NOTES
Electrical Protection:	None	Temperature Category:	T6		
Gas Group:	N/A	Enclosure Protection IP:	6	IP2:	7
Factory Calibration:	Yes				
Accuracy:	0.039in				
Sensor Connection:	screened 4-wire cable				
Conduit Connection:	qty 1 M20x1.5; qty 1 M12x1				
Body Material:	Plastic PBT				
Calibrated Range:	18 ft	Full Range:	114.8 ft		
Gasket Material:	Silicon	SS Tag:	LLW-LIT-1302		

ELEMENT

Type:	Antenna Horn	Gauge:	VEGADIS 61
Gauge Material:	AL 316L, PBT	Gauge Dimensions	4.84" X 3.03"
Insertion Depth:	10.547 in		
Process Connection:	Flange 6" 150lb		
Transmitter Connection:	Remote		
Element Dimen.:	5.71 in diameter, 7.68 in height		
Element Material:	Alloy C22		
Radar Frequency:	C-band		
Displacer Extension:	N/A		
Displacer Spring / Tube Material:	N/A		
Float Well Clearance:	N/A	Float Shaft Clearance:	N/A

SWITCHES

RELAY 1	Tag No:	N/A			
	Power Rating:	N/A	Type:	N/A	
	Alarm Setting:	N/A			
RELAY 2	Tag No:	N/A			
	Power Rating:	N/A	Type:	N/A	
	Alarm Setting:	N/A			
Contact Rating:		N/A	Contact Form:	N/A	
Conduit Connection:		N/A			
Manufacturer:		N/A			
Model No.		N/A			
Electrical Protection:		N/A	Temperature Category:	N/A	
Gas Group:	N/A	Enclosure Protection IP	N/A	IP2:	N/A

NOTES

Furnish with 70 ft four wire cable w/screen
VEGAPULS 66 Model PS66
UX - FM(N)CL I, DIV2,GP ABCD (DIP)CL II, III, DIV1, GP EFG
Q - With horn antenna 145mm/2.4602 C22
BM - Flange: 6" 150lb RF 2.4602, alloy C22
2 - Seal: FKM (Viton) -40-150 deg C
H - Two wire 4-20 mA / Hart
V - Housing: StSt (Precision Casting) 316L / IP66 / IP68 (0.2 bar)
N - Cable Entry: 1/2 NPT without cable gland, Without plug connection
X - Without Indicating/adjustment module (PLICSCOM)
1 - Antenna extension / 316L or C-22 same as horn selected

DIS61 VEGADIS 61
CI Approval: IEC Ex ia IIC Ga, Gb
V Housing: Stainless Steel 316L
N Cable Entry: 1/2" NPT
C Mounting: Rail mounting (Plastic)
Provide with 5 meter cable as required

AECOM

Level Instrument

Radar

NO	BY	DATE	REVISION

DATA SHEET NO.		REV.
LIT-1344		A
SHEET	OF	DATE
1	1	1-17-13
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project:	RLWTF				
TAG NO:	LLW-LIT-1344	Hookup Drawing No:		Loop Wiring Diagram:	M-6219
		Spec:	40 9100	Vessel Number:	TK-1304
Asset No:		P&ID:	D-6016		
Service Description:	Reverse Osmosis Permeate			Manufacturer:	Yokogawa
				Model:	EJA118W-EMH#A1FA-AA10-92EJ/N4/M05/T36
Safety Class:	NS			User 3:	
Quality Assurance Level:	ML-4			User 4:	

PROCESS CONDITIONS

	Lower Fluid			Upper Fluid			Units
Fluid:	LLW			N/A			
Fluid Density @ Operating Temperature:	0.0361			0.361			lbm/in^3
Viscosity @ Operating Temperature:	1.05			1.05			
% Solids:	N/A	Dielectric Constant:	Water Based	N/A	Dielectric Constant:	Water Based	
Service:	TK-1102	Critical:	N/A	N/A	Critical:	N/A	

Temperature Min:	N/A	Normal:	75	Max:	125	deg F
Pressure Min:	N/A	Normal:	1	Max:	N/A	atm
Area Classification:	N/A	Ambient Temperature Requirements:			77 deg F	

REMOTE INDICATOR

Voltage:	24V DC		
Power Wiring:	LOOP	Signal Type:	4 - 20mA
Communication Protocol:	HART	Location:	REMOTE
Body Material:	Cast AL alloy	Display:	Six 7-segment LCD
Operating Current:	3.6mA to 28mA	Over Range:	200mA w/o damage
Amb Temperature:	-22 - 140F	Accuracy:	±0.05% FS +1 digit
Meter Height:	4.02" / 6.46" Mounted	Diameter:	4.37"
Meter Length:	5.12"		
Mounting:	2" Horizontal Pipe		

TRANSMITTER

Voltage:	24V DC				
Power Wiring:	LOOP	Signal Type:	4 - 20 mA		
Communication Protoca	HART	Location:	REMOTE		
Smart:	YES	Indicate:	SEE NOTES	Isolate:	SEE NOTES
Electrical Protection:	None	Temperature Category:	T6		
Gas Group:		Enclosure Protection IP1	6	IP2:	7
Factory Calibration:	Yes				
Accuracy:	0.2%				
Sensor Connection:	Capillary Tube				
Conduit Connection:	1/2" NPT Female				
Body Material:	Low Cu / AL alloy w/ Polyurethane paint				
Calibrated Range:	18 ft	Full Range:	N/A		
Gasket Material:	Silicon	SS Tag	LLW-LIT-1344		

ELEMENT

Type:	Differential Pressure	Gauge	N/A
Gauge Material:	N/A	Gauge Dimensions	N/A
Capillary Length	10m (390 in)		
Process Connection:	1/2" MNPT		
Transmitter Connection:	1/2" NPT Female		
Element Dimen.:	6" Diameter., 1.34" thick		
Body Material:	Hastelloy C276 /PTFE gasket		
Capsule Material:	Hastelloy C276 /PTFE gasket		
Vent Plug Material:	SUS316		
Displacer Spring / Tube Material:	N/A		
Float Well Clearance:	N/A	Float Shaft Clearance	N/A

SWITCHES

RELAY 1	Tag No:	N/A			
	Power Rating:	N/A	Type:	N/A	
	Alarm Setting:	N/A			
RELAY 2	Tag No:	N/A			
	Power Rating:	N/A	Type:	N/A	
	Alarm Setting:	N/A			
Contact Rating:	N/A	Contact Form:	N/A		
Conduit Connection:	N/A				
Manufacturer:	N/A				
Model No.	N/A				
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1	N/A	IP2:	N/A

NOTES

Model Code: EJA110A-EMH4A-92NA/N4

E - 4 - 20 mA communications with HART protocol
M - Range: 2.5 to 100 kPa (10 to 400 in H2O)
H - Hastelloy C-276
4 - Process Flange Rating: ANSI Class 150
A - Bolts and Nuts material (SCM435 - 16 Mpa {160 kgf/cm2} (>2200psi)
-9 - Horizontal impulse piping type, left side high pressure
2 - 1/2 NPT Female, tow electrical connections without blind plug
N - No Integral Indicator
A - Mounting Bracket: SECC Carbon Steel 2" (flat type)
/N4- SUS304 stainless steel tag plate wired onto transmitter

Remote Indicator: Yokogawa Model MLX

-A - 4 to 20 mA DC
1 - Mounting 2" Horizontal Pipe
1 - Housing: Cast Aluminum alloy
-2 - HART Communications
1 - Electrical: Two 1/2" FNPT electrical connections and a 304 SST blind plug
/SSW - Stainless steel tag wired to housing

AECOM

Level Instrument
DP

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
LIT-1511			A
SHEET	OF	DATE	
1	1	1-17-13	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project:	RLWTF				
TAG NO:	LLW-LIT-1511	Hookup Drawing No:	N/A	Loop Wiring Diagram:	M-6377
		Spec:	40 9100	Vessel Number:	TK-1501
Asset No:		P&ID:	D-6410		
Service Description:	LLW Effluent System Tank TK-1501			Manufacturer:	Yokogawa
				Model:	EJA118W-EMH#A1FA-AA10-92EJ/N4/M05/T36
Safety Class:	NS			Quality Assurance Level:	ML-4

PROCESS CONDITIONS

	Lower Fluid			Upper Fluid			Units
Fluid:	LLW			LLW			
Fluid Density @ Operating Temperature:	0.0361			0.0361			lbm/in^3
Viscosity @ Operating Temperature:	1.05			1.05			cP
% Solids:	N/A	Dielectric Constant:	Water Based	N/A	Dielectric Constant:	Water Based	
Service:	EFF	Critical:	N/A	EFF	Critical:	N/A	
Temperature Min:	N/A	Normal:	75	Max:	125		deg F
Pressure Min:	N/A	Normal:	1	Max:	N/A		atm
Area Classification:	N/A	Ambient Temperature Requirements:		77 deg F			

BODY / CAGE

Voltage:	24V DC		
Power Wiring:	LOOP	Signal Type:	4 - 20mA
Communication Protocol:	HART	Location:	REMOTE
Body Material:	Cast AL alloy	Display:	Six 7-segment LCD
Operating Current:	3.6mA to 28mA	Over Range:	200mA w/o damage
Amb Temperature:	-22 - 140F	Accuracy:	±0.05% FS +1 digit
Meter Height:	4.02" / 6.46" Mounted	Diameter:	4.37"
Meter Length:	5.12"		
Mounting:	2" Horizontal Pipe		

TRANSMITTER

Voltage:	24V DC				
Power Wiring:	LOOP	Signal Type:	4 - 20 mA		
Communication Protocol:	HART	Location:	REMOTE		
Smart:	YES	Indicate:	SEE NOTES	Isolate:	SEE NOTES
Electrical Protection:	None	Temperature Category:	T6		
Gas Group:		Enclosure Protection IP1:	6	IP2:	7
Factory Calibration:	Yes				
Accuracy:	0.2%				
Sensor Connection:	Capillary Tube				
Conduit Connection:	1/2" NPT Female				
Body Material:	Low Cu / AL alloy w / Polyurethane paint				
Calibrated Range:	18 ft	Full Range:	N/A		
Gasket Material:	Silicon	SS Tag:	LLW-LIT-1511		

ELEMENT

Type:	Differential Pressure	Gauge	N/A
Gauge Material:	N/A	Gauge Dimensions:	N/A
Capillary Length	10m (390 in)		
Process Connection:	1/2" MNPT		
Transmitter Connection:	1/2" NPT Female		
Element Dimen.:	6" Diameter., 1.34" thick		
Body Material:	Hastelloy C276 /PTFE gasket		
Capsule Material:	Hastelloy C276 /PTFE gasket		
Vent Plug Material:	SUS316		
Displacer Spring / Tube Material:	N/A		
Float Well Clearance:	N/A	Float Shaft Clearance:	N/A

SWITCHES

RELAY 1	Tag No:	N/A			
	Power Rating:	N/A	Type:	N/A	
	Alarm Setting:	N/A			
RELAY 2	Tag No:	N/A			
	Power Rating:	N/A	Type:	N/A	
	Alarm Setting:	N/A			
Contact Rating:		N/A	Contact Form:	N/A	
Conduit Connection:		N/A			
Manufacturer:		N/A			
Model No.		N/A			
Electrical Protection:		N/A	Temperature Category:	N/A	
Gas Group:	N/A	Enclosure Protection IP1	N/A	IP2:	N/A

Model Code: EJA110A-EMH4A-92NA/N4
E - 4 - 20 mA communications with HART protocol
M - Range: 2.5 to 100 kPa (10 to 400 in H2O)
H - Hastelloy C-276
4 - Process Flange Rating: ANSI Class 150
A - Bolts and Nuts material (SCM435 - 16 Mpa {160 kgf/cm2} (>2200psi)
-9 - Horizontal impulse piping type, left side high pressure
2 - 1/2 NPT Female, tow electrical connections without blind plug
N - No Integral Indicator
A - Mounting Bracket: SECC Carbon Steel 2" (flat type)
/N4- SUS304 stainless steel tag plate wired onto transmitter

Remote Indicator: Yokogawa Model MLX
-A - 4 to 20 mA DC
1 - Mounting 2" Horizontal Pipe
1 - Housing: Cast Aluminum alloy
-2 - HART Communications
1 - Electrical: Two 1/2" FNPT electrical connections and a 304 SST blind plug
/SSW - Stainless steel tag wired to housing

AECOM

Level Instrument

DP

DATA SHEET NO.	REV.
LIT-1537	A

NO.	BY	DATE	REVISION

SHEET	OF	DATE
1	1	1-17-13

BY	CHK'D	PROC.	APPR.
NCC	AME		

P.O.

REQ.

Project: RLWTF

TAG NO:	LLW-LIT-1537	Hookup Drawing No:	N/A	Loop Wiring Diagram:	M-6377
		Spec:	40 9100	Vessel Number:	TK-1501
Asset No:		P&ID:	D-6410		
Service Description:	LLW Effluent System Tank TK-1501			Manufacturer:	Yokogawa
				Model:	EJA118W-EMH#A1FA-AA10-92EJ/N4/M05/T36
Safety Class:	NS			Quality Assurance Level:	ML-4

PROCESS CONDITIONS

	Lower Fluid			Upper Fluid			Units
Fluid:	LLW			LLW			
Fluid Density @ Operating Temperature:	0.0361			0.0361			lbm/in^3
Viscosity @ Operating Temperature:	1.05			1.05			cP
% Solids:	N/A	Dielectric Constant:	Water Based	N/A	Dielectric Constant:	Water Based	
Service:	EFF	Critical:	N/A	EFF	Critical:	N/A	
Temperature Min:	N/A	Normal:	75	Max:	125		deg F
Pressure Min:	N/A	Normal:	1	Max:	N/A		atm
Area Classification:	N/A	Ambient Temperature Requirements:		77 deg F			

REMOTE INDICATOR

Voltage:	24V DC		
Power Wiring:	LOOP	Signal Type:	4 - 20mA
Communication Protocol:	HART	Location:	REMOTE
Body Material:	Cast AL alloy	Display:	Six 7-segment LCD
Operating Current:	3.6mA to 28mA	Over Range:	200mA w/o damage
Amb Temperature:	-22 - 140F	Accuracy:	±0.05% FS +1 digit
Meter Height:	4.02" / 6.46" Mounted	Diameter:	4.37"
Meter Length:	5.12"		
Mounting:	2" Horizontal Pipe		

TRANSMITTER

Voltage:	24V DC				
Power Wiring:	LOOP	Signal Type:	4 - 20 mA		
Communication Protocol:	HART	Location:	REMOTE		
Smart:	YES	Indicate:	SEE NOTES	Isolate:	SEE NOTES
Electrical Protection:	None	Temperature Category:	T6		
Gas Group:		Enclosure Protection IP1	6	IP2:	7
Factory Calibration:	Yes				
Accuracy:	0.2%				
Sensor Connection:	Capillary Tube				
Conduit Connection:	1/2" NPT Female				
Body Material:	Low Cu / AL alloy w / Polyurethane paint				
Calibrated Range:	18 ft	Full Range:	N/A		
Gasket Material:	Silicon	SS Tag:	LLW-LIT-1537		

ELEMENT

Type:	Differential Pressure	Gauge	N/A
Gauge Material:	N/A	Gauge Dimensions:	N/A
Capillary Length	10m (390 in)		
Process Connection:	1/2" MNPT		
Transmitter Connection:	1/2" NPT Female		
Element Dimen.:	6" Diameter., 1.34" thick		
Body Material:	Hastelloy C276 /PTFE gasket		
Capsule Material:	Hastelloy C276 /PTFE gasket		
Vent Plug Material:	SUS316		
Displacer Spring / Tube Material:	N/A		
Float Well Clearance:	N/A	Float Shaft Clearance:	N/A

SWITCHES

RELAY 1	Tag No:	N/A			
	Power Rating:	N/A	Type:	N/A	
	Alarm Setting:	N/A			
RELAY 2	Tag No:	N/A			
	Power Rating:	N/A	Type:	N/A	
	Alarm Setting:	N/A			
Contact Rating:	N/A	Contact Form:	N/A		
Conduit Connection:	N/A				
Manufacturer:	N/A				
Model No.	N/A				
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1	N/A	IP2:	N/A

Model Code: EJA110A-EMH4A-92NA/N4
E - 4 - 20 mA communications with HART protocol
M - Range: 2.5 to 100 kPa (10 to 400 in H2O)
H - Hastelloy C-276
4 - Process Flange Rating: ANSI Class 150
A - Bolts and Nuts material (SCM435 - 16 Mpa (160 kgf/cm2) (>2200psi)
-9 - Horizontal impulse piping type, left side high pressure
2 - 1/2 NPT Female, tow electrical connections without blind plug
N - No integral Indicator
A - Mounting Bracket: SECC Carbon Steel 2" (flat type)
/N4- SUS304 stainless steel tag plate wired onto transmitter

Remote Indicator: Yokogawa Model MLX
-A - 4 to 20 mA DC
1 - Mounting 2" Horizontal Pipe
1 - Housing: Cast Aluminum alloy
-2 - HART Communications
1 - Electrical: Two 1/2" FNPT electrical connections and a 304 SST blind plug
/SSW - Stainless steel tag wired to housing

AECOM

Level Instrument
Radar

DATA SHEET NO.			REV.
LIT-1700			A
SHEET	OF	DATE	
1	1	1-17-13	

NO.	BY	DATE	REVISION

BY	CHK'D	PROC.	APPR.
NCC	AME		

P.O.	
REQ.	

Project:	RLWTF				
TAG NO:	LLW-LIT-1700	Hookup Drawing No:		Loop Wiring Diagram:	E-6219
		Spec:	40 9100	Vessel Number:	TK-1706
Asset No:		P&ID:	D-6030		
Service Description:	LLW Evaporator Condensate Tank			Manufacturer:	Ohmart / VEGA
				Model:	VEGAPULS 66, PS66.UXQBM2HVNX1
Safety Class:	NS			User 3:	
Quality Assurance Level:	ML-4			User 4:	

PROCESS CONDITIONS

	Lower Fluid			Upper Fluid			Units
Fluid:	LLW			N/A			
Fluid Density @ Operating Temperature:	0.0361			N/A			lbm/in^3
Viscosity @ Operating Temperature:	N/A			N/A			
% Solids	N/A	Dielectric Constant:	Water Based	N/A	Dielectric Constant:	N/A	
Service:	TK-1706	Critical:	N/A	N/A	Critical:	N/A	

Temperature Min:	N/A	Normal:	75	Max:	125	deg F
Pressure Min:	N/A	Normal:	1	Max:	N/A	atm
Area Classification:	TBD	Ambient Temperature Requirements:	77 deg F			

REMOTE INDICATOR

Display Type:	VEGADIS 61 LC display in dot matrix		
Housing:	316L SS	WT.	0.772 lbs
Indicating and Adjusment Module			
Body / Cage Material:	ABS	Length	4.84"
Inspection Window	Polyester foil	Dia	3.35"
Ambient Conditions			
Temperature:	-4 - 156F	Storage	-40 - 176 F
Extension Length:	5 meters		
Sensor:	Plics®		
Mounting:	Wall, rail and tube mounting kits included.		
Model:	DIS61CIVNC		

TRANSMITTER

Voltage:	24V DC				
Power Wiring:	LOOP	Signal Type:	4 - 20 mA		
Communication Protoca	HART	Location:	REMOTE		
Smart:	YES	Indicate:	SEE NOTES	Isolate:	SEE NOTES
Electrical Protection:	None	Temperature Category:	T6		
Gas Group:	N/A	Enclosure Protection IP	6	IP2:	7
Factory Calibration:	Yes				
Accuracy:	0.039in				
Sensor Connection:	screened 4-wire cable				
Conduit Connection:	qty 1 M20x1.5; qty 1 M12x1				
Body Material:	Plastic PBT				
Calibrated Range:	18 ft	Full Range:	114.8 ft		
Gasket Material:	Silicon	SS Tag:	LLW-LIT-1700		

ELEMENT

Type:	Antenna Horn	Gauge:	VEGADIS 61
Gauge Material:	AL 316L, PBT	Gauge Dimensions	4.84" X 3.03"
Insertion Depth:	10.547 in		
Process Connection:	Flange 6" 150lb		
Transmitter Connection:	Remote		
Element Dimen.:	5.71 in diameter, 7.68 in height		
Element Material:	Alloy C22		
Radar Frequency:	C-band		
Displacer Extension:	N/A		
Displacer Spring / Tube Material:	N/A		
Float Well Clearance:	N/A	Float Shaft Clearance:	N/A

SWITCHES

RELAY 1	Tag No:	N/A			
	Power Rating:	N/A	Type:	N/A	
	Alarm Setting:	N/A			
RELAY 2	Tag No:	N/A			
	Power Rating:	N/A	Type:	N/A	
	Alarm Setting:	N/A			
Contact Rating:	N/A	Contact Form:	N/A		
Conduit Connection:	N/A				
Manufacturer:	N/A				
Model No.	N/A				
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP	N/A	IP2:	N/A

NOTES

Furnish with 70 ft four wire cable w/screen
VEGAPULS 66 Model PS66
UX - FM(N)CL I, DIV2,GP ABCD (DIP)CL II, III, DIV1, GP EFG
Q - With horn antenna 145mm/2.4602 C22
BM - Flange: 6" 150lb RF 2.4602, alloy C22
2 - Seal: FKM (Viton) -40-150 deg C
H - Two wire 4-20 mA / Hart
V - Housing: StSt (Precision Casting) 316L / IP66 / IP68 (0.2 bar)
N - Cable Entry: 1/2 NPT without cable gland, Without plug connection
X - Without Indicating/adjustment module (PLICSCOM)
1 - Antenna extension / 316L or C-22 same as horn selected

DIS61. VEGADIS 61
CI Approval: IEC Ex ia IIC Ga, Gb
V Housing: Stainless Steel 316L
N Cable Entry: 1/2" NPT
C Mounting: Rail mounting (Plastic)
Provide with 5 meter cable as required

AECOM

Level Instrument

Radar

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
LIT-1710			A
SHEET	OF	DATE	
1	1	1-17-13	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project:	RLWTF				
TAG NO:	LLW-LIT-1710	Hookup Drawing No:		Loop Wiring Diagram:	M-6298
		Spec:	40 9100	Vessel Number:	TK-1707
Asset No:		P&ID:	D-6023		
Service Description:	LLW Solids and Concentration Tank			Manufacturer:	Yokogawa
				Model:	EJA118W-EMH#A1FA-AA10-92EJ/N4/M05/T36
Safety Class:	NS			User 3:	
Quality Assurance Level:	ML-4			User 4:	

PROCESS CONDITIONS

	Lower Fluid	Upper Fluid	Units
Fluid:	LLW	LLW	
Fluid Density @ Operating Temperature:	0.0361	0.0361	lbm/in^3
Viscosity @ Operating Temperature:	1.05	1.05	cP
% Solids:	N/A	N/A	
Dielectric Constant:	Water Based	Water Based	
Service:	EFF	EFF	
Critical:	N/A	N/A	

Temperature Min:	N/A	Normal:	75	Max:	125	deg F
Pressure Min:	N/A	Normal:	1	Max:	N/A	atm
Area Classification:	N/A	Ambient Temperature Requirements:	77 deg F			

REMOTE INDICATOR

Voltage:	24V DC		
Power Wiring:	LOOP	Signal Type:	4 - 20mA
Communication Protocol:	HART	Location:	REMOTE
Body Material:	Cast AL alloy	Display:	Six 7-segment LCD
Operating Current:	3.6mA to 28mA	Over Range:	200mA w/o damage
Amb Temperature:	-22 - 140F	Accuracy:	±0.05% FS +1 digit
Meter Height:	4.02" / 6.46" Mounted	Diameter:	4.37"
Meter Length:	5.12"		
Mounting:	2" Horizontal Pipe		

TRANSMITTER

Voltage:	24V DC		
Power Wiring:	LOOP	Signal Type:	4 - 20 mA
Communication Protoca	HART	Location:	REMOTE
Smart:	YES	Indicate:	SEE NOTES
Isolate:	SEE NOTES		
Electrical Protection:	None	Temperature Category:	T6
Gas Group:		Enclosure Protection IP1:	6
IP2:	7		
Factory Calibration:	Yes		
Accuracy:	0.2%		
Sensor Connection:	Capillary Tube		
Conduit Connection:	1/2" NPT Female		
Body Material:	Low Cu / AL alloy w/ Polyurethane paint		
Calibrated Range:	18 ft	Full Range:	N/A
Gasket Material:	Silicon	SS Tag:	LLW-LIT-1710

ELEMENT

Type:	Differential Pressure	Gauge	N/A
Gauge Material:	N/A	Gauge Dimensions	N/A
Capillary Length	10m (390 in)		
Process Connection:	1/2" MNPT		
Transmitter Connection:	1/2" NPT Female		
Element Dimen.:	6" Diameter., 1.34" thick		
Body Material:	Hastelloy C276 /PTFE gasket		
Capsule Material:	Hastelloy C276 /PTFE gasket		
Vent Plug Material:	SUS316		
Displacer Spring / Tube Material:	N/A		
Float Well Clearance:	N/A	Float Shaft Clearance:	N/A

SWITCHES

RELAY 1	Tag No:	N/A			
	Power Rating:	N/A	Type:	N/A	
	Alarm Setting:	N/A			
RELAY 2	Tag No:	N/A			
	Power Rating:	N/A	Type:	N/A	
	Alarm Setting:	N/A			
Contact Rating:	N/A	Contact Form:	N/A		
Conduit Connection:	N/A				
Manufacturer:	N/A				
Model No.	N/A				
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1:	N/A	IP2:	N/A

NOTES

Model Code: EJA110A-EMH4A-92NA/N4
E - 4 - 20 mA communications with HART protocol
M - Range: 2.5 to 100 kPa (10 to 400 in H2O)
H - Hastelloy C-276
4 - Process Flange Rating: ANSI Class 150
A - Bolts and Nuts material (SCM435 - 16 Mpa {160 kgf/cm2} (>2200psi)
-9 - Horizontal impulse piping type, left side high pressure
2 - 1/2 NPT Female, tow electrical connections without blind plug
N - No Integral Indicator
A - Mounting Bracket: SECC Carbon Steel 2" (flat type)
/N4- SUS304 stainless steel tag plate wired onto transmitter

Remote Indicator: Yokogawa Model MLX
-A - 4 to 20 mA DC
1 - Mounting 2" Horizontal Pipe
1 - Housing: Cast Aluminum alloy
-2 - HART Communications
1 - Electrical: Two 1/2" FNPT electrical connections and a 304 SST blind plug
/SSW - Stainless steel tag wired to housing

AECOM

Level Instrument
Radar

DATA SHEET NO.			REV.
LIT-1716			A
SHEET	OF	DATE	
1	1	1-17-13	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

NO.	BY	DATE	REVISION

Project:	RLWTF				
TAG NO:	LLW-LIT-1716	Hookup Drawing No:		Loop Wiring Diagram:	E-6320
		Spec:	40 9100	Vessel Number:	TK-1702
Asset No:		P&ID:	D-6025		
Service Description:	LLW Sludge Thickening Tank			Manufacturer:	Ohmart / VEGA
				Model:	VEGAPULS 66, PS66.UXQBM2HVNX1
Safety Class:	NS			User 3:	
Quality Assurance Level:	ML-4			User 4:	

PROCESS CONDITIONS

Lower Fluid				Upper Fluid				Units
Fluid:	LLW			Fluid:	N/A			
Fluid Density @ Operating Temperature:	0.0361			Fluid Density @ Operating Temperature:	N/A			lbm/in^3
Viscosity @ Operating Temperature:	N/A			Viscosity @ Operating Temperature:	N/A			
% Solids	N/A	Dielectric Constant:	Water Based	% Solids	N/A	Dielectric Constant:	N/A	
Service:	LLW Sludge	Critical:	N/A	Service:	N/A	Critical:	N/A	

Temperature Min:	N/A	Normal:	75	Max:	125	deg F
Pressure Min:	N/A	Normal:	1	Max:	N/A	atm
Area Classification:	TBD	Ambient Temperature Requirements:			77 deg F	

REMOTE INDICATOR

Display Type:	VEGADIS 61 LC display in dot matrix		
Housing:	316L SS	WT:	0.772 lbs
Indicating and Adjusment Module			
Body / Cage Material:	ABS	Length	4.84"
Inspection Window	Polyester foil	Dia	3.35"
Ambient Conditions			
Temperature:	-4 - 156F	Storage	-40 - 176 F
Extension Length:	5 meters		
Sensor:	Plics®		
Mounting:	Wall, rail and tube mounting kits included.		
Model:	DIS61CIVNC		

TRANSMITTER

Voltage:	24V DC		
Power Wiring:	LOOP	Signal Type:	4 - 20 mA
Communication Protoca	HART	Location:	REMOTE
Smart: YES	Indicate: SEE NOTES	Isolate:	SEE NOTES
Electrical Protection:	None	Temperature Category:	T6
Gas Group: N/A	Enclosure Protection IP: 6	IP2:	7
Factory Calibration:	Yes		
Accuracy:	0.039in		
Sensor Connection:	screened 4-wire cable		
Conduit Connection:	qty 1 M20x1.5; qty 1 M12x1		
Body Material:	Plastic PBT		
Calibrated Range:	18 ft	Full Range:	114.8 ft
Gasket Material:	Silicon	SS Tag:	LLW-LIT-1716

ELEMENT

Type:	Antenna Horn	Gauge:	VEGADIS 61
Gauge Material:	AL 316L, PBT	Gauge Dimensions	4.84" X 3.03"
Insertion Depth:	10.547 in		
Process Connection:	Flange 6" 150lb		
Transmitter Connection:	Remote		
Element Dimen.:	5.71 in diameter, 7.68 in height		
Element Material:	Alloy C22		
Radar Frequency:	C-band		
Displacer Extension:	N/A		
Displacer Spring / Tube Material:	N/A		
Float Well Clearance:	N/A	Float Shaft Clearance:	N/A

SWITCHES

RELAY 1	Tag No:	N/A			
	Power Rating:	N/A	Type:	N/A	
	Alarm Setting:	N/A			
RELAY 2	Tag No:	N/A			
	Power Rating:	N/A	Type:	N/A	
	Alarm Setting:	N/A			
Contact Rating:	N/A	Contact Form:	N/A		
Conduit Connection:	N/A				
Manufacturer:	N/A				
Model No.	N/A				
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP	N/A	IP2:	N/A

NOTES

Furnish with 70 ft four wire cable w/screen
VEGAPULS 66 Model PS66
UX - FM(N)CL I, DIV2,GP ABCD (DIP)CL II, III, DIV1, GP EFG
Q - With horn antenna 145mm/2.4602 C22
BM - Flange: 6" 150lb RF 2.4602, alloy C22
2 - Seal: FKM (Viton) -40-150 deg C
H - Two wire 4-20 mA / Hart
V - Housing: StSt (Precision Casting) 316L / IP66 / IP68 (0.2 bar)
N - Cable Entry: 1/2 NPT without cable gland, Without plug connection
X - Without Indicating/adjustment module (PLICSCOM)
1 - Antenna extension / 316L or C-22 same as horn selected

DIS61, VEGADIS 61
CI Approval: IEC Ex ia IIC Ga, Gb
V Housing: Stainless Steel 316L
N Cable Entry: 1/2" NPT
C Mounting: Rail mounting (Plastic)
Provide with 5 meter cable as required

AECOM

Level Instrument
Radar

DATA SHEET NO.			REV.
LIT-1722			A
SHEET	OF	DATE	
1	1	1-17-13	

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BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project:	RLWTF				
TAG NO:	LLW-LIT-1722	Hookup Drawing No:		Loop Wiring Diagram:	E-6341
		Spec:	40 9100	Vessel Number:	TK-1705
Asset No:		P&ID:	D-6028		
Service Description:	LLW Evaporator Supply Tank			Manufacturer:	Ohmart / VEGA
				Model:	VEGAPULS 66, PS66.UXQBM2HVNX1
Safety Class:	NS			User 3:	
Quality Assurance Level:	ML-4			User 4:	

PROCESS CONDITIONS

	Lower Fluid			Upper Fluid			Units
Fluid:	LLW			N/A			
Fluid Density @ Operating Temperature:	0.0361			N/A			lbm/in^3
Viscosity @ Operating Temperature:	N/A			N/A			
% Solids	N/A	Dielectric Constant:	Water Based	N/A	Dielectric Constant:	N/A	
Service:	LLW RO Concentrate	Critical:	N/A	N/A	Critical:	N/A	

Temperature Min:	N/A	Normal:	75	Max:	125	deg F
Pressure Min:	N/A	Normal:	1	Max:	N/A	atm
Area Classification:	N/A	Ambient Temperature Requirements:	77 deg F			

REMOTE INDICATOR

Display Type:	VEGADIS 61 LC display in dot matrix		
Housing:	316L SS	WT.	0.772 lbs
Indicating and Adjusment Module			
Body / Cage Material:	ABS	Length	4.84"
Inspection Window	Polyester foil	Dia	3.35"
Ambient Conditions			
Temperature:	-4 - 158F	Storage	-40 - 176 F
Extension Length:	5 meters		
Sensor:	Plics®		
Mounting:	Wall, rail and tube mounting kits included		
Model:	DIS61CIVNC		

TRANSMITTER

Voltage:	24V DC		
Power Wiring:	LOOP	Signal Type:	4 - 20 mA
Communication Protoca	HART	Location:	REMOTE
Smart: YES	Indicate:	SEE NOTES	Isolate: SEE NOTES
Electrical Protection:	None	Temperature Category:	T6
Gas Group: N/A	Enclosure Protection IP	6	IP2: 7
Factory Calibration:	Yes		
Accuracy:	0.039in		
Sensor Connection:	screened 4-wire cable		
Conduit Connection:	qty 1 M20x1.5; qty 1 M12x1		
Body Material:	Plastic PBT		
Calibrated Range:	18 ft	Full Range:	114.8 ft
Gasket Material:	Silicon	SS Tag:	LLW-LIT-1722

ELEMENT

Type:	Antenna Horn	Gauge:	VEGADIS 61
Gauge Material:	AL 316L, PBT	Gauge Dimensions	4.84" X 3.03"
Insertion Depth:	10.547 in		
Process Connection:	Flange 6" 150lb		
Transmitter Connection:	Remote		
Element Dimen.:	5.71 in diameter, 7.68 in height		
Element Material:	Alloy C22		
Radar Frequency:	C-band		
Displacer Extension:	N/A		
Displacer Spring / Tube Material:	N/A		
Float Well Clearance:	N/A	Float Shaft Clearance:	N/A

SWITCHES

RELAY 1	Tag No:	N/A			
	Power Rating:	N/A	Type:	N/A	
	Alarm Setting:	N/A			
RELAY 2	Tag No:	N/A			
	Power Rating:	N/A	Type:	N/A	
	Alarm Setting:	N/A			
Contact Rating:	N/A	Contact Form:	N/A		
Conduit Connection:	N/A				
Manufacturer:	N/A				
Model No.	N/A				
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP	N/A	IP2:	N/A

NOTES

Furnish with 70 ft four wire cable w/screen
VEGAPULS 66 Model PS66
UX - FM(N)CL I, DIV2,GP ABCD (DIP)CL II, III, DIV1, GP EFG
Q - With horn antenna 145mm/2.4602 C22
BM - Flange: 6" 150lb RF 2.4602, alloy C22
2 - Seal: FKM (Viton) -40-150 deg C
H - Two wire 4-20 mA / Hart
V - Housing: StSt (Precision Casting) 316L / IP66 / IP68 (0.2 bar)
N - Cable Entry: 1/2 NPT without cable gland, Without plug connection
X - Without Indicating/adjustment module (PLICSCOM)
1 - Antenna extension / 316L or C-22 same as horn selected

DIS61. VEGADIS 61
CI Approval: IEC Ex ia IIC Ga, Gb
V Housing: Stainless Steel 316L
N Cable Entry: 1/2" NPT
C Mounting: Rail mounting (Plastic)
Provide with 5 meter cable as required

AECOM

Level Instrument

Radar

DATA SHEET NO.			REV.
LIT-1723			A
SHEET	OF	DATE	
1	1	1-17-13	

NO.	BY	DATE	REVISION

BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project:	RLWTF				
TAG NO:	LLW-LIT-1723	Hookup Drawing No:		Loop Wiring Diagram:	M-6332
		Spec:	40 9100	Vessel Number:	TK-1703
Asset No:		P&ID:	D-6027		
Service Description:	Sludge Thickener Decant Tank			Manufacturer:	Yokogawa
				Model:	EJA118W-EMH#A1FA-AA10-92EJ/N4/M05/T36
Safety Class:	NS			User 3:	
Quality Assurance Level:	ML-4			User 4:	

PROCESS CONDITIONS

	Lower Fluid				Upper Fluid				Units
Fluid:	LLW				LLW				
Fluid Density @ Operating Temperature:	0.0361				0.0361				lbm/in^3
Viscosity @ Operating Temperature:	1.05				1.05				cP
% Solids:	N/A	Dielectric Constant:	Water Based		N/A	Dielectric Constant:	Water Based		
Service:	EFF	Critical:	N/A		EFF	Critical:	N/A		
Temperature Min:	N/A	Normal:	75	Max:	125				deg F
Pressure Min:	N/A	Normal:	1	Max:	N/A				atm
Area Classification:	N/A	Ambient Temperature Requirements:	77 deg F						

REMOTE INDICATOR

Voltage:	24V DC		
Power Wiring:	LOOP	Signal Type:	4 - 20mA
Communication Protocol:	HART	Location:	REMOTE
Body Material:	Cast AL alloy	Display:	Six 7-segment LCD
Operating Current:	3.6mA to 28mA	Over Range:	200mA w/o damage
Amb Temperature:	-22 - 140F	Accuracy:	±0.05% FS +1 digit
Meter Height:	4.02" / 6.46" Mounted	Diameter:	4.37"
Meter Length:	5.12"		
Mounting:	2" Horizontal Pipe		

TRANSMITTER

Voltage:	24V DC				
Power Wiring:	LOOP	Signal Type:	4 - 20 mA		
Communication Protoca	HART	Location:	REMOTE		
Smart:	YES	Indicate:	SEE NOTES	Isolate:	SEE NOTES
Electrical Protection:	None	Temperature Category:	T6		
Gas Group:		Enclosure Protection IP:	6	IP2:	7
Factory Calibration:	Yes				
Accuracy:	0.2%				
Sensor Connection:	Capillary Tube				
Conduit Connection:	1/2" NPT Female				
Body Material:	Low Cu / AL alloy w/ Polyurethane paint				
Calibrated Range:	18 ft	Full Range:	N/A		
Gasket Material:	Silicon	SS Tag:	LLW-LIT-1723		

ELEMENT

Type:	Differential Pressure	Gauge	N/A
Gauge Material:	N/A	Gauge Dimensions	N/A
Capillary Length	10m (390 in)		
Process Connection:	1/2" MNPT		
Transmitter Connection:	1/2" NPT Female		
Element Dimen.:	6" Diameter., 1.34" thick		
Body Material:	Hastelloy C276 /PTFE gasket		
Capsule Material:	Hastelloy C276 /PTFE gasket		
Vent Plug Material:	SUS316		
Displacer Spring / Tube Material:	N/A		
Float Well Clearance:	N/A	Float Shaft Clearance:	N/A

SWITCHES

RELAY 1	Tag No:	N/A			
	Power Rating:	N/A	Type:	N/A	
	Alarm Setting:	N/A			
RELAY 2	Tag No:	N/A			
	Power Rating:	N/A	Type:	N/A	
	Alarm Setting:	N/A			
Contact Rating:	N/A	Contact Form:	N/A		
Conduit Connection:	N/A				
Manufacturer:	N/A				
Model No.	N/A				
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP:	N/A	IP2:	N/A

NOTES

Model Code: EJA110A-EMH4A-92NA/N4
E - 4 - 20 mA communications with HART protocol
M - Range: 2.5 to 100 kPa (10 to 400 in H2O)
H - Hastelloy C-276
4 - Process Flange Rating: ANSI Class 150
A - Bolts and Nuts material (SCM435 - 16 Mpa {160 kgf/cm2} (>2200psi)
-9 - Horizontal impulse piping type, left side high pressure
2 - 1/2 NPT Female, tow electrical connections without blind plug
N - No Integral Indicator
A - Mounting Bracket: SECC Carbon Steel 2" (flat type)
/N4- SUS304 stainless steel tag plate wired onto transmitter

Remote Indicator: Yokogawa Model MLX
-A - 4 to 20 mA DC
1 - Mounting 2" Horizontal Pipe
1 - Housing: Cast Aluminum alloy
-2 - HART Communications
1 - Electrical: Two 1/2" FNPT electrical connections and a 304 SST blind plug
/SSW - Stainless steel tag wired to housing

AECOM

Leak Detector
Conductivity Sensor

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
LSH-5701			A
SHEET	OF	DATE	
1	1	1-17-13	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project:	RLWTF				
TAG NO:	LLW-LSH-5701	Hookup Drawing No:		Loop Wiring Diagram:	M-6405
		Spec:	40 9100	Vessel Number:	N/A
Asset No:		P&ID:	P-6001		
Service Description:	Process Area Sump			Manufacturer:	Raychem
				Model:	TraceTek TTC-1, TT1000-3M/10ft-PC
Safety Class:	NS			User 3:	
Quality Assurance Level:	ML-4			User 4:	

PROCESS CONDITIONS

Lower Fluid							
Fluid:	Filtered LLW						
Fluid Density @ Operating Temperature:	0.0361						
Viscosity @ Operating Temperature:	N/A						
% Solids:	N/A	Dielectric Constant:	Water Based				
Service:	Water-based Leak	Critical:	N/A				
Temperature Min:	N/A	Normal:	75	Max:	125	deg F	
Pressure Min:	N/A	Normal:	1	Max:	N/A	atm	
Area Classification:	N/A	Ambient Temperature Requirements:	77 deg F				

TRANSMITTER

Voltage:	24V DC				
Power Wiring:	EXTERNAL	Signal Type:	N/A		
Communication Protocal:	N/A	Location:	REMOTE		
Smart:	N/A	Indicate:	YES	Isolate:	N/A
Electrical Protection:	None	Temperature Category:	T6		
Gas Group:	N/A	Enclosure Protection IP1	2	IP2:	0
Factory Calibration:	No				
Accuracy:	N/A				
Sensor Connection:	Lead wire				
Conduit Connection:	1/2" NPT				
Body Material:	Plastic				
Calibrated Range:	N/A	Full Range:	N/A		
Gasket Material:	N/A	SS Tag:	LLW-LSH-5701		

ELEMENT

Type:	Sensing Cable	Signal Gauge:	2 x 26 AWG
Gauge Material:	Fluoropolymer	Gauge Dimensions:	2 x 30 AWG
Insertion Depth:	N/A		
Process Connection:	N/A		
Transmitter Connection:	Integral plastic connectors		
Element Dimen.:	0.24 in diameter, 10 ft length		
Element Material:	Fluoropolymer		

Switches

RELAY 1

Tag No:	LSH-5701		
Power Rating:	3A, 30V DC	Type:	N/C
Alarm Setting:	N/A		
Contact Rating:	N/A	Contact Form:	N/A

NOTES

TT1000-1M/3FT-PC	3ft (1 m) sensing cable
TT1000-3M/10FT-PC	10ft (3 m) sensing cable
TT1000-7M/25FT-PC	25ft (7 m) sensing cable
TT1000-15M/50FT-PC	50ft (15 m) sensing cable
TTC-DRC	DIN 1 rail mounting clip

18-Dec-12

AECOM

Leak Detector
Conductivity Sensor

NO.	BY	DATE	REVISION

DATA SHEET NO.		REV.
LSH-5704		A
SHEET	OF	DATE
1	1	1-17-13
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.		
REQ.		

Project:	RLWTF				
TAG NO:	LLW-LSH-5704	Hookup Drawing No:		Loop Wiring Diagram:	M-6406
		Spec:	40 9100	Vessel Number:	N/A
Asset No:		P&ID:	P-6001		
Service Description:	Corridor Sump			Manufacturer:	Raychem
				Model:	TraceTek TTC-1, TT1000-3M/10ft-PC
Safety Class:	NS			User 3:	
Quality Assurance Level:	ML-4			User 4:	

PROCESS CONDITIONS

Lower Fluid			
Fluid:	Filtered LLW		
Fluid Density @ Operating Temperature:	0.0361		
Viscosity @ Operating Temperature:	N/A		
% Solids:	N/A	Dielectric Constant:	Water Based
Service:	Water-based Leak	Critical:	N/A

Temperature Min:	N/A	Normal:	75	Max:	125	deg F
Pressure Min:	N/A	Normal:	1	Max:	N/A	atm
Area Classification:	N/A	Ambient Temperature Requirements:	77 deg F			

TRANSMITTER

Voltage:	24V DC				
Power Wiring:	EXTERNAL	Signal Type:	N/A		
Communication Protocal:	N/A	Location:	REMOTE		
Smart:	N/A	Indicate:	YES	Isolate:	N/A
Electrical Protection:	None	Temperature Category:	T6		
Gas Group:	N/A	Enclosure Protection IP1	2	IP2:	0
Factory Calibration:	No				
Accuracy:	N/A				
Sensor Connection:	Lead wire				
Conduit Connection:	1/2" NPT				
Body Material:	Plastic				
Calibrated Range:	N/A	Full Range:	N/A		
Gasket Material:	N/A	SS Tag:	LLW-LSH-5704		

ELEMENT

Type:	Sensing Cable	Signal Gauge:	2 x 26 AWG
Gauge Material:	Fluoropolymer	Gauge Dimensions:	2 x 30 AWG
Insertion Depth:	N/A		
Process Connection:	N/A		
Transmitter Connection:	Integral plastic connectors		
Element Dimen.:	0.24 in diameter, 10 ft length		
Element Material:	Fluoropolymer		

Switches

RELAY 1				
Tag No:	LSH-5701			
Power Rating:	3A, 30V DC	Type:	N/C	
Alarm Setting:	N/A			
Contact Rating:	N/A	Contact Form:	N/A	

NOTES

TT1000-1M/3FT-PC	3ft (1 m) sensing cable
TT1000-3M/10FT-PC	10ft (3 m) sensing cable
TT1000-7M/25FT-PC	25ft (7 m) sensing cable
TT1000-15M/50FT-PC	50ft (15 m) sensing cable
TTC-DRC	DIN 1 rail mounting clip

18-Dec-12

AECOM

Leak Detector
Conductivity Sensor

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
LSH-5705			A
SHEET	OF	DATE	
1	1	1-17-13	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project:	RLWTF				
TAG NO:	LLW-LSH-5705	Hookup Drawing No:		Loop Wiring Diagram:	M-6407
		Spec:	40 9100	Vessel Number:	N/A
Asset No:		P&ID:	P-6001		
Service Description:	Wet Lab Sump			Manufacturer:	Raychem
				Model:	TraceTek TTC-1, TT1000-3M/10ft-PC
Safety Class:	NS			User 3:	
Quality Assurance Level:	ML-4			User 4:	

PROCESS CONDITIONS

Lower Fluid			
Fluid:	Filtered LLW		
Fluid Density @ Operating Temperature:	0.0361		
Viscosity @ Operating Temperature:	N/A		
% Solids:	N/A	Dielectric Constant:	Water Based
Service:	Water-based Leak	Critical:	N/A

Temperature Min:	N/A	Normal:	75	Max:	125	deg F
Pressure Min:	N/A	Normal:	1	Max:	N/A	atm
Area Classification:	N/A	Ambient Temperature Requirements:	77 deg F			

TRANSMITTER

Voltage:	24V DC				
Power Wiring:	EXTERNAL	Signal Type:	N/A		
Communication Protocal:	N/A	Location:	REMOTE		
Smart:	N/A	Indicate:	YES	Isolate:	N/A
Electrical Protection:	None	Temperature Category:	T6		
Gas Group:	N/A	Enclosure Protection IP1	2	IP2:	0
Factory Calibration:	No				
Accuracy:	N/A				
Sensor Connection:	Lead wire				
Conduit Connection:	1/2" NPT				
Body Material:	Plastic				
Calibrated Range:	N/A	Full Range:	N/A		
Gasket Material:	N/A	SS Tag:	LLW-LSH-5705		

ELEMENT

Type:	Sensing Cable	Signal Gauge:	2 x 26 AWG
Gauge Material:	Fluoropolymer	Gauge Dimensions:	2 x 30 AWG
Insertion Depth:	N/A		
Process Connection:	N/A		
Transmitter Connection:	Integral plastic connectors		
Element Dimen.:	0.24 in diameter, 10 ft length		
Element Material:	Fluoropolymer		

Switches

RELAY 1

Tag No:	LSH-5701		
Power Rating:	3A, 30V DC	Type:	N/C
Alarm Setting:	N/A		
Contact Rating:	N/A	Contact Form:	N/A

NOTES

TT1000-1M/3FT-PC	3ft (1 m) sensing cable
TT1000-3M/10FT-PC	10ft (3 m) sensing cable
TT1000-7M/25FT-PC	25ft (7 m) sensing cable
TT1000-15M/50FT-PC	50ft (15 m) sensing cable
TTC-DRC	DIN 1 rail mounting clip

19-Dec-12

AECOM

Leak Detector
Conductivity Sensor

DATA SHEET NO.			REV.
LSH-5706			A
SHEET	OF	DATE	
1	1	1-17-13	

NO.	BY	DATE	REVISION

BY	CHK'D	PROC.	APPR.
NCC	AME		

P.O. | REQ.

Project: RLWTF

TAG NO:	LLW-LSH-5706	Hookup Drawing No:		Loop Wiring Diagram:	M-6407
		Spec:	40 9100	Vessel Number:	N/A
Asset No:		P&ID:	P-6001		
Service Description:	Effluent Storage Basin Sump			Manufacturer:	Raychem
				Model:	TraceTek TTC-1, TT1000-3M/10ft-PC
Safety Class:	NS			User 3:	
Quality Assurance Level:	ML-4			User 4:	

PROCESS CONDITIONS

Lower Fluid							
Fluid:	Treated LLW						
Fluid Density @ Operating Temperature:	0.0361						
Viscosity @ Operating Temperature:	N/A						
% Solids	N/A	Dielectric Constant:	Water Based				
Service:	Water-based Leak	Critical:	N/A				
Temperature Min:	N/A	Normal:	75	Max:	125	deg F	
Pressure Min:	N/A	Normal:	1	Max:	N/A	atm	
Area Classification:	N/A	Ambient Temperature Requirements:	77 deg F				

TRANSMITTER

Voltage:	24V DC				
Power Wiring:	EXTERNAL	Signal Type:	N/A		
Communication Protocol:	N/A	Location:	REMOTE		
Smart:	N/A	Indicate:	YES	Isolate:	N/A
Electrical Protection:	None	Temperature Category:	T6		
Gas Group:	N/A	Enclosure Protection IP	2	IP2:	0
Factory Calibration:	No				
Accuracy:	N/A				
Sensor Connection:	Lead wire				
Conduit Connection:	1/2" NPT				
Body Material:	Plastic				
Calibrated Range:	N/A	Full Range:	N/A		
Gasket Material:	N/A	SS Tag:	LLW-LSH-5706		

ELEMENT

Type:	Sensing Cable	Signal Gauge:	2 x 26 AWG
Gauge Material:	Fluoropolymer	Gauge Dimensions	2 x 30 AWG
Insertion Depth:	N/A		
Process Connection:	N/A		
Transmitter Connection:	Integral plastic connectors		
Element Dimen.:	0.24 in diameter, 10 ft length		
Element Material:	Fluoropolymer		

Switches

RELAY 1				
Tag No:	LSH-5706			
Power Rating:	3A, 30V DC	Type:	N/C	
Alarm Setting:	N/A			
Contact Rating:	N/A	Contact Form:	N/A	

NOTES

TT1000-1M/3FT-PC	3ft (1 m) sensing cable
TT1000-3M/10FT-PC	10ft (3 m) sensing cable
TT1000-7M/25FT-PC	25ft (7 m) sensing cable
TT1000-15M/50FT-PC	50ft (15 m) sensing cable
TTC-DRC	DIN 1 rail mounting clip

27-Dec-12

AECOM

Leak Detector
Conductivity Sensor

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
LI-5707			A
SHEET	OF	DATE	
1	1	1-17-13	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project:	RLWTF					
TAG NO:	LLW-LI-5707	Hookup Drawing No:		Loop Wiring Diagram:	M-6382, M-6394	<-
		Spec:	40 9100	Vessel Number:	N/A	<-
Asset No:		P&ID:	D-6410, D-6411			<-
Service Description:	Treated Effluent (LSH-5707), Fire Water (LSH-5708)			Manufacturer:	Asahi	<-
				Model:	LiquidWatch Model LW64	<-
Safety Class:	NS			User 3:		<-
Quality Assurance Level:	ML-4			User 4:		<-

PROCESS CONDITIONS

Lower Fluid							
Fluid:	Treated Effluent (LSH-5707), Fire Water (LSH-5708)						<-
Fluid Density @ Operating Temperature:	0.0361						<-
Viscosity @ Operating Temperature:	N/A						<-
% Solids	N/A	Dielectric Constant:	Water Based				<-
Service:	Water-based Leak	Critical:	N/A				<-
Temperature Min:	N/A	Normal:	75	Max:	125	deg F	<-
Pressure Min:	N/A	Normal:	1	Max:	N/A	atm	<-
Area Classification:	N/A	Ambient Temperature Requirements:	77 deg F				<-

TRANSMITTER

Voltage:	120VAC 60 Hz, 8VA					
Power Wiring:	EXTERNAL	Signal Type:	N/A			
Communication Protoca	N/A	Location:	REMOTE			
Smart:	No	Indicate:	YES	Isolate:	N/A	
Electrical Protection:	None	Temperature Category:	T6			
Gas Group:	N/A	Enclosure Protection IP	6	IP2:	7	
Factory Calibration:	No					
Accuracy:	N/A					
Sensor Connection:	Lead wire					
Conduit Connection:	1/2" NPT					
Body Material:	Plastic					
Calibrated Range:	N/A	Full Range:	N/A			
Gasket Material:	N/A	SS Tag:	LLW-LSH-5707			

ELEMENT

Type:	Water Probe	Signal Gauge:	N/A	<-
Temperature:	0 - 100° F	Gauge Dimensions	3/4" dia X 2" length	<-
Process Connection:	N/A			<-
Transmitter Connection:	Integral plastic connectors			<-
Element Dimen.:	0.24 in diameter, 10 ft length			<-
Element Material:	Fluoropolymer			<-

SWITCHES

RELAY 1	Tag No:	LSH-5707			<-
	Power Rating:	N/A	Type:	N/C	<-
	Contact Rating:	10A 250VAC	Contact Form:	N/A	<-
RELAY 2	Tag No:	LSH-5708			<-
	Power Rating:	N/A	Type:	N/C	<-
	Contact Rating:	10A 250VAC	Contact Form:	N/A	

NOTES

Part 8027570 Model LW64 LiquidWatch® Monitoring Unit (Std Location) <-
Part 8027904 Model PWS-LW LiquidWatch Water Probe Assembly <-
Part 8067573 Probe Adapter <-
Part 8057940 Heat Shrink Butt Splice <-
LiquidWatch 2 conductor Probe lead cable 6" X 6" junction box <-

18-Dec-12

AECOM

Leak Detector
Conductivity Sensor

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
LSH-5710			A
SHEET	OF	DATE	
1	1	1-17-13	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project:	RLWTF				
TAG NO:	LLW-LSH-5710	Hookup Drawing No:		Loop Wiring Diagram:	M-6408
		Spec:	40 9100	Vessel Number:	N/A
Asset No:		P&ID:	P-6001		
Service Description:	Wet Lab Trench			Manufacturer:	Raychem
				Model:	TraceTek TTC-1, TT1000-3M/10ft-PC
Safety Class:	NS			User 3:	
Quality Assurance Level:	ML-4			User 4:	

PROCESS CONDITIONS

Lower Fluid							
Fluid:	Grey Water						
Fluid Density @ Operating Temperature:	0.0361						
Viscosity @ Operating Temperature:	N/A						
% Solids:	N/A	Dielectric Constant:	Water Based				
Service:	Water-based Leak	Critical:	N/A				
Temperature Min:	N/A	Normal:	75	Max:	125	deg F	
Pressure Min:	N/A	Normal:	1	Max:	N/A	atm	
Area Classification:	N/A	Ambient Temperature Requirements:	77 deg F				

TRANSMITTER

Voltage:	24V DC				
Power Wiring:	EXTERNAL	Signal Type:	N/A		
Communication Protocal:	N/A	Location:	REMOTE		
Smart:	N/A	Indicate:	YES	Isolate:	N/A
Electrical Protection:	None	Temperature Category:	T6		
Gas Group:	N/A	Enclosure Protection IP1	2	IP2:	0
Factory Calibration:	No				
Accuracy:	N/A				
Sensor Connection:	Lead wire				
Conduit Connection:	1/2" NPT				
Body Material:	Plastic				
Calibrated Range:	N/A	Full Range:	N/A		
Gasket Material:	N/A	SS Tag:	LLW-LSH-5710		

ELEMENT

Type:	Sensing Cable	Signal Gauge:	2 x 26 AWG
Gauge Material:	Fluoropolymer	Gauge Dimensions:	2 x 30 AWG
Insertion Depth:	N/A		
Process Connection:	N/A		
Transmitter Connection:	Integral plastic connectors		
Element Dimen.:	0.24 in diameter, 10 ft length		
Element Material:	Fluoropolymer		

Switches

RELAY 1				
Tag No:	LSH-5701			
Power Rating:	3A, 30V DC	Type:	N/C	
Alarm Setting:	N/A			
Contact Rating:	N/A	Contact Form:	N/A	

NOTES

TT1000-1M/3FT-PC	3ft (1 m) sensing cable
TT1000-3M/10FT-PC	10ft (3 m) sensing cable
TT1000-7M/25FT-PC	25ft (7 m) sensing cable
TT1000-15M/50FT-PC	50ft (15 m) sensing cable
TTC-DRC	DIN 1 rail mounting clip

18-Dec-12

AECOM

Pressure Indicator
C-Type Bourdon Tube Gauge

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
PI-1108			A
SHEET	OF	DATE	
1	1	1-17-13	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project:	RLWTF				
TAG NO:	CA-PI-1108	Hookup Drawings:		Loop Wiring Diagrams:	N/A
		Spec No:	40 9100	Line / Vessel Number:	CA-100-CU150
Asset No:		P&ID:	D-6010	Line ID: 0.436" Size: 0.5"	Schedule: N/A
Service Description:	Compressed Air to Roughing Filter FLT-1101			Manufacturer:	Ascroft
				Model:	451279SS04L0/160
Safety Class:	NS			Quality Assurance Level	ML-4

PROCESS CONDITIONS

	Hi Pressure Connection:					Low Pressure Connection					Units:
Fluid:	Compressed Air					Fluid:	N/A				
Fluid Density @ Operating Temp:	0.585 @ 70 F and 100psig					Fluid Density @ Operating Temp:	N/A				lbm/in3
Viscosity @ Operating Temp:	N/A					Viscosity @ Operating Temp:	N/A				N/A
	Pressure:						Pressure:				
Oper:	80	Design:	100	H2OTst:	150	Oper:	N/A	Design:	N/A	H2OTst: N/A	psig
	Temperature:						Temperature:				
Min:	32	Normal:	75	Max:	125	Min:	N/A	Normal:	N/A	Max: N/A	F
% solids:	N/A	% Quality:	N/A			% solids:	N/A	% Quality:	N/A		
Service:	N/A	Critical:	N/A	Pulsating:	N/A	Service:	N/A	Critical:	N/A	Pulsating: N/A	
Area Classification:	N/A					Ambient Temperature Requiremen	N/A				

ELEMENT

Type:	Bourdon C-tube		
Fill Fluid:	N/A		
Min Range:	12 psi	Max Range:	1500 psi
Diaphragm/Wetted Material:	316L SS		
Vent/Drain Location:	N/A		
Vent/Drain Material:	N/A		
Process Connection:	1/2" NPT		

GAUGE

Voltage:	N/A		
Power Wiring:	N/A	Signal Type:	N/A
Communication Protocol:	N/A	Location:	N/A
Smart: N/A	Indicate:	4.5 in. Isolate:	Yes
Electrical Protection:	N/A	Temperature Category:	N/A
Gas Group: N/A	Enclosure Protection IP1:	N/A IP2:	N/A
Factory Calibration:	Yes		
Ambient Temperature Compensation:	N/A		
Characteristic:	N/A	Calibrated Range:	0-15 psi
Over Range:	N/A	Zero Elevation:	N/A
Accuracy:	N/A	Gasket Material:	N/A
Conduit Connection:	N/A	NACE:	N/A
Element Connection:	N/A	SS Tag:	PI-1108
Body Max Pressure Rating:	N/A		
Body/Flange Material:	Ring Threaded Reinforced Polypropylene		
Mounting:	N/A		

SEAL DIAPHRAM & CAPILLARY

Length:	N/A	ID:	N/A
Armor:	N/A		
Fill Fluid:	N/A	Max Response Time:	N/A
SG @ 60 °F:	N/A	Capilary Material:	N/A

Diaphragm:	Hi Press:	Low Press:
Size & Type:	N/A	N/A
Thickness:	N/A	N/A
Material:	N/A	N/A
Flush Ring:	N/A	N/A

Process Connection:	N/A
Max Temperature:	N/A
Pressure Rating:	N/A
Max Pressure:	N/A
Manufacturer:	N/A
Model:	N/A

MANIFOLD

Type:	N/A
Material:	N/A
Transmitter Connection:	N/A
Process Connection:	N/A
Manufacturer:	N/A
Model:	N/A

NOTES

1279 - Pressure Guage
45 - 4.5" dial
SS - 316L SS Bourdon system & socket material
04 - 1/2" NPT connection
L - Lower connection
0 - No Options
160 - 0 - 160 standard pressure range

AECOM

Pressure Indicator
C-Type Bourdon Tube Gauge

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
PI-1311			A
SHEET	OF	DATE	
1	1	1-17-13	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project:	RLWTF						
TAG NO:	CA-PI-1311	Hookup Drawings:		Loop Wiring Diagrams:	N/A		
		Spec No:	40 9100	Line / Vessel Number:	CA-230-CU150		
Asset No:		P&ID:	D-6018	Line ID: 0.065"	Size: 0.125"	Schedule:	N/A
Service Description:	Compressed Air to Reverse Osmosis Unit ROU-1301			Manufacturer:	Ascroft		
				Model:	451279SS02L0/160		
Safety Class:	NS			Quality Assurance Level	ML-4		

PROCESS CONDITIONS

	Hi Pressure Connection:					Low Pressure Connection					Units:
Fluid:	Compressed Air					Fluid:	N/A				
Fluid Density @ Operating Temp:	0.585 @ 70 F and 100psig					Fluid Density@ Operating Temp:	N/A				lbm/in3
Viscosity @ Operating Temp:	N/A					Viscosity @ Operating Temp:	N/A				N/A
	Pressure:						Pressure:				
Oper:	100	Design:	100	H2OTst:	150	Oper:	N/A	Design:	N/A	H2OTst:	N/A	psig
	Temperature:						Temperature:				
Min:	32	Normal:	75	Max:	125	Min:	N/A	Normal:	N/A	Max:	N/A	F
% solids:	N/A	% Quality:	N/A			% solids:	N/A	% Quality:	N/A		
Service:	N/A	Critical:	N/A	Pulsating:	N/A	Service:	N/A	Critical:	N/A	Pulsating:	N/A	
Area Classification:	N/A					Ambient Temperature Requiremen	N/A				

ELEMENT

Type:	Bourdon C-tube		
Fill Fluid:	N/A		
Min Range:	12 psi	Max Range:	1500 psi
Diaphragm/Wetted Material:	316L SS		
Vent/Drain Location:	N/A		
Vent/Drain Material:	N/A		
Process Connection:	1/4" NPT		

GAUGE

Voltage:	N/A		
Power Wiring:	N/A	Signal Type:	N/A
Communication Protocol:	N/A	Location:	N/A
Smart: N/A	Indicate:	4.5 in.	Isolate: Yes
Electrical Protection:	N/A	Temperature Category:	N/A
Gas Group: N/A	Enclosure Protection IP1	N/A	IP2: N/A
Factory Calibration:	Yes		
Ambient Temperature Compensation:	N/A		
Characteristic:	N/A	Calibrated Range:	0-15 psi
Over Range:	N/A	Zero Elevation:	N/A
Accuracy:	N/A	Gasket Material:	N/A
Conduit Connection:	N/A	NACE:	N/A
Element Connection:	N/A	SS Tag:	PI-1108
Body Max Pressure Rating:	N/A		
Body/Flange Material:	Ring Threaded Reinforced Polypropylene		
Mounting:	N/A		

SEAL DIAPHRAM & CAPILLARY

Length:	N/A	ID:	N/A
Armor:	N/A		
Fill Fluid:	N/A	Max Response Time:	N/A
SG @ 60 °F:	N/A	Capilary Material:	N/A
Diaphragm:	Hi Press:		Low Press:
Size & Type:	N/A		N/A
Thickness:	N/A		N/A
Material:	N/A		N/A
Flush Ring:	N/A		N/A
Process Connection:	N/A		
Max Temperature:	N/A		
Pressure Rating:	N/A		
Max Pressure:	N/A		
Manufacturer:	N/A		
Model:	N/A		

MANIFOLD

Type:	N/A
Material:	N/A
Transmitter Connection:	N/A
Process Connection:	N/A
Manufacturer:	N/A
Model:	N/A

NOTES

1279 - Pressure Guage
45 - 4.5" dial
SS - 316L SS Bourdon system & socket material
02 - 1/4" NPT connection - Requires reducer to 1/8'
L - Lower connection
0 - No Options
160 - 0 - 160 standard pressure range

AECOM

Pressure Indicator
C-Type Bourdon Tube Gauge

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
PI-1317			A
SHEET	OF	DATE	
1	1	1-17-13	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project:	RLWTF								
TAG NO:	LLW-PI-1317	Hookup Drawings:		Loop Wiring Diagrams:	N/A				
		Spec No:	40 9100	Line / Vessel Number:	LLW-094-SS150				
Asset No:		P&ID:	D-6018	Line ID:	0.82"	Size:	0.75"	Schedule:	40
Service Description:	LLW RO Concentrate from ROU-1301			Manufacturer:	Ascroft				
				Model:	451279SS04L0/100				
Safety Class:	NS			Quality Assurance Level	ML-4				

PROCESS CONDITIONS

	Hi Pressure Connection:					Low Pressure Connection					Units:
Fluid:	LLW RO Concentrate					Fluid:	N/A				
Fluid Density @ Operating Temp:	Varies					Fluid Density@ Operating Temp:	N/A				lbm/in3
Viscosity @ Operating Temp:	N/A					Viscosity @ Operating Temp:	N/A				N/A
Pressure:						Pressure:					
Oper:	45	Design:	100	H2OTst:	150	Oper:	N/A	Design:	N/A	H2OTst:	N/A	psig
Temperature:						Temperature:					
Min:	32	Normal:	75	Max:	125	Min:	N/A	Normal:	N/A	Max:	N/A	F
% solids:	N/A	% Quality:	N/A			% solids:	N/A	% Quality:	N/A		
Service:	N/A	Critical:	N/A	Pulsating:	N/A	Service:	N/A	Critical:	N/A	Pulsating:	N/A	
Area Classification:	N/A					Ambient Temperature Requirement:	N/A				

ELEMENT

Type:	Bourdon C-tube		
Fill Fluid:	N/A		
Min Range:	12 psi	Max Range:	1500 psi
Diaphragm/Wetted Material:	316L SS		
Vent/Drain Location:	N/A		
Vent/Drain Material:	N/A		
Process Connection:	1/2" NPT		

SEAL DIAPHRAM & CAPILLARY

Length:	N/A	ID:	N/A
Armor:	N/A		
Fill Fluid:	Silicone Oil	Max Response Time:	N/A
SG @ 60 °F:	N/A	Capilary Material:	N/A
Diaphragm:	Hi Press:		Low Press:
Size & Type:	Capsule Diaphram Seal		N/A
Thickness:	2 7/8		N/A
Material:	Halar Coated Monel		N/A
Flush Ring:	Viton		N/A
Process Connection:	Flanged		
Max Temperature:	100 deg F		
Pressure Rating:	N/A		
Max Pressure:	75 psi		
Manufacturer:	Ashcroft		
Model:	102PHBH04TCK		

GAUGE

Voltage:	N/A				
Power Wiring:	N/A	Signal Type:	N/A		
Communication Protocol:	N/A	Location:	N/A		
Smart:	N/A	Indicate:	4.5 in.	Isolate:	Yes
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP:	N/A	IP2:	N/A
Factory Calibration:	Yes				
Ambient Temperature Compensation:	N/A				
Characteristic:	N/A	Calibrated Range:	0-15 psi		
Over Range:	N/A	Zero Elevation:	N/A		
Accuracy:	N/A	Gasket Material:	N/A		
Conduit Connection:	N/A	NACE:	N/A		
Element Connection:	N/A	SS Tag:	PI-1108		
Body Max Pressure Rating:	N/A				
Body/Flange Material:	Ring Threaded Reinforced Polypropylene				
Mounting:	N/A				

MANIFOLD

Type:	N/A
Material:	N/A
Transmitter Connection:	N/A
Process Connection:	N/A
Manufacturer:	N/A
Model:	N/A

NOTES

1279 - Pressure Guage
45 - 4.5" dial
SS - 316L SS Bourdon system & socket material
04 - 1/2" NPT connection - Requires adapter to 3/4"
L - Lower connection
0 - No Options
100 - 0 - 100 standard pressure range
Capsule Diaphram Seal Type 102 - Flanged process connection
PH - Halar coated Monel Diaphragm material
BH - Halar coated SS bottom housing material
04T - 1/2" NPT
CK - Silicone -40 - 600 deg F temperature range

AECOM

Pressure Indicator
C-Type Bourdon Tube Gauge

DATA SHEET NO.	REV.
PI-1401	A

SHEET	OF	DATE
1	1	1-17-13

NO.	BY	DATE	REVISION

BY	CHK'D	PROC.	APPR.
NCC	AME		

P.O.
REQ.

Project: RLWTF

TAG NO:	LLW-PI-1401	Hookup Drawings:		Loop Wiring Diagrams:	N/A			
		Spec No	40 9100	Line / Vessel Number:	LLW-264-SS150			
Asset No:		P&ID:	D-6021	Line ID:	1.05"	Size:	2"	Schedule: 40
Service Description:	LLW Reverse Osmosis Permeate TK-1304 to P-1407			Manufacturer:	Ascroft			
				Model:	451279SS04LD/15			
Safety Class:	NS			Quality Assurance Level	ML-4			

PROCESS CONDITIONS

	Hi Pressure Connection:					Low Pressure Connection					Units:
Fluid:	RO Permeate					Fluid:	N/A				
Fluid Density @ Operating Temp:	Varies					Fluid Density@ Operating Temp:	N/A				lbm/in3
Viscosity @ Operating Temp:	N/A					Viscosity @ Operating Temp:	N/A				N/A
Pressure:						Pressure:					
Oper:	TBD	Design:	TBD	H2OTst:	150	Oper:	N/A	Design:	N/A	H2OTst: N/A	psig
Temperature:						Temperature:					
Min:	32	Normal:	75	Max:	125	Min:	N/A	Normal:	N/A	Max: N/A	F
% solids:	N/A	% Quality:	N/A			% solids:	N/A	% Quality:	N/A		
Service:	N/A	Critical:	N/A	Pulsating:	N/A	Service:	N/A	Critical:	N/A	Pulsating: N/A	
Area Classification:	N/A					Ambient Temperature Requirem	N/A				

ELEMENT

Type:	Bourdon C-tube		
Fill Fluid:	N/A		
Min Range:	12 psi	Max Range:	1500 psi
Diaphragm/Wetted Material:	316L SS		
Vent/Drain Location:	N/A		
Vent/Drain Material:	N/A		
Process Connection:	1/2" NPT		

GAUGE

Voltage:	N/A		
Power Wiring:	N/A	Signal Type:	N/A
Communication Protocc	N/A	Location:	N/A
Smart: N/A	Indicate:	4.5 in.	Isolate: Yes
Electrical Protection:	N/A	Temperature Category:	N/A
Gas Group: N/A	Enclosure Protection IP	N/A	IP2: N/A
Factory Calibration:	Yes		
Ambient Temperature Compensation:	N/A		
Characteristic:	N/A	Calibrated Range:	0-15 psi
Over Range:	N/A	Zero Elevation:	N/A
Accuracy:	N/A	Gasket Material:	N/A
Conduit Connection:	N/A	NACE:	N/A
Element Connection:	N/A	SS Tag:	PI-1108
Body Max Pressure Rating:	N/A		
Body/Flange Material:	Ring Threaded Reinforced Polypropylene		
Mounting:	N/A		

SEAL DIAPHRAM & CAPILLARY

Length:	N/A	ID:	N/A
Armor:	N/A		
Fill Fluid:	Silicone Oil	Max Response Time:	N/A
SG @ 60 °F:	N/A	Capilary Material:	N/A
Diaphragm:	Hi Press:		Low Press:
Size & Type:	Capsule Diaphram Seal		N/A
Thickness:	2 7/8		N/A
Material:	Halar Coated Monel		N/A
Flush Ring:	Viton		N/A
Process Connection:	Flanged		
Max Temperature:	100 deg F		
Pressure Rating:	N/A		
Max Pressure:	75 psi		
Manufacturer:	Ashcroft		
Model:	102PHBH04TCK		

MANIFOLD

Type:	N/A
Material:	N/A
Transmitter Connection:	N/A
Process Connection:	N/A
Manufacturer:	N/A
Model:	N/A

NOTES

1279 - Pressure Guage
45 - 4.5" dial
SS - 316L SS Bourdon system & socket material
04 - 1/2" NPT connection - Requires adapter to 2"
L - Lower connection
0 - No Options
15 - 0 - 15 standard pressure range
Capsule Diaphram Seal Type 102 - Flanged process connection
PH - Halar coated Monel Diaphragm material
BH - Halar coated SS bottom housing material
04T - 1/2" NPT
CK - Silicone -40 - 600 deg F temperature range

AECOM

Pressure Indicator
C-Type Bourdon Tube Gauge

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
PI-1438			A
SHEET	OF	DATE	
1	1	1-17-13	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project:	RLWTF						
TAG NO:	CA-PI-1438	Hookup Drawings:		Loop Wiring Diagrams:	N/A		
		Spec No:	40 9100	Line / Vessel Number:	CA-102-CU150		
Asset No:		P&ID:	D-6012	Line ID: 0.436"	Size: 0.5"	Schedule:	N/A
Service Description:	Compressed Air to Pump P-1701			Manufacturer:	Ascroft		
				Model:	451279SS04L0/100		
Safety Class:	NS			Quality Assurance Level	ML-4		

PROCESS CONDITIONS

Hi Pressure Connection:						Low Pressure Connection						Units:
Fluid:	Compressed Air					Fluid:	N/A					
Fluid Density @ Operating Temp:	0.253 @ 70 F and 35psig					Fluid Density@ Operating Temp:	N/A					lbm/in3
Viscosity @ Operating Temp:	N/A					Viscosity @ Operating Temp:	N/A					N/A
Pressure:						Pressure:						
Oper:	35	Design:	100	H2OTst:	150	Oper:	N/A	Design:	N/A	H2OTst:	N/A	psig
Temperature:						Temperature:						
Min:	32	Normal:	75	Max:	125	Min:	N/A	Normal:	N/A	Max:	N/A	F
% solids:	N/A	% Quality:	N/A			% solids:	N/A	% Quality:	N/A			
Service:	N/A	Critical:	N/A	Pulsating:	N/A	Service:	N/A	Critical:	N/A	Pulsating:	N/A	
Area Classification:	N/A					Ambient Temperature Requirement	N/A					

ELEMENT

Type:	Bourdon C-tube		
Fill Fluid:	N/A		
Min Range:	12 psi	Max Range:	1500 psi
Diaphragm/Wetted Material:	316L SS		
Vent/Drain Location:	N/A		
Vent/Drain Material:	N/A		
Process Connection:	1/2" NPT		

GAUGE

Voltage:	N/A				
Power Wiring:	N/A	Signal Type:	N/A		
Communication Protocol:	N/A	Location:	N/A		
Smart:	N/A	Indicate:	4.5 in.	Isolate:	Yes
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1	N/A	IP2:	N/A
Factory Calibration:	Yes				
Ambient Temperature Compensation:	N/A				
Characteristic:	N/A	Calibrated Range:	0-15 psi		
Over Range:	N/A	Zero Elevation:	N/A		
Accuracy:	N/A	Gasket Material:	N/A		
Conduit Connection:	N/A	NACE:	N/A		
Element Connection:	N/A	SS Tag:	PI-1108		
Body Max Pressure Rating:	N/A				
Body/Flange Material:	Ring Threaded Reinforced Polypropylene				
Mounting:	N/A				

SEAL DIAPHRAM & CAPILLARY

Length:	N/A	ID:	N/A
Armor:	N/A		
Fill Fluid:	N/A	Max Response Time:	N/A
SG @ 60 °F:	N/A	Capilary Material:	N/A

Diaphragm:	Hi Press:	Low Press:
Size & Type:	N/A	N/A
Thickness:	N/A	N/A
Material:	N/A	N/A
Flush Ring:	N/A	N/A

Process Connection:	N/A
Max Temperature:	N/A
Pressure Rating:	N/A
Max Pressure:	N/A
Manufacturer:	N/A
Model:	N/A

MANIFOLD

Type:	N/A
Material:	N/A
Transmitter Connection:	N/A
Process Connection:	N/A
Manufacturer:	N/A
Model:	N/A

NOTES

1279 - Pressure Guage
45 - 4.5" dial
SS - 316L SS Bourdon system & socket material
04 - 1/2" NPT connection
L - Lower connection
0 - No Options
100 - 0 - 100 standard pressure range

AECOM

Pressure Indicator
C-Type Bourdon Tube Gauge

DATA SHEET NO.	REV.
PI-1718	A

SHEET	OF	DATE
1	1	1-17-13

NO.	BY	DATE	REVISION

BY	CHK'D	PROC.	APPR.
NCC	AME		

P.O.	
REQ.	

Project: RLWTF

TAG NO: LLW-PI-1718

Hookup Drawings:		Loop Wiring Diagrams:	N/A
Spec No	40 9100	Line / Vessel Number:	LLW-023-SS150
P&ID:	D-6027	Line ID: 1.05" Size: 1.0"	Schedule: 40
Asset No:		Manufacturer:	Ascroft
Service Description:	Sludge Decant from Tank TK-1703	Model:	451279SS04L0/15
Safety Class:	NS	Quality Assurance Level	ML-4

PROCESS CONDITIONS

Hi Pressure Connection:						Low Pressure Connection						Units:
Fluid:	LLW Sludge Decant					Fluid:	N/A					
Fluid Density @ Operating Temp:	Varies					Fluid Density@ Operating Temp:	N/A					lbm/in3
Viscosity @ Operating Temp:	N/A					Viscosity @ Operating Temp:	N/A					N/A
Pressure:						Pressure:						
Oper:	TBD	Design:	TBD	H2OTst:	150	Oper:	N/A	Design:	N/A	H2OTst:	N/A	psig
Temperature:						Temperature:						
Min:	32	Normal:	75	Max:	125	Min:	N/A	Normal:	N/A	Max:	N/A	F
% solids:	N/A	% Quality:	N/A			% solids:	N/A	% Quality:	N/A			
Service:	N/A	Critical:	N/A	Pulsating:	N/A	Service:	N/A	Critical:	N/A	Pulsating:	N/A	
Area Classification:	N/A					Ambient Temperature Requirem	N/A					

ELEMENT

Type:	Bourdon C-tube		
Fill Fluid:	N/A		
Min Range:	12 psi	Max Range:	1500 psi
Diaphragm/Wetted Material:	316L SS		
Vent/Drain Location:	N/A		
Vent/Drain Material:	N/A		
Process Connection:	1/2" NPT		

GAUGE

Voltage:	N/A		
Power Wiring:	N/A	Signal Type:	N/A
Communication Protocc	N/A	Location:	N/A
Smart: N/A	Indicate:	4.5 in.	Isolate: Yes
Electrical Protection:	N/A	Temperature Category:	N/A
Gas Group: N/A	Enclosure Protection IP	N/A	IP2: N/A
Factory Calibration:	Yes		
Ambient Temperature Compensation:	N/A		
Characteristic:	N/A	Calibrated Range:	0-15 psi
Over Range:	N/A	Zero Elevation:	N/A
Accuracy:	N/A	Gasket Material:	N/A
Conduit Connection:	N/A	NACE:	N/A
Element Connection:	N/A	SS Tag:	PI-1108
Body Max Pressure Rating:	N/A		
Body/Flange Material:	Ring Threaded Reinforced Polypropylene		
Mounting:	N/A		

SEAL DIAPHRAM & CAPILLARY

Length:	N/A	ID:	N/A
Armor:	N/A		
Fill Fluid:	Silicone Oil	Max Response Time:	N/A
SG @ 60 °F:	N/A	Capilary Material:	N/A

Diaphragm:	Hi Press:	Low Press:
Size & Type:	Capsule Diaphram Seal	N/A
Thickness:	2 7/8	N/A
Material:	Halar Coated Monel	N/A
Flush Ring:	Viton	N/A

Process Connection:	Flanged
Max Temperature:	100 deg F
Pressure Rating:	N/A
Max Pressure:	75 psi
Manufacturer:	Ashcroft
Model:	102PHBH04TCK

MANIFOLD

Type:	N/A
Material:	N/A
Transmitter Connection:	N/A
Process Connection:	N/A
Manufacturer:	N/A
Model:	N/A

NOTES

1279 - Pressure Guage
45 - 4.5" dial
SS - 316L SS Bourdon system & socket material
04 - 1/2" NPT connection
L - Lower connection
0 - No Options
15 - 0 - 15 standard pressure range
Capsule Diaphram Seal Type 102 - Flanged process connection
PH - Halar coated Monel Diaphragm material
BH - Halar coated SS bottom housing material
04T - 1/2" NPT
CK - Silicone -40 - 600 deg F temperature range

AECOM

Pressure Indicator
C-Type Bourdon Tube Gauge

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
PI-1724			A
SHEET	OF	DATE	
1	1	1-17-13	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project:	RLWTF								
TAG NO:	LLW-PI-1724	Hookup Drawings:		Loop Wiring Diagrams:	N/A				
		Spec No	40 9100	Line / Vessel Number:	LLW-013-SS150				
Asset No:		P&ID:	D-6028	Line ID:	.62"	Size:	0.5"	Schedule:	40
Service Description:	Evaporator Supply from Tank TK-1705 to P-1705			Manufacturer:	Ascroft				
				Model:	451279SS04L0/15				
Safety Class:	NS			Quality Assurance Level	ML-4				

PROCESS CONDITIONS

	Hi Pressure Connection:					Low Pressure Connection					Units:
Fluid:	LLW Evaporator Supply					Fluid:	N/A				
Fluid Density @ Operating Temp:	Varies					Fluid Density@ Operating Temp:	N/A				lbm/in3
Viscosity @ Operating Temp:	N/A					Viscosity @ Operating Temp:	N/A				N/A
Pressure:						Pressure:					
Oper:	TBD	Design:	TBD	H2OTst:	150	Oper:	N/A	Design:	N/A	H2OTst:	N/A	psig
Temperature:						Temperature:					
Min:	32	Normal:	75	Max:	125	Min:	N/A	Normal:	N/A	Max:	N/A	F
% solids:	N/A	% Quality:	N/A			% solids	N/A	% Quality:	N/A		
Service:	N/A	Critical:	N/A	Pulsating:	N/A	Service:	N/A	Critical:	N/A	Pulsating:	N/A	
Area Classification:	N/A					Ambient Temperature Requiremer	N/A				

ELEMENT

Type:	Bourdon C-tube		
Fill Fluid:	N/A		
Min Range:	12 psi	Max Range:	1500 psi
Diaphragm/Wetted Material:	316L SS		
Vent/Drain Location:	N/A		
Vent/Drain Material:	N/A		
Process Connection:	1/2" NPT		

GAUGE

Voltage:	N/A				
Power Wiring:	N/A	Signal Type:	N/A		
Communication Protocc	N/A	Location:	N/A		
Smart:	N/A	Indicate:	4.5 in.	Isolate:	Yes
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP	N/A	IP2:	N/A
Factory Calibration:	Yes				
Ambient Temperature Compensation:	N/A				
Characteristic:	N/A	Calibrated Range:	0-15 psi		
Over Range:	N/A	Zero Elevation:	N/A		
Accuracy:	N/A	Gasket Material:	N/A		
Conduit Connection:	N/A	NACE:	N/A		
Element Connection:	N/A	SS Tag:	PI-1108		
Body Max Pressure Rating:	N/A				
Body/Flange Material:	Ring Threaded Reinforced Polypropylene				
Mounting:	N/A				

SEAL DIAPHRAM & CAPILLARY

Length:	N/A	ID:	N/A
Armor:	N/A		
Fill Fluid:	Silicone Oil	Max Response Time:	N/A
SG @ 60 °F:	N/A	Capilary Material:	N/A
Diaphragm:	Hi Press:		Low Press:
Size & Type:	Capsule Diaphram Seal		N/A
Thickness:	2 7/8		N/A
Material:	Halar Coated Monel		N/A
Flush Ring:	Viton		N/A
Process Connection:	Flanged		
Max Temperature:	100 deg F		
Pressure Rating:	N/A		
Max Pressure:	75 psi		
Manufacturer:	Ashcroft		
Model:	102PHBH04TCK		

MANIFOLD

Type:	N/A
Material:	N/A
Transmitter Connection:	N/A
Process Connection:	N/A
Manufacturer:	N/A
Model:	N/A

NOTES

1279 - Pressure Guage
45 - 4.5" dial
SS - 316L SS Bourdon system & socket material
04 - 1/2" NPT connection
L - Lower connection
0 - No Options
15 - 0 - 15 standard pressure range
Capsule Diaphram Seal Type 102 - Flanged process connection
PH - Halar coated Monel Diaphragm material
BH - Halar coated SS bottom housing material
04T - 1/2" NPT
CK - Silicone -40 - 600 deg F temperature range

AECOM

Pressure Indicator
C-Type Bourdon Tube Gauge

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
PI-1757			A
SHEET	OF	DATE	
1	1	1-17-13	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project:	RLWTF							
TAG NO:	LLW-PI-1757	Hookup Drawings:		Loop Wiring Diagrams:	N/A			
		Spec No	40 9100	Line / Vessel Number:	LLW-092-SS150			
Asset No:		P&ID:	D-6023	Line ID:	1.05"	Size:	1"	Schedule: 40
Service Description:	LLW Rotary Press Filtrate from Tank TK-1707 to P-1707			Manufacturer:	Ascroft			
				Model:	451279SS04L0/15			
Safety Class:	NS			Quality Assurance Level	ML-4			

PROCESS CONDITIONS

	Hi Pressure Connection:					Low Pressure Connection					Units:
Fluid:	LLW Rotary Press Filtrate					Fluid:	N/A				
Fluid Density @ Operating Temp:	Varies					Fluid Density@ Operating Temp:	N/A				lbm/in3
Viscosity @ Operating Temp:	N/A					Viscosity @ Operating Temp:	N/A				N/A
Pressure:						Pressure:					
Oper:	TBD	Design:	TBD	H2OTst:	150	Oper:	N/A	Design:	N/A	H2OTst:	N/A psig
Temperature:						Temperature:					
Min:	32	Normal:	75	Max:	125	Min:	N/A	Normal:	N/A	Max:	N/A F
% solids:	N/A	% Quality:	N/A			% solids:	N/A	% Quality:	N/A		
Service:	N/A	Critical:	N/A	Pulsating:	N/A	Service:	N/A	Critical:	N/A	Pulsating:	N/A
Area Classification:	N/A					Ambient Temperature Requiremer	N/A				

ELEMENT

Type:	Bourdon C-tube		
Fill Fluid:	N/A		
Min Range:	12 psi	Max Range:	1500 psi
Diaphragm/Wetted Material:	316L SS		
Vent/Drain Location:	N/A		
Vent/Drain Material:	N/A		
Process Connection:	1/2" NPT		

GAUGE

Voltage:	N/A				
Power Wiring	N/A	Signal Type:	N/A		
Communication Protoc	N/A	Location:	N/A		
Smart:	N/A	Indicate:	4.5 in	Isolate:	Yes
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP	N/A	IP2:	N/A
Factory Calibration:	Yes				
Ambient Temperature Compensation:	N/A				
Characteristic:	N/A	Calibrated Range:	0-15 psi		
Over Range:	N/A	Zero Elevation:	N/A		
Accuracy:	N/A	Gasket Material:	N/A		
Conduit Connection:	N/A	NACE:	N/A		
Element Connection:	N/A	SS Tag:	PI-1108		
Body Max Pressure Rating:	N/A				
Body/Flange Material:	Ring Threaded Reinforced Polypropylene				
Mounting:	N/A				

SEAL DIAPHRAM & CAPILLARY

Length:	N/A	ID:	N/A
Armor:	N/A		
Fill Fluid:	Silicone Oil	Max Response Time:	N/A
SG @ 60 °F:	N/A	Capilary Material:	N/A

Diaphragm:	Hi Press:	Low Press:
Size & Type:	Capsule Diaphram Seal	N/A
Thickness:	2 7/8	N/A
Material:	Halar Coated Monel	N/A
Flush Ring:	Viton	N/A
Process Connection:	Flanged	
Max Temperature:	100 deg F	
Pressure Rating:	N/A	
Max Pressure:	75 psi	
Manufacturer:	Ashcroft	
Model:	102PHBH04TCK	

MANIFOLD

Type:	N/A
Material:	N/A
Transmitter Connection:	N/A
Process Connection:	N/A
Manufacturer:	N/A
Model:	N/A

NOTES

1279 - Pressure Guage
45 - 4.5" dial
SS - 316L SS Bourdon system & socket material
04 - 1/2" NPT connection - Requires adapter to 1"
L - Lower connection
0 - No Options
15 - 0 - 15 standard pressure range
Capsule Diaphram Seal Type 102 - Flanged process connection
PH - Halar coated Monel Diaphragm material
BH - Halar coated SS bottom housing material
04T - 1/2" NPT
CK - Silicone -40 - 600 deg F temperature range

AECOM

Pressure Indicator
C-Type Bourdon Tube Gauge

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
PI-1758			A
SHEET	OF	DATE	
1	1	1-17-13	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project:	RLWTF						
TAG NO:	LLW-PI-1758	Hookup Drawings:		Loop Wiring Diagrams:	N/A		
		Spec No:	40 9100	Line / Vessel Number:	LLW-088-SS150		
Asset No:		P&ID:	D-6023	Line ID: 1.05"	Size: 1"	Schedule:	40
Service Description:	LLW Rotary Press Filtrate from P-1707			Manufacturer:	Ascroft		
				Model:	451279SS04L0/100		
Safety Class:	NS			Quality Assurance Level	ML-4		

PROCESS CONDITIONS

	Hi Pressure Connection:					Low Pressure Connection					Units:
Fluid:	LLW Rotary Press Filtrate					Fluid:	N/A				
Fluid Density @ Operating Temp:	Varies					Fluid Density@ Operating Temp:	N/A				lbm/in3
Viscosity @ Operating Temp:	N/A					Viscosity @ Operating Temp:	N/A				N/A
Pressure:						Pressure:					
Oper:	45	Design:	100	H2OTst:	150	Oper:	N/A	Design:	N/A	H2OTst: N/A	psig
Temperature:						Temperature:					
Min:	32	Normal:	75	Max:	125	Min:	N/A	Normal:	N/A	Max: N/A	F
% solids:	N/A	% Quality:	N/A			% solids:	N/A	% Quality:	N/A		
Service:	N/A	Critical:	N/A	Pulsating:	N/A	Service:	N/A	Critical:	N/A	Pulsating:	N/A
Area Classification:	N/A					Ambient Temperature Requireme	N/A				

ELEMENT

Type:	Bourdon C-tube		
Fill Fluid:	N/A		
Min Range:	12 psi	Max Range:	1500 psi
Diaphragm/Wetted Material:	316L SS		
Vent/Drain Location:	N/A		
Vent/Drain Material:	N/A		
Process Connection:	1/2" NPT		

GAUGE

Voltage:	N/A				
Power Wiring:	N/A	Signal Type:	N/A		
Communication Protocc	N/A	Location:	N/A		
Smart:	N/A	Indicate:	4.5 in.	Isolate:	Yes
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP	N/A	IP2:	N/A
Factory Calibration:	Yes				
Ambient Temperature Compensation:	N/A				
Characteristic:	N/A	Calibrated Range:	0-15 psi		
Over Range:	N/A	Zero Elevation:	N/A		
Accuracy:	N/A	Gasket Material:	N/A		
Conduit Connection:	N/A	NACE:	N/A		
Element Connection:	N/A	SS Tag:	PI-1108		
Body Max Pressure Rating:	N/A				
Body/Flange Material:	Ring Threaded Reinforced Polypropylene				
Mounting:	N/A				

SEAL DIAPHRAM & CAPILLARY

Length:	N/A	ID:	N/A
Armor:	N/A		
Fill Fluid:	Silicone Oil	Max Response Time:	N/A
SG @ 60 °F:	N/A	Capilary Material:	N/A
Diaphragm:	Hi Press:		Low Press:
Size & Type:	Capsule Diaphram Seal		N/A
Thickness:	2 7/8		N/A
Material:	Halar Coated Monel		N/A
Flush Ring:	Viton		N/A
Process Connection:	Flanged		
Max Temperature:	100 deg F		
Pressure Rating:	N/A		
Max Pressure:	75 psi		
Manufacturer:	Ashcroft		
Model:	102PHBH04TCK		

MANIFOLD

Type:	N/A
Material:	N/A
Transmitter Connection:	N/A
Process Connection:	N/A
Manufacturer:	N/A
Model:	N/A

NOTES

1279 - Pressure Guage
45 - 4.5" dial
SS - 316L SS Bourdon system & socket material
04 - 1/2" NPT connection - Requires adapter to 1"
L - Lower connection
0 - No Options
100 - 0 - 100 standard pressure range
Capsule Diaphram Seal Type 102 - Flanged process connection
PH - Halar coated Monel Diaphragm material
BH - Halar coated SS bottom housing material
04T - 1/2" NPT
CK - Silicone -40 - 600 deg F temperature range

AECOM

Pressure Instrument
Differential Pressure Line to Atmosphere

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
PIT-1104			A
SHEET	OF	DATE	
1	1	1-17-13	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project:	RLWTF								
TAG NO:	LLW-PIT-1104	Hookup Drawings:		Loop Wiring Diagrams:	M-6152				
		Spec No	40 9100	Line / Vessel Number:	LLW-101-SSL				
Asset No:		P&ID:	D-6010	Line ID:	1.61"	Size:	1 1/2"	Schedule:	40
Service Description:	Roughing Filter FLT-1101 Inlet Pressure			Manufacturer:	Yokogawa				
				Model:	EJA530AEBH#7N02EL/N4T06				
Safety Class:	NS			Quality Assurance Level	ML-4				

PROCESS CONDITIONS

Hi Pressure Connection:						Low Pressure Connection						Units:
Fluid:	LLW Influent					Fluid:	Atmosphere					
Fluid Density @ Operating Temp:	0.0361					Fluid Density @ Operating Temp:	N/A					lbm/in3
Viscosity @ Operating Temp:	N/A					Viscosity @ Operating Temp:	N/A					N/A
Pressure:						Pressure:						
Oper:	45	Design:	100	H2OTst:	150	Oper:	N/A	Design:	N/A	H2OTst:	N/A	psig
Temperature:						Temperature:						
Min:	32	Normal:	75	Max:	125	Min:	N/A	Normal:	N/A	Max:	N/A	F
% solids:	N/A	% Quality:	N/A			% solids:	N/A	% Quality:	N/A			
Service:	N/A	Critical:	N/A	Pulsating:	N/A	Service:	N/A	Critical:	N/A	Pulsating:	N/A	
Area Classification:	N/A					Ambient Temperature Requirement	N/A					

ELEMENT

Type:	N/A		
Fill Fluid:	Silicone Oil		
Min Span:	14.5 psi	Max Span:	290 psi
Diaphragm/Wetted Material:	Hastelloy C276		
Vent/Drain Location:	N/A		
Vent/Drain Material:	N/A		
Process Connection:	1/2" NPT		

TRANSMITTER

Voltage:	24V dc				
Power Wiring:	Loop	Signal Type:	4-20mA		
Communication Protocol:	HART	Location:	Local		
Smart:	Yes	Indicate:	Yes	Isolate:	N/A
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1	6	IP2:	7
Factory Calibration:	Yes				
Ambient Temperature Compensation:	+/- [0.15%span + 0.15%Max]				
Characteristic:	N/A	Calibrated Range:	0-75 psig		
Over Range:	580 psig	Zero Elevation:	N/A		
Accuracy:	+/-0.2% span	Gasket Material:	BUNA		
Conduit Connection:	1/2" NPT	NACE:	N/A		
Element Connection:	none	SS Tag:	Yes		
Body Max Pressure Rating:	580 psig				
Body/Flange Material:	Cast Aluminum				
Mounting:	Direct Mount				

SEAL DIAPHRAM & CAPILLARY

Length:	N/A	ID:	N/A
Armor:	N/A		
Fill Fluid:	N/A	Max Response Time:	N/A
SG @ 60 °F:	N/A	Capilary Material:	N/A

Diaphragm:	Hi Press:	Low Press:
Size & Type:	N/A	N/A
Thickness:	N/A	N/A
Material:	N/A	N/A
Flush Ring:	N/A	N/A
Temperature Rating:	N/A	
Max Temperature:	N/A	
Pressure Rating:	N/A	
Max Pressure:	N/A	
Manufacturer:	N/A	
Model:	N/A	

MANIFOLD

Type:	N/A
Material:	N/A
Transmitter Connection:	N/A
Process Connection:	N/A
Manufacturer:	N/A
Model:	N/A

NOTES

EJA530A - Guage Pressure Transmitter
E - 4-20 mA DC with Hart protocol
B - 14.5 - 290 psi
H# - Hastelloy C276 or ASTM N10 276 for process connection and diaphragm
7 - Process Connection: 1/2" NPT male
N - Always N
0 - Always 0
2 - 1/2" NPT Female, 2 electrical connections without blind plug
E - Digital indicator with range setting switch
L - SUS316 2" Pipe mounting bracket
N4 - Wired stainless steel tag plate
T06 - Pressure leak test 2 MPa (20Kgf/cm2)

19-Dec-12

AECOM

Pressure Instrument

Differential Pressure Line to Atmosphere

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
PIT-1106			A
SHEET	OF	DATE	
1	1	1-17-13	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project:	RLWTF								
TAG NO:	LLW-PIT-1106	Hookup Drawings:		Loop Wiring Diagrams:	E-6153				
		Spec No:	40 9100	Line / Vessel Number:	LLW-075-SSL				
Asset No:		P&ID:	D-6010	Line ID:	1.38"	Size:	1 1/4"	Schedule:	40
Service Description:	Roughing Filter FLT-1101 Outlet Pressure			Manufacturer:	Yokogawa				
				Model:	EJA530AEBH#7N02EL/N4T06				
Safety Class:	NS			Quality Assurance Level	ML-4				

PROCESS CONDITIONS

	Hi Pressure Connection:					Low Pressure Connection					Units:
Fluid:	LLW Influent					Fluid:	Atmosphere				
Fluid Density @ Operating Temp:	0.0361					Fluid Density@ Operating Temp:	N/A				lbm/in3
Viscosity @ Operating Temp:	N/A					Viscosity @ Operating Temp:	N/A				N/A
Pressure:						Pressure:					
Oper:	45	Design:	100	H2OTst.	150	Oper:	N/A	Design:	N/A	H2OTst:	N/A	psig
Temperature:						Temperature:					
Min:	32	Normal:	75	Max:	125	Min:	N/A	Normal:	N/A	Max:	N/A	F
% solids:	N/A		% Quality:	N/A		% solids:	N/A		% Quality:	N/A	
Service:	N/A	Critical:	N/A	Pulsating:	N/A	Service:	N/A	Critical:	N/A	Pulsating:	N/A
Area Classification:	N/A					Ambient Temperature Requireme	N/A				

ELEMENT

Type:	N/A		
Fill Fluid:	Silicone Oil		
Min Span:	14.5 psi	Max Span:	290 psi
Diaphragm/Wetted Material:	Hastelloy C276		
Vent/Drain Location:	N/A		
Vent/Drain Material:	N/A		
Process Connection:	1/2" NPT		

TRANSMITTER

Voltage:	24V dc				
Power Wiring:	Loop	Signal Type:	4-20mA		
Communication Protoc	HART	Location:	Local		
Smart:	Yes	Indicate:	Yes	Isolate:	N/A
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP	6	IP2:	7
Factory Calibration:	Yes				
Ambient Temperature Compensation:	+/- [0.15%span + 0.15%Max]				
Characteristic:	N/A	Calibrated Range:	0-75 psig		
Over Range:	580 psig	Zero Elevation:	N/A		
Accuracy:	+/-0.2% span	Gasket Material:	BUNA		
Conduit Connection:	1/2" NPT	NACE:	N/A		
Element Connection:	none	SS Tag:	Yes		
Body Max Pressure Rating:	580 psig				
Body/Flange Material:	Cast Aluminum				
Mounting:	Direct Mount				

SEAL DIAPHRAM & CAPILLARY

Length:	N/A	ID:	N/A		
Armor:	N/A				
Fill Fluid:	N/A	Max Response Time:	N/A		
SG @ 60 °F:	N/A	Capilary Material:	N/A		
Diaphragm:	Hi Press:		Low Press:		
Size & Type:	N/A		N/A		
Thickness:	N/A		N/A		
Material:	N/A		N/A		
Flush Ring:	N/A		N/A		
Temperature Rating:	N/A				
Max Temperature:	N/A				
Pressure Rating:	N/A				
Max Pressure:	N/A				
Manufacturer:	N/A				
Model:	N/A				

MANIFOLD

Type:	N/A		
Material:	N/A		
Transmitter Connection	N/A		
Process Connection:	N/A		
Manufacturer:	N/A		
Model:	N/A		

NOTES

EJA530A - Guage Pressure Transmitter
E - 4-20 mA DC with Hart protocol
B - 14.5 - 290 psi
H# - Hastelloy C276 or ASTM N10 276 for process connection and diaphragm
7 - 1/2" NPT male
N - Always N
0 - Always 0
2 - 1/2" NPT Female, 2 electrical connections without blind plug
E - Digital indicator with range setting switch
L - SUS316 2" Pipe mounting bracket
N4 - Wired stainless steel tag plate
T06 - Pressure leak test 2 MPa (20Kgf/cm2)

16-Nov-12

AECOM

Pressure Instrument

Differential Pressure Line to Atmosphere

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
PIT-1211			A
SHEET	OF	DATE	
1	1	1-17-13	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project:	RLWTF								
TAG NO:	LLW-PIT-1211	Hookup Drawings:		Loop Wiring Diagrams:	E-6197				
		Spec No:	40 9100	Line / Vessel Number:	Internal MicroFilter Feed Line				
Asset No:		P&ID:	D-6014	Line ID:	3.06"	Size:	3"	Schedule:	N/A
Service Description:	MicroFilter Feed (Inlet) to FLT-1201			Manufacturer:	Yokogawa				
				Model:	EJA530AEBH#7N02EL/N4T06				
Safety Class:	NS			Quality Assurance Level	ML-4				

PROCESS CONDITIONS

	Hi Pressure Connection:					Low Pressure Connection					Units:
Fluid:	LLW MicroFilter Feed					Fluid:	Atmosphere				
Fluid Density @ Operating Temp:	0.0361					Fluid Density@ Operating Temp:	N/A				lbm/in3
Viscosity @ Operating Temp:	N/A					Viscosity @ Operating Temp:	N/A				N/A
Pressure:						Pressure:					
Oper:	45	Design:	100	H2OTst:	150	Oper:	N/A	Design:	N/A	H2OTst:	N/A	psig
Temperature:						Temperature:					
Min:	32	Normal:	75	Max:	125	Min:	N/A	Normal:	N/A	Max:	N/A	F
% solids:	N/A	% Quality:	N/A			% solids:	N/A	% Quality:	N/A		
Service:	N/A	Critical:	N/A	Pulsating:	N/A	Service:	N/A	Critical:	N/A	Pulsating:	N/A	
Area Classification:	N/A					Ambient Temperature Requirement:	N/A				

ELEMENT

Type:	N/A		
Fill Fluid:	Silicone Oil		
Min Span:	14.5 psi	Max Span:	290 psi
Diaphragm/Wetted Material:	Hastelloy C276		
Vent/Drain Location:	N/A		
Vent/Drain Material:	N/A		
Process Connection:	1/2" NPT		

TRANSMITTER

Voltage:	24V dc				
Power Wiring:	Loop	Signal Type:	4-20mA		
Communication Protocol:	HART	Location:	Local		
Smart:	Yes	Indicate:	Yes	Isolate:	N/A
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP:	6	IP2:	7
Factory Calibration:	Yes				
Ambient Temperature Compensation:	+/- [0.15%span + 0.15%Max]				
Characteristic:	N/A	Calibrated Range:	0-75 psig		
Over Range:	580 psig	Zero Elevation:	N/A		
Accuracy:	+/-0.2% span	Gasket Material:	BUNA		
Conduit Connection:	1/2" NPT	NACE:	N/A		
Element Connection:	none	SS Tag:	Yes		
Body Max Pressure Rating:	580 psig				
Body/Flange Material:	Cast Aluminum				
Mounting:	Direct Mount				

SEAL DIAPHRAM & CAPILLARY

Length:	N/A	ID:	N/A		
Armor:	N/A				
Fill Fluid:	N/A	Max Response Time:	N/A		
SG @ 60 °F:	N/A	Capilary Material:	N/A		
Diaphragm:	Hi Press:		Low Press:		
Size & Type:	N/A		N/A		
Thickness:	N/A		N/A		
Material:	N/A		N/A		
Flush Ring:	N/A		N/A		
Temperature Rating:	N/A				
Max Temperature:	N/A				
Pressure Rating:	N/A				
Max Pressure:	N/A				
Manufacturer:	N/A				
Model:	N/A				

MANIFOLD

Type:	N/A		
Material:	N/A		
Transmitter Connection:	N/A		
Process Connection:	N/A		
Manufacturer:	N/A		
Model:	N/A		

NOTES

EJA530A - Guage Pressure Transmitter
E - 4-20 mA DC with Hart protocol
B - 14.5 - 290 psi
H# - Hastelloy C276 or ASTM N10 276 for process connection and diaphragm
7 - 1/2" NPT male
N - Always N
0 - Always 0
2 - 1/2" NPT Female, 2 electrical connections without blind plug
E - Digital indicator with range setting switch
L - SUS316 2" Pipe mounting bracket
N4 - Wired stainless steel tag plate
T06 - Pressure leak test 2 MPa (20Kgf/cm2)

16-Nov-12

AECOM

Pressure Instrument

Differential Pressure Line to Atmosphere

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
PIT-1218			A
SHEET	OF	DATE	
1	1	1-17-13	
BY	CHK'D	PROC.	APPR
NCC	AME		
P.O.			
REQ.			

Project:	RLWTF								
TAG NO:	LLW-PIT-1218	Hookup Drawings:		Loop Wiring Diagrams:	E-6199				
		Spec No:	40 9100	Line / Vessel Number:	LLW-180-SS150				
Asset No:		P&ID:	D-6014	Line ID:	2.07"	Size:	2"	Schedule:	N/A
Service Description:	MicroFilter Filtrate from FLT-1201			Manufacturer:	Yokogawa				
				Model:	EJA530AEBH#7N02EL/N4T06				
Safety Class:	NS			Quality Assurance Level	ML-4				

PROCESS CONDITIONS

	Hi Pressure Connection:					Low Pressure Connection					Units:
Fluid:	LLW MicroFilter Filtrate					Fluid:	Atmosphere				
Fluid Density @ Operating Temp:	0.0361					Fluid Density@ Operating Temp:	N/A				lbm/in3
Viscosity @ Operating Temp:	N/A					Viscosity @ Operating Temp:	N/A				N/A
	Pressure:						Pressure:				
Oper:	45	Design:	100	H2OTst:	150	Oper:	N/A	Design:	N/A	H2OTst:	N/A	psig
	Temperature:						Temperature:				
Min:	32	Normal:	75	Max:	125	Min:	N/A	Normal:	N/A	Max:	N/A	F
% solids:	N/A	% Quality:	N/A			% solids:	N/A	% Quality:	N/A		
Service:	N/A	Critical:	N/A	Pulsating:	N/A	Service:	N/A	Critical:	N/A	Pulsating:	N/A
Area Classification:	N/A					Ambient Temperature Requiremer	N/A				

ELEMENT

Type:	N/A		
Fill Fluid:	Silicone Oil		
Min Span:	14.5 psi	Max Span:	290 psi
Diaphragm/Wetted Material:	Hastelloy C276		
Vent/Drain Location:	N/A		
Vent/Drain Material:	N/A		
Process Connection:	1/2" NPT		

TRANSMITTER

Voltage:	24V dc				
Power Wiring:	Loop	Signal Type:	4-20mA		
Communication Protocc	HART	Location:	Local		
Smart:	Yes	Indicate:	Yes	Isolate:	N/A
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP	6	IP2:	7
Factory Calibration:	Yes				
Ambient Temperature Compensation:	+/- [0.15%span + 0.15%Max]				
Characteristic:	N/A	Calibrated Range:	0-75 psig		
Over Range:	580 psig	Zero Elevation:	N/A		
Accuracy:	+/-0.2% span	Gasket Material:	BUNA		
Conduit Connection:	1/2" NPT	NACE:	N/A		
Element Connection:	none	SS Tag:	Yes		
Body Max Pressure Rating:	580 psig				
Body/Flange Material:	Cast Aluminum				
Mounting:	Direct Mount				

SEAL DIAPHRAM & CAPILLARY

Length:	N/A	ID:	N/A	
Armor:	N/A			
Fill Fluid:	N/A	Max Response Time:	N/A	
SG @ 60 °F:	N/A	Capilary Material:	N/A	
Diaphragm:	Hi Press:		Low Press:	
Size & Type:	N/A		N/A	
Thickness:	N/A		N/A	
Material:	N/A		N/A	
Flush Ring:	N/A		N/A	
Temperature Rating:	N/A			
Max Temperature:	N/A			
Pressure Rating:	N/A			
Max Pressure:	N/A			
Manufacturer:	N/A			
Model:	N/A			

MANIFOLD

Type:	N/A		
Material:	N/A		
Transmitter Connection:	N/A		
Process Connection:	N/A		
Manufacturer:	N/A		
Model:	N/A		

NOTES

EJA530A - Guage Pressure Transmitter
E - 4-20 mA DC with Hart protocol
B - 14.5 - 290 psi
H# - Hastelloy C276 or ASTM N10 276 for process connection and diaphragm
7 - 1/2" NPT male
N - Always N
0 - Always 0
2 - 1/2" NPT Female, 2 electrical connections without blind plug
E - Digital indicator with range setting switch
L - SUS316 2" Pipe mounting bracket
N4 - Wired stainless steel tag plate
T06 - Pressure leak test 2 MPa (20Kgf/cm2)

18-Nov-12

AECOM

Pressure Instrument

Differential Pressure Line to Atmosphere

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
PIT-1309			A
SHEET	OF	DATE	
1	1	1-17-13	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project:	RLWTF								
TAG NO:	LLW-PIT-1309	Hookup Drawings:		Loop Wiring Diagrams:	E-6232				
		Spec No:	40 9100	Line / Vessel Number:	LLW-208-SS150				<-
Asset No:		P&ID:	D-6017	Line ID:	1.61"	Size:	1.5"	Schedule:	N/A <-
Service Description:	RO Feed to P-1302			Manufacturer:	Yokogawa				<-
				Model:	EJA530AEAH#7N02EL/N4T06				<-
Safety Class:	NS			Quality Assurance Level	ML-4				<-

PROCESS CONDITIONS

	Hi Pressure Connection:					Low Pressure Connection					Units:
Fluid:	LLW RO Feed					Fluid:	Atmosphere				
Fluid Density @ Operating Temp:	0.0361					Fluid Density@ Operating Temp:	N/A				lbm/in3
Viscosity @ Operating Temp:	N/A					Viscosity @ Operating Temp:	N/A				N/A
Pressure:						Pressure:					
Oper:	45	Design:	100	H2OTst:	150	Oper:	N/A	Design:	N/A	H2OTst:	N/A psig
Temperature:						Temperature:					
Min:	32	Normal:	75	Max:	125	Min:	N/A	Normal:	N/A	Max:	N/A F
% solids:	N/A	% Quality:	N/A			% solids:	N/A	% Quality:	N/A		
Service:	N/A	Critical:	N/A	Pulsating:	N/A	Service:	N/A	Critical:	N/A	Pulsating:	N/A
Area Classification:	N/A					Ambient Temperature Requirem	N/A				

ELEMENT

Type:	N/A		
Fill Fluid:	Silicone Oil		
Min Span:	1.45 psi	Max Span:	29 psi
Diaphragm/Wetted Material:	Hastelloy C276		
Vent/Drain Location:	N/A		
Vent/Drain Material:	N/A		
Process Connection:	1/2" NPT		

TRANSMITTER

Voltage:	24V dc				
Power Wiring:	Loop	Signal Type:	4-20mA		
Communication Protoc	HART	Location:	Local		
Smart:	Yes	Indicate:	Yes	Isolate:	N/A
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP	6	IP2:	7
Factory Calibration:	Yes				
Ambient Temperature Compensation:	+/- [0.15%span + 0.15%Max]				
Characteristic:	N/A	Calibrated Range:	0-75 psig		
Over Range:	580 psig	Zero Elevation:	N/A		
Accuracy:	+/-0.2% span	Gasket Material:	BUNA		
Conduit Connection:	1/2" NPT	NACE:	N/A		
Element Connection:	none	SS Tag:	Yes		
Body Max Pressure Rating:	580 psig				
Body/Flange Material:	Cast Aluminum				
Mounting:	Direct Mount				

SEAL DIAPHRAM & CAPILLARY

Length:	N/A	ID:	N/A
Armor:	N/A		
Fill Fluid:	N/A	Max Response Time:	N/A
SG @ 60 °F:	N/A	Capilary Material:	N/A

Diaphragm:	Hi Press:	Low Press:
Size & Type:	N/A	N/A
Thickness:	N/A	N/A
Material:	N/A	N/A
Flush Ring:	N/A	N/A

Temperature Rating:	N/A
Max Temperature:	N/A
Pressure Rating:	N/A
Max Pressure:	N/A
Manufacturer:	N/A
Model:	N/A

MANIFOLD

Type:	N/A
Material:	N/A
Transmitter Connection:	N/A
Process Connection:	N/A
Manufacturer:	N/A
Model:	N/A

NOTES

EJA530A - Guage Pressure Transmitter
E - 4-20 mA DC with Hart protocol
A - 1.45 - 29 psi
H# - Hastelloy C276 or ASTM N10 276 for process connection and diaphragm
7 - 1/2" NPT male
N - Always N
0 - Always 0
2 - 1/2" NPT Female, 2 electrical connections without blind plug
E - Digital indicator with range setting switch
L - SUS316 2" Pipe mounting bracket
N4 - Wired stainless steel tag plate
T06 - Pressure leak test 2 MPa (20Kgf/cm2)

16-Nov-12 <-

AECOM

Pressure Instrument

Differential Pressure Line to Atmosphere

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
PIT-1313			A
SHEET	OF	DATE	
1	1	1-17-13	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project:	RLWTF								
TAG NO:	LLW-PIT-1313	Hookup Drawings:		Loop Wiring Diagrams:	E-6233				
		Spec No:	40 9100	Line / Vessel Number:	LLW-220-SS150				
Asset No:		P&ID:	D-6017	Line ID:	.62"	Size:	0.5"	Schedule:	N/A
Service Description:	Pump P-1302 Outlet RO Feed Recycle			Manufacturer:	Yokogawa				
				Model:	EJA530AEBH#7N02EL/N4T06				
Safety Class:	NS			Quality Assurance Level	ML-4				

PROCESS CONDITIONS

	Hi Pressure Connection:					Low Pressure Connection					Units:
Fluid:	LLW RO Feed					Fluid:	Atmosphere				
Fluid Density @ Operating Temp:	0.0361					Fluid Density@ Operating Temp:	N/A				lbm/in3
Viscosity @ Operating Temp:	N/A					Viscosity @ Operating Temp:	N/A				N/A
Pressure:						Pressure:					
Oper:	45	Design:	100	H2OTst:	150	Oper:	N/A	Design:	N/A	H2OTst:	N/A	psig
Temperature:						Temperature:					
Min:	32	Normal:	75	Max:	125	Min:	N/A	Normal:	N/A	Max:	N/A	F
% solids:	N/A		% Quality:	N/A		% solids:	N/A		% Quality:	N/A	
Service:	N/A	Critical:	N/A	Pulsating:	N/A	Service:	N/A	Critical:	N/A	Pulsating:	N/A
Area Classification:	N/A					Ambient Temperature Requiremer	N/A				

ELEMENT

Type:	N/A		
Fill Fluid:	Silicone Oil		
Min Span:	14.5 psi	Max Span:	290 psi
Diaphragm/Wetted Material:	Hastelloy C276		
Vent/Drain Location:	N/A		
Vent/Drain Material:	N/A		
Process Connection:	1/2" NPT		

TRANSMITTER

Voltage:	24V dc				
Power Wiring:	Loop	Signal Type:	4-20mA		
Communication Protocc	HART	Location:	Local		
Smart:	Yes	Indicate:	Yes	Isolate:	N/A
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP	6	IP2:	7
Factory Calibration:	Yes				
Ambient Temperature Compensation:	+/- [0.15%span + 0.15%Max]				
Characteristic:	N/A	Calibrated Range:	0-75 psig		
Over Range:	580 psig	Zero Elevation:	N/A		
Accuracy:	+/-0.2% span	Gasket Material:	BUNA		
Conduit Connection:	1/2" NPT	NACE:	N/A		
Element Connection:	none	SS Tag:	Yes		
Body Max Pressure Rating:	580 psig				
Body/Flange Material:	Cast Aluminum				
Mounting:	Direct Mount				

SEAL DIAPHRAM & CAPILLARY

Length:	N/A	ID:	N/A		
Armor:	N/A				
Fill Fluid:	N/A	Max Response Time:	N/A		
SG @ 60 °F:	N/A	Capilary Material:	N/A		
Diaphragm:	Hi Press:		Low Press:		
Size & Type:	N/A		N/A		
Thickness:	N/A		N/A		
Material:	N/A		N/A		
Flush Ring:	N/A		N/A		
Temperature Rating:	N/A				
Max Temperature:	N/A				
Pressure Rating:	N/A				
Max Pressure:	N/A				
Manufacturer:	N/A				
Model:	N/A				

MANIFOLD

Type:	N/A		
Material:	N/A		
Transmitter Connection	N/A		
Process Connection:	N/A		
Manufacturer:	N/A		
Model:	N/A		

NOTES

EJA530A - Guage Pressure Transmitter
E - 4-20 mA DC with Hart protocol
B - 14.5 - 290 psi
H# - Hastelloy C276 or ASTM N10 276 for process connection and diaphragm
7 - 1/2" NPT male
N - Always N
0 - Always 0
2 - 1/2" NPT Female, 2 electrical connections without blind plug
E - Digital indicator with range setting switch
L - SUS316 2" Pipe mounting bracket
N4 - Wired stainless steel tag plate
T06 - Pressure leak test 2 MPa (20Kgf/cm2)

18-Nov-12

AECOM

Pressure Instrument

Differential Pressure Line to Atmosphere

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
PIT-1316			A
SHEET	OF	DATE	
1	1	1-17-13	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project:	RLWTF								
TAG NO:	LLW-PIT-1316	Hookup Drawings:		Loop Wiring Diagrams:	E-6231				
		Spec No:	40 9100	Line / Vessel Number:	LLW-228-SS150				
Asset No:		P&ID:	D-6017	Line ID:	1.61"	Size:	1.5"	Schedule:	N/A
Service Description:	RO Feed From Pump P-1302 to ROU-1301			Manufacturer:	Yokogawa				
				Model:	EJA530AEBH#7N02EL/N4T06				
Safety Class:	NS			Quality Assurance Level	ML-4				

PROCESS CONDITIONS

	Hi Pressure Connection:					Low Pressure Connection					Units:
Fluid:	LLW RO Feed					Fluid:	Atmosphere				
Fluid Density @ Operating Temp:	0.0361					Fluid Density@ Operating Temp:	N/A				lbm/in3
Viscosity @ Operating Temp:	N/A					Viscosity @ Operating Temp:	N/A				N/A
Pressure:						Pressure:					
Oper:	45	Design:	100	H2OTst:	150	Oper:	N/A	Design:	N/A	H2OTst:	N/A	psig
Temperature:						Temperature:					
Min:	32	Normal:	75	Max:	125	Min:	N/A	Normal:	N/A	Max:	N/A	F
% solids:	N/A	% Quality:	N/A			% solids:	N/A	% Quality:	N/A		
Service:	N/A	Critical:	N/A	Pulsating:	N/A	Service:	N/A	Critical:	N/A	Pulsating:	N/A	
Area Classification:	N/A					Ambient Temperature Requireme	N/A				

ELEMENT

Type:	N/A		
Fill Fluid:	Silicone Oil		
Min Span:	14.5 psi	Max Span:	290 psi
Diaphragm/Wetted Material:	Hastelloy C276		
Vent/Drain Location:	N/A		
Vent/Drain Material:	N/A		
Process Connection:	1/2" NPT		

TRANSMITTER

Voltage:	24V dc				
Power Wiring:	Loop	Signal Type:	4-20mA		
Communication Protocc	HART	Location:	Local		
Smart:	Yes	Indicate:	Yes	Isolate:	N/A
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP	6	IP2:	7
Factory Calibration:	Yes				
Ambient Temperature Compensation:	+/- [0.15%span + 0.15%Max]				
Characteristic:	N/A	Calibrated Range:	0-75 psig		
Over Range:	580 psig	Zero Elevation:	N/A		
Accuracy:	+/-0.2% span	Gasket Material:	BUNA		
Conduit Connection:	1/2" NPT	NACE:	N/A		
Element Connection:	none	SS Tag:	Yes		
Body Max Pressure Rating:	580 psig				
Body/Flange Material:	Cast Aluminum				
Mounting:	Direct Mount				

SEAL DIAPHRAM & CAPILLARY

Length:	N/A	ID:	N/A
Armor:	N/A		
Fill Fluid:	N/A	Max Response Time:	N/A
SG @ 60 °F:	N/A	Capilary Material:	N/A

Diaphragm:	Hi Press:	Low Press:
Size & Type:	N/A	N/A
Thickness:	N/A	N/A
Material:	N/A	N/A
Flush Ring:	N/A	N/A

Temperature Rating:	N/A
Max Temperature:	N/A
Pressure Rating:	N/A
Max Pressure:	N/A
Manufacturer:	N/A
Model:	N/A

MANIFOLD

Type:	N/A
Material:	N/A
Transmitter Connection:	N/A
Process Connection:	N/A
Manufacturer:	N/A
Model:	N/A

NOTES

EJA530A - Guage Pressure Transmitter
E - 4-20 mA DC with Hart protocol
B - 14.5 - 290 psi
H# - Hastelloy C276 or ASTM N10 276 for process connection and diaphragm
7 - 1/2" NPT male
N - Always N
0 - Always 0
2 - 1/2" NPT Female, 2 electrical connections without blind plug
E - Digital indicator with range setting switch
L - SUS316 2" Pipe mounting bracket
N4 - Wired stainless steel tag plate
T06 - Pressure leak test 2 MPa (20Kg/cm2)

16-Nov-12

AECOM

Pressure Instrument

Differential Pressure Line to Atmosphere

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
PIT-1337			A
SHEET	OF	DATE	
1	1	1-17-13	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project:	RLWTF							
TAG NO:	LLW-PIT-1337	Hookup Drawings:		Loop Wiring Diagrams:	E-6260			
		Spec No:	40 9100	Line / Vessel Number:	LLW-245-SS150			
Asset No:		P&ID:	D-6017	Line ID:	1.61"	Size: 1.5"	Schedule: N/A	
Service Description:	RO Permeate From ROU-1301 to Holding Tank TK-1304			Manufacturer:	Yokogawa			
				Model:	EJA530AEBH#7N02EL/N4T06			
Safety Class:	NS			Quality Assurance Level	ML-4			

PROCESS CONDITIONS

	Hi Pressure Connection:					Low Pressure Connection					Units:
Fluid:	LLW RO Permeate					Fluid:	Atmosphere				
Fluid Density @ Operating Temp:	0.0361					Fluid Density@ Operating Temp:	N/A				lbm/in3
Viscosity @ Operating Temp:	N/A					Viscosity @ Operating Temp:	N/A				N/A
Pressure:						Pressure:					
Oper:	45	Design:	100	H2OTst:	150	Oper:	N/A	Design:	N/A	H2OTst: N/A	psig
Temperature:						Temperature:					
Min:	32	Normal:	75	Max:	125	Min:	N/A	Normal:	N/A	Max: N/A	F
% solids:	N/A	% Quality:	N/A			% solids:	N/A	% Quality:	N/A		
Service:	N/A	Critical:	N/A	Pulsating:	N/A	Service:	N/A	Critical:	N/A	Pulsating: N/A	
Area Classification:	N/A					Ambient Temperature Requirement:	N/A				

ELEMENT

Type:	N/A		
Fill Fluid:	Silicone Oil		
Min Span:	14.5 psi	Max Span:	290 psi
Diaphragm/Wetted Material:	Hastelloy C276		
Vent/Drain Location:	N/A		
Vent/Drain Material:	N/A		
Process Connection:	1/2" NPT		

TRANSMITTER

Voltage:	24V dc				
Power Wiring:	Loop	Signal Type:	4-20mA		
Communication Protocol:	HART	Location:	Local		
Smart:	Yes	Indicate:	Yes	Isolate:	N/A
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP:	6	IP2:	7
Factory Calibration:	Yes				
Ambient Temperature Compensation:	+/- [0.15%span + 0.15%Max]				
Characteristic:	N/A	Calibrated Range:	0-75 psig		
Over Range:	580 psig	Zero Elevation:	N/A		
Accuracy:	+/-0.2% span	Gasket Material:	BUNA		
Conduit Connection:	1/2" NPT	NACE:	N/A		
Element Connection:	none	SS Tag:	Yes		
Body Max Pressure Rating:	580 psig				
Body/Flange Material:	Cast Aluminum				
Mounting:	Direct Mount				

SEAL DIAPHRAM & CAPILLARY

Length:	N/A	ID:	N/A
Armor:	N/A		
Fill Fluid	N/A	Max Response Time:	N/A
SG @ 60 °F:	N/A	Capilary Material:	N/A

Diaphragm:	Hi Press:	Low Press:
Size & Type:	N/A	N/A
Thickness:	N/A	N/A
Material:	N/A	N/A
Flush Ring:	N/A	N/A
Temperature Rating:	N/A	
Max Temperature:	N/A	
Pressure Rating:	N/A	
Max Pressure:	N/A	
Manufacturer:	N/A	
Model:	N/A	

MANIFOLD

Type:	N/A
Material:	N/A
Transmitter Connection:	N/A
Process Connection:	N/A
Manufacturer:	N/A
Model:	N/A

NOTES

EJA530A - Guage Pressure Transmitter
E - 4-20 mA DC with Hart protocol
B - 14.5 - 290 psi
H# - Hastelloy C276 or ASTM N10 276 for process connection and diaphragm
7 - 1/2" NPT male
N - Always N
0 - Always 0
2 - 1/2" NPT Female, 2 electrical connections without blind plug
E - Digital indicator with range setting switch
L - SUS316 2" Pipe mounting bracket
N4 - Wired stainless steel tag plate
T06 - Pressure leak test 2 MPa (20Kgf/cm2)

16-Nov-12

AECOM

Pressure Instrument

Differential Pressure Line to Atmosphere

DATA SHEET NO.			REV.
PIT-1402			A
SHEET	OF	DATE	
1	1	1-17-13	

NO.	BY	DATE	REVISION

BY	CHK'D	PROC.	APPR.
NCC	AME		

P.O.

REQ.

Project:	RLWTF							
TAG NO:	LLW-PIT-1402	Hookup Drawings:		Loop Wiring Diagrams:	E-6275			
		Spec No:	40 9100	Line / Vessel Number:	LLW-245-SS150			
Asset No:		P&ID:	D-6021	Line ID:	2.07"	Size:	2"	Schedule: N/A
Service Description:	RO Permeate From P-1407 to IXM Filters			Manufacturer:	Yokogawa			
				Model:	EJA530AEBH#7N02EL/N4T06			
Safety Class:	NS			Quality Assurance Level	ML-4			

PROCESS CONDITIONS

	Hi Pressure Connection:					Low Pressure Connection					Units:
Fluid:	LLW RO Permeate					Fluid:	Atmosphere				
Fluid Density @ Operating Temp:	0.0361					Fluid Density@ Operating Temp:	N/A				lbm/in3
Viscosity @ Operating Temp:	N/A					Viscosity @ Operating Temp:	N/A				N/A
Pressure:						Pressure:					
Oper:	45	Design:	100	H2OTst:	150	Oper:	N/A	Design:	N/A	H2OTst: N/A	psig
Temperature:						Temperature:					
Min:	32	Normal:	75	Max:	125	Min:	N/A	Normal:	N/A	Max: N/A	F
% solids:	N/A	% Quality:	N/A			% solids:	N/A	% Quality:	N/A		
Service:	N/A	Critical:	N/A	Pulsating:	N/A	Service:	N/A	Critical:	N/A	Pulsating: N/A	
Area Classification:	N/A					Ambient Temperature Requirem	N/A				

ELEMENT

Type:	N/A		
Fill Fluid:	Silicone Oil		
Min Span:	14.5 psi	Max Span:	290 psi
Diaphragm/Wetted Material:	Hastelloy C276		
Vent/Drain Location:	N/A		
Vent/Drain Material:	N/A		
Process Connection:	1/2" NPT		

TRANSMITTER

Voltage:	24V dc				
Power Wiring	Loop	Signal Type:	4-20mA		
Communication Protoc	HART	Location:	Local		
Smart:	Yes	Indicate:	Yes	Isolate:	N/A
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP	6	IP2:	7
Factory Calibration:	Yes				
Ambient Temperature Compensation:	+/- [0.15%span + 0.15%Max]				
Characteristic:	N/A	Calibrated Range:	0-75 psig		
Over Range:	580 psig	Zero Elevation:	N/A		
Accuracy:	+/-0.2% span	Gasket Material:	BUNA		
Conduit Connection:	1/2" NPT	NACE:	N/A		
Element Connection:	none	SS Tag:	Yes		
Body Max Pressure Rating:	580 psig				
Body/Flange Material:	Cast Aluminum				
Mounting:	Direct Mount				

SEAL DIAPHRAM & CAPILLARY

Length:	N/A	ID:	N/A
Armor:	N/A		
Fill Fluid:	N/A	Max Response Time:	N/A
SG @ 60 °F:	N/A	Capilary Material:	N/A

Diaphragm:	Hi Press:	Low Press:
Size & Type:	N/A	N/A
Thickness:	N/A	N/A
Material:	N/A	N/A
Flush Ring:	N/A	N/A

Temperature Rating:	N/A
Max Temperature:	N/A
Pressure Rating:	N/A
Max Pressure:	N/A
Manufacturer:	N/A
Model:	N/A

MANIFOLD

Type:	N/A
Material:	N/A
Transmitter Connection:	N/A
Process Connection:	N/A
Manufacturer:	N/A
Model:	N/A

NOTES

EJA530A - Guage Pressure Transmitter
E - 4-20 mA DC with Hart protocol
B - 14.5 - 290 psi
H# - Hastelloy C276 or ASTM N10 276 for process connection and diaphragm
7 - 1/2" NPT male
N - Always N
0 - Always 0
2 - 1/2" NPT Female, 2 electrical connections without blind plug
E - Digital indicator with range setting switch
L - SUS316 2" Pipe mounting bracket
N4 - Wired stainless steel tag plate
T06 - Pressure leak test 2 MPa (20Kgf/cm2)

16-Nov-12

AECOM

Pressure Instrument

Differential Pressure Line to Atmosphere

DATA SHEET NO.			REV.
PIT-1406			A
SHEET	OF	DATE	
1	1	1-17-13	

NO.	BY	DATE	REVISION

BY	CHK'D	PROC.	APPR.
NCC	AME		

P.O.	
REQ.	

Project:	RLWTF						
TAG NO:	LLW-PIT-1406	Hookup Drawings:		Loop Wiring Diagrams:	M-6280		
		Spec No:	40 9100	Line / Vessel Number:	LLW-205-SS150		<-
Asset No:		P&ID:	D-6021	Line ID: 1.61"	Size: 1.5"	Schedule: N/A	<-
Service Description:	RO Permeate From P-1408 to Filter Aid Make-up			Manufacturer:	Yokogawa		<-
				Model:	EJA530AEBH#7N02EL/N4T06		<-
Safety Class:	NS			Quality Assurance Level	ML-4		<-

PROCESS CONDITIONS

	Hi Pressure Connection:					Low Pressure Connection					Units:
Fluid:	LLW RO Permeate					Fluid:	Atmosphere				
Fluid Density @ Operating Temp:	0.0361					Fluid Density @ Operating Temp:	N/A				lbm/in3
Viscosity @ Operating Temp:	N/A					Viscosity @ Operating Temp:	N/A				N/A
Pressure:						Pressure:					
Oper:	45	Design:	100	H2OTst:	150	Oper:	N/A	Design:	N/A	H2OTst:	N/A	psig
Temperature:						Temperature:					
Min:	32	Normal:	75	Max:	125	Min:	N/A	Normal:	N/A	Max:	N/A	F
% solids:	N/A	% Quality:	N/A			% solids:	N/A	% Quality:	N/A		
Service:	N/A	Critical:	N/A	Pulsating:	N/A	Service:	N/A	Critical:	N/A	Pulsating:	N/A	
Area Classification:	N/A					Ambient Temperature Requiremen	N/A				

ELEMENT

Type:	N/A		
Fill Fluid:	Silicone Oil		
Min Span:	14.5 psi	Max Span:	290 psi
Diaphragm/Wetted Material:	Hastelloy C276		
Vent/Drain Location:	N/A		
Vent/Drain Material:	N/A		
Process Connection:	1/2" NPT		

TRANSMITTER

Voltage:	24V dc				
Power Wiring	Loop	Signal Type:	4-20mA		
Communication Protocol:	HART	Location:	Local		
Smart:	Yes	Indicate:	Yes	Isolate:	N/A
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1	6	IP2:	7
Factory Calibration:	Yes				
Ambient Temperature Compensation:	+/- [0.15%span + 0.15%Max]				
Characteristic:	N/A	Calibrated Range:	0-75 psig		
Over Range:	580 psig	Zero Elevation:	N/A		
Accuracy:	+/-0.2% span	Gasket Material:	BUNA		
Conduit Connection:	1/2" NPT	NACE:	N/A		
Element Connection:	none	SS Tag:	Yes		
Body Max Pressure Rating:	580 psig				
Body/Flange Material:	Cast Aluminum				
Mounting:	Direct Mount				

SEAL DIAPHRAM & CAPILLARY

Length:	N/A	ID:	N/A
Armor:	N/A		
Fill Fluid:	N/A	Max Response Time:	N/A
SG @ 60 °F:	N/A	Capilary Material:	N/A

Diaphragm:	Hi Press:	Low Press:
Size & Type:	N/A	N/A
Thickness:	N/A	N/A
Material:	N/A	N/A
Flush Ring:	N/A	N/A

Temperature Rating:	N/A
Max Temperature:	N/A
Pressure Rating:	N/A
Max Pressure:	N/A
Manufacturer:	N/A
Model:	N/A

MANIFOLD

Type:	N/A
Material:	N/A
Transmitter Connection:	N/A
Process Connection:	N/A
Manufacturer:	N/A
Model:	N/A

NOTES

EJA530A - Guage Pressure Transmitter
E - 4-20 mA DC with Hart protocol
B - 14.5 - 290 psi
H# - Hastelloy C276 or ASTM N10 276 for process connection and diaphragm
7 - Process Connection: 1/2" NPT male
N - Always N
0 - Always 0
2 - 1/2" NPT Female, 2 electrical connections without blind plug
E - Digital indicator with range setting switch
L - SUS316 2" Pipe mounting bracket
N4 - Wired stainless steel tag plate
T06 - Pressure leak test 2 MPa (20Kgf/cm2)

19-Dec-12 <-

AECOM

Pressure Instrument

Differential Pressure Line to Atmosphere

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
PIT-1410			A
SHEET	OF	DATE	
1	1	1-17-13	
BY	CHK'D	PROC	APPR.
NCC	AME		
P.O.			
REQ.			

Project:	RLWTF							
TAG NO:	LLW-PIT-1410	Hookup Drawings:		Loop Wiring Diagrams:	E-6278			
Asset No:		Spec No	40 9100	Line / Vessel Number:	LLW-268-SS150			
Service Description:	RO Permeate From P-1407 to IXM Lead Filter FLT-1401	P&ID:	D-6021	Line ID:	1.61"	Size:	1.5"	Schedule: N/A
				Manufacturer:	Yokogawa			
				Model:	EJA530AEBH#7N02EL/N4T06			
Safety Class:	NS			Quality Assurance Level	ML-4			

PROCESS CONDITIONS

	Hi Pressure Connection:					Low Pressure Connection					Units:
Fluid:	LLW RO Permeate					Fluid:	Atmosphere				
Fluid Density @ Operating Temp:	0.0361					Fluid Density@ Operating Temp:	N/A				lbm/in3
Viscosity @ Operating Temp:	N/A					Viscosity @ Operating Temp:	N/A				N/A
Pressure:						Pressure:					
Oper:	45	Design:	100	H2OTst:	150	Oper:	N/A	Design:	N/A	H2OTst: N/A	psig
Temperature:						Temperature:					
Min:	32	Normal:	75	Max:	125	Min:	N/A	Normal:	N/A	Max: N/A	F
% solids:	N/A	% Quality:	N/A			% solids:	N/A	% Quality:	N/A		
Service:	N/A	Critical:	N/A	Pulsating:	N/A	Service:	N/A	Critical:	N/A	Pulsating: N/A	
Area Classification:	N/A					Ambient Temperature Requirement:	N/A				

ELEMENT

Type:	N/A
Fill Fluid:	Silicone Oil
Min Span:	14.5 psi
Max Span:	290 psi
Diaphragm/Wetted Material:	Hastelloy C276
Vent/Drain Location:	N/A
Vent/Drain Material:	N/A
Process Connection:	1/2" NPT

TRANSMITTER

Voltage:	24V dc				
Power Wiring:	Loop	Signal Type:	4-20mA		
Communication Protocol:	HART	Location:	Local		
Smart:	Yes	Indicate:	Yes	Isolate:	N/A
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP:	6	IP2:	7
Factory Calibration:	Yes				
Ambient Temperature Compensation:	+/- [0.15%span + 0.15%Max]				
Characteristic:	N/A	Calibrated Range:	0-75 psig		
Over Range:	580 psig	Zero Elevation:	N/A		
Accuracy:	+/-0.2% span	Gasket Material:	BUNA		
Conduit Connection:	1/2" NPT	NACE:	N/A		
Element Connection:	none	SS Tag:	Yes		
Body Max Pressure Rating:	580 psig				
Body/Flange Material:	Cast Aluminum				
Mounting:	Direct Mount				

SEAL DIAPHRAM & CAPILLARY

Length:	N/A	ID:	N/A
Armor:	N/A		
Fill Fluid:	N/A	Max Response Time:	N/A
SG @ 60 °F:	N/A	Capilary Material:	N/A

Diaphragm:	Hi Press:	Low Press:
Size & Type:	N/A	N/A
Thickness:	N/A	N/A
Material:	N/A	N/A
Flush Ring:	N/A	N/A

Temperature Rating:	N/A
Max Temperature:	N/A
Pressure Rating:	N/A
Max Pressure:	N/A
Manufacturer:	N/A
Model:	N/A

MANIFOLD

Type:	N/A
Material:	N/A
Transmitter Connection:	N/A
Process Connection:	N/A
Manufacturer:	N/A
Model:	N/A

NOTES

EJA530A - Guage Pressure Transmitter
E - 4-20 mA DC with Hart protocol
B - 14.5 - 290 psi
H# - Hastelloy C276 or ASTM N10 276 for process connection and diaphragm
7 - 1/2" NPT male
N - Always N
0 - Always 0
2 - 1/2" NPT Female, 2 electrical connections without blind plug
E - Digital indicator with range setting switch
L - SUS316 2" Pipe mounting bracket
N4 - Wired stainless steel tag plate
T06 - Pressure leak test 2 MPa (20Kgf/cm2)

16-Nov-12

AECOM

Pressure Instrument

Differential Pressure Line to Atmosphere

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
PIT-1411			A
SHEET	OF	DATE	
1	1	1-17-13	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project:	RLWTF							
TAG NO:	LLW-PIT-1411	Hookup Drawings:		Loop Wiring Diagrams:	E-6279			
		Spec No:	40 9100	Line / Vessel Number:	LLW-272-SS150			
Asset No:		P&ID:	D-6021	Line ID:	1.61"	Size:	1.5"	Schedule: N/A
Service Description:	RO Permeate From P-1407 to IXM Lag Filter FLT-1402			Manufacturer:	Yokogawa			
				Model:	EJA530AEBH#7N02EL/N4T06			
Safety Class:	NS			Quality Assurance Level	ML-4			

PROCESS CONDITIONS

	Hi Pressure Connection:					Low Pressure Connection					Units:
Fluid:	LLW RO Permeate					Fluid:	Atmosphere				
Fluid Density @ Operating Temp:	0.0361					Fluid Density@ Operating Temp:	N/A				lbm/in3
Viscosity @ Operating Temp:	N/A					Viscosity @ Operating Temp:	N/A				N/A
Pressure:						Pressure:					
Oper:	45	Design:	100	H2OTst:	150	Oper:	N/A	Design:	N/A	H2OTst: N/A	psig
Temperature:						Temperature:					
Min:	32	Normal:	75	Max:	125	Min:	N/A	Normal:	N/A	Max: N/A	F
% solids:	N/A	% Quality:	N/A			% solids:	N/A	% Quality:	N/A		
Service:	N/A	Critical:	N/A	Pulsating:	N/A	Service:	N/A	Critical:	N/A	Pulsating: N/A	
Area Classification:	N/A					Ambient Temperature Requireme	N/A				

ELEMENT

Type:	N/A		
Fill Fluid:	Silicone Oil		
Min Span:	14.5 psi	Max Span:	290 psi
Diaphragm/Wetted Material:	Hastelloy C276		
Vent/Drain Location:	N/A		
Vent/Drain Material:	N/A		
Process Connection:	1/2" NPT		

TRANSMITTER

Voltage:	24V dc				
Power Wiring:	Loop	Signal Type:	4-20mA		
Communication Protocc	HART	Location:	Local		
Smart:	Yes	Indicate:	Yes	Isolate:	N/A
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP	6	IP2:	7
Factory Calibration:	Yes				
Ambient Temperature Compensation:	+/- [0.15%span + 0.15%Max]				
Characteristic:	N/A	Calibrated Range:	0-75 psig		
Over Range:	580 psig	Zero Elevation:	N/A		
Accuracy:	+/-0.2% span	Gasket Material:	BUNA		
Conduit Connection:	1/2" NPT	NACE:	N/A		
Element Connection:	none	SS Tag:	Yes		
Body Max Pressure Rating:	580 psig				
Body/Flange Material:	Cast Aluminum				
Mounting:	Direct Mount				

SEAL DIAPHRAM & CAPILLARY

Length:	N/A	ID:	N/A		
Armor:	N/A				
Fill Fluid:	N/A	Max Response Time:	N/A		
SG @ 60 °F:	N/A	Capilary Material:	N/A		
Diaphragm:	Hi Press:		Low Press:		
Size & Type:	N/A		N/A		
Thickness:	N/A		N/A		
Material:	N/A		N/A		
Flush Ring:	N/A		N/A		
Temperature Rating:	N/A				
Max Temperature:	N/A				
Pressure Rating:	N/A				
Max Pressure:	N/A				
Manufacturer:	N/A				
Model:	N/A				

MANIFOLD

Type:	N/A		
Material:	N/A		
Transmitter Connection:	N/A		
Process Connection:	N/A		
Manufacturer:	N/A		
Model:	N/A		

NOTES

EJA530A - Guage Pressure Transmitter
E - 4-20 mA DC with Hart protocol
B - 14.5 - 290 psi
H# - Hastelloy C276 or ASTM N10 276 for process connection and diaphragm
7 - 1/2" NPT male
N - Always N
0 - Always 0
2 - 1/2" NPT Female, 2 electrical connections without blind plug
E - Digital indicator with range setting switch
L - SUS316 2" Pipe mounting bracket
N4 - Wired stainless steel tag plate
T06 - Pressure leak test 2 MPa (20Kgf/cm2)

16-Nov-12

AECOM

Pressure Instrument

Differential Pressure Line to Atmosphere

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
PIT-1422			A
SHEET	OF	DATE	
1	1	1-17-13	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project:	RLWTF								
TAG NO:	LLW-PIT-1422	Hookup Drawings:		Loop Wiring Diagrams:	E-6285				
		Spec No	40 9100	Line / Vessel Number:	LLW-276-SS150				
Asset No:		P&ID:	D-6022	Line ID:	1.61"	Size:	1.5"	Schedule:	N/A
Service Description:	RO Permeate From P-1407 to IXM Filter FLT-1403			Manufacturer:	Yokogawa				
				Model:	EJA530AEBH#7N02EL/N4T06				
Safety Class:	NS			Quality Assurance Level	ML-4				

PROCESS CONDITIONS

	Hi Pressure Connection:					Low Pressure Connection					Units:
Fluid:	LLW RO Permeate					Fluid:	Atmosphere				
Fluid Density @ Operating Temp:	0.0361					Fluid Density@ Operating Temp:	N/A				lbm/in3
Viscosity @ Operating Temp:	N/A					Viscosity @ Operating Temp:	N/A				N/A
Pressure:						Pressure:					
Oper:	45	Design:	100	H2OTst:	150	Oper:	N/A	Design:	N/A	H2OTst:	N/A	psig
Temperature:						Temperature:					
Min:	32	Normal:	75	Max:	125	Min:	N/A	Normal:	N/A	Max:	N/A	F
% solids	N/A	% Quality:	N/A			% solids:	N/A	% Quality:	N/A		
Service:	N/A	Critical:	N/A	Pulsating:	N/A	Service:	N/A	Critical:	N/A	Pulsating:	N/A	
Area Classification:	N/A					Ambient Temperature Requireme	N/A				

ELEMENT

Type:	N/A		
Fill Fluid:	Silicone Oil		
Min Span:	14.5 psi	Max Span:	290 psi
Diaphragm/Wetted Material:	Hastelloy C276		
Vent/Drain Location:	N/A		
Vent/Drain Material:	N/A		
Process Connection:	1/2" NPT		

TRANSMITTER

Voltage:	24V dc				
Power Wiring:	Loop	Signal Type:	4-20mA		
Communication Protocc	HART	Location:	Local		
Smart:	Yes	Indicate:	Yes	Isolate:	N/A
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP	6	IP2:	7
Factory Calibration:	Yes				
Ambient Temperature Compensation:	+/- [0.15%span + 0.15%Max]				
Characteristic:	N/A	Calibrated Range:	0-75 psig		
Over Range:	580 psig	Zero Elevation:	N/A		
Accuracy:	+/-0.2% span	Gasket Material:	BUNA		
Conduit Connection:	1/2" NPT	NACE:	N/A		
Element Connection:	none	SS Tag:	Yes		
Body Max Pressure Rating:	580 psig				
Body/Flange Material:	Cast Aluminum				
Mounting:	Direct Mount				

SEAL DIAPHRAM & CAPILLARY

Length:	N/A	ID:	N/A	
Armor:	N/A			
Fill Fluid:	N/A	Max Response Time:	N/A	
SG @ 60 °F:	N/A	Capilary Material:	N/A	
Diaphragm:	Hi Press:		Low Press:	
Size & Type:	N/A		N/A	
Thickness:	N/A		N/A	
Material:	N/A		N/A	
Flush Ring:	N/A		N/A	
Temperature Rating:	N/A			
Max Temperature:	N/A			
Pressure Rating:	N/A			
Max Pressure:	N/A			
Manufacturer:	N/A			
Model:	N/A			

MANIFOLD

Type:	N/A
Material:	N/A
Transmitter Connection:	N/A
Process Connection:	N/A
Manufacturer:	N/A
Model:	N/A

NOTES

EJA530A - Guage Pressure Transmitter
E - 4-20 mA DC with Hart protocol
B - 14.5 - 290 psi
H# - Hastelloy C276 or ASTM N10 276 for process connection and diaphragm
7 - 1/2" NPT male
N - Always N
0 - Always 0
2 - 1/2" NPT Female, 2 electrical connections without blind plug
E - Digital indicator with range setting switch
L - SUS316 2" Pipe mounting bracket
N4 - Wired stainless steel tag plate
T06 - Pressure leak test 2 MPa (20Kgf/cm2)

16-Nov-12

AECOM

Pressure Instrument

Differential Pressure Line to Atmosphere

DATA SHEET NO.			REV.
PIT-1423			A
SHEET	OF	DATE	
1	1	1-17-13	

NO.	BY	DATE	REVISION

BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project:	RLWTF			Loop Wiring Diagrams:	E-6286				
TAG NO:	LLW-PIT-1423	Hookup Drawings:		Line / Vessel Number:	LLW-282-SS150				
		Spec No:	40 9100						
Asset No:		P&ID:	D-6022	Line ID:	1.61"	Size:	1.5"	Schedule:	N/A
Service Description:	RO Permeate From P-1407 to IXM Filter FLT-1404			Manufacturer:	Yokogawa				
				Model:	EJA530AEBH#7N02EL/N4T06				
Safety Class:	NS			Quality Assurance Level	ML-4				

PROCESS CONDITIONS

Hi Pressure Connection:						Low Pressure Connection						Units:
Fluid:	LLW RO Permeate					Fluid:	Atmosphere					
Fluid Density @ Operating Temp:	0.0361					Fluid Density@ Operating Temp:	N/A					lbm/in3
Viscosity @ Operating Temp:	N/A					Viscosity @ Operating Temp:	N/A					N/A
Pressure:						Pressure:						
Oper:	45	Design:	100	H2OTst:	150	Oper:	N/A	Design:	N/A	H2OTst:	N/A	psig
Temperature:						Temperature:						
Min:	32	Normal:	75	Max:	125	Min:	N/A	Normal:	N/A	Max:	N/A	F
% solids	N/A	% Quality:	N/A			% solids:	N/A	% Quality:	N/A			
Service:	N/A	Critical:	N/A	Pulsating:	N/A	Service:	N/A	Critical:	N/A	Pulsating:	N/A	
Area Classification:	N/A					Ambient Temperature Requireme	N/A					

ELEMENT

Type:	N/A		
Fill Fluid:	Silicone Oil		
Min Span:	14.5 psi	Max Span:	290 psi
Diaphragm/Wetted Material:	Hastelloy C276		
Vent/Drain Location:	N/A		
Vent/Drain Material:	N/A		
Process Connection:	1/2" NPT		

TRANSMITTER

Voltage:	24V dc				
Power Wiring:	Loop	Signal Type:	4-20mA		
Communication Protocc	HART	Location:	Local		
Smart:	Yes	Indicate:	Yes	Isolate:	N/A
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP	6	IP2:	7
Factory Calibration:	Yes				
Ambient Temperature Compensation:	+/- [0.15%span + 0.15%Max]				
Characteristic:	N/A	Calibrated Range:	0-75 psig		
Over Range:	580 psig	Zero Elevation:	N/A		
Accuracy:	+/-0.2% span	Gasket Material:	BUNA		
Conduit Connection:	1/2" NPT	NACE:	N/A		
Element Connection:	none	SS Tag:	Yes		
Body Max Pressure Rating:	580 psig				
Body/Flange Material:	Cast Aluminum				
Mounting:	Direct Mount				

SEAL DIAPHRAM & CAPILLARY

Length:	N/A	ID:	N/A		
Armor:	N/A				
Fill Fluid:	N/A	Max Response Time:	N/A		
SG @ 60 °F:	N/A	Capilary Material:	N/A		
Diaphragm:	Hi Press:		Low Press:		
Size & Type:	N/A		N/A		
Thickness:	N/A		N/A		
Material:	N/A		N/A		
Flush Ring:	N/A		N/A		
Temperature Rating:	N/A				
Max Temperature:	N/A				
Pressure Rating:	N/A				
Max Pressure:	N/A				
Manufacturer:	N/A				
Model:	N/A				

MANIFOLD

Type:	N/A		
Material:	N/A		
Transmitter Connection	N/A		
Process Connection:	N/A		
Manufacturer:	N/A		
Model:	N/A		

NOTES

EJA530A - Guage Pressure Transmitter
E - 4-20 mA DC with Hart protocol
B - 14.5 - 290 psi
H# - Hastelloy C276 or ASTM N10 276 for process connection and diaphragm
7 - 1/2" NPT male
N - Always N
0 - Always 0
2 - 1/2" NPT Female, 2 electrical connections without blind plug
E - Digital indicator with range setting switch
L - SUS316 2" Pipe mounting bracket
N4 - Wired stainless steel tag plate
T06 - Pressure leak test 2 MPa (20Kgf/cm2)

16-Nov-12

AECOM

Pressure Instrument

Differential Pressure Line to Atmosphere

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
PIT-1437			A
SHEET	OF	DATE	
1	1	1-17-13	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project:	RLWTF							
TAG NO:	LLW-PIT-1437	Hookup Drawings:		Loop Wiring Diagrams:	E-6287			
		Spec No:	40 9100	Line / Vessel Number:	LLW-282-SS150			
Asset No:		P&ID:	D-6022	Line ID:	1.61"	Size:	1.5"	Schedule: N/A
Service Description:	RO Permeate From P-1407 to IXM Filter FLT-1405			Manufacturer:	Yokogawa			
				Model:	EJA530AEBH#7N02EL/N4T06			
Safety Class:	NS			Quality Assurance Level	ML-4			

PROCESS CONDITIONS

	Hi Pressure Connection:					Low Pressure Connection					Units:
Fluid:	LLW RO Permeate					Fluid:	Atmosphere				
Fluid Density @ Operating Temp:	0.0361					Fluid Density@ Operating Temp:	N/A				lbm/in3
Viscosity @ Operating Temp:	N/A					Viscosity @ Operating Temp:	N/A				N/A
Pressure:						Pressure:					
Oper:	45	Design:	100	H2OTst:	150	Oper:	N/A	Design:	N/A	H2OTst: N/A	psig
Temperature:						Temperature:					
Min:	32	Normal:	75	Max:	125	Min:	N/A	Normal:	N/A	Max: N/A	F
% solids:	N/A	% Quality:	N/A			% solids:	N/A	% Quality:	N/A		
Service:	N/A	Critical:	N/A	Pulsating:	N/A	Service:	N/A	Critical:	N/A	Pulsating: N/A	
Area Classification:	N/A					Ambient Temperature Requireme	N/A				

ELEMENT

Type:	N/A		
Fill Fluid:	Silicone Oil		
Min Span:	14.5 psi	Max Span:	290 psi
Diaphragm/Wetted Material:	Hastelloy C276		
Vent/Drain Location:	N/A		
Vent/Drain Material:	N/A		
Process Connection:	1/2" NPT		

TRANSMITTER

Voltage:	24V dc				
Power Wiring:	Loop	Signal Type:	4-20mA		
Communication Protoc	HART	Location:	Local		
Smart:	Yes	Indicate:	Yes	Isolate:	N/A
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP	6	IP2:	7
Factory Calibration:	Yes				
Ambient Temperature Compensation:	+/- [0.15%span + 0.15%Max]				
Characteristic:	N/A	Calibrated Range:	0-75 psig		
Over Range:	580 psig	Zero Elevation:	N/A		
Accuracy:	+/-0.2% span	Gasket Material:	BUNA		
Conduit Connection:	1/2" NPT	NACE:	N/A		
Element Connection:	none	SS Tag:	Yes		
Body Max Pressure Rating:	580 psig				
Body/Flange Material:	Cast Aluminum				
Mounting:	Direct Mount				

SEAL DIAPHRAM & CAPILLARY

Length:	N/A	ID:	N/A
Armor:	N/A		
Fill Fluid:	N/A	Max Response Time:	N/A
SG @ 60 °F:	N/A	Capillary Material:	N/A

Diaphragm:	Hi Press:	Low Press:
Size & Type:	N/A	N/A
Thickness:	N/A	N/A
Material:	N/A	N/A
Flush Ring:	N/A	N/A
Temperature Rating:	N/A	
Max Temperature:	N/A	
Pressure Rating:	N/A	
Max Pressure:	N/A	
Manufacturer:	N/A	
Model:	N/A	

MANIFOLD

Type:	N/A
Material:	N/A
Transmitter Connection:	N/A
Process Connection:	N/A
Manufacturer:	N/A
Model:	N/A

NOTES

EJA530A - Guage Pressure Transmitter
E - 4-20 mA DC with Hart protocol
B - 14.5 - 290 psi
H# - Hastelloy C276 or ASTM N10 276 for process connection and diaphragm
7 - 1/2" NPT male
N - Always N
0 - Always 0
2 - 1/2" NPT Female, 2 electrical connections without blind plug
E - Digital indicator with range setting switch
L - SUS316 2" Pipe mounting bracket
N4 - Wired stainless steel tag plate
T06 - Pressure leak test 2 MPa (20Kgf/cm2)

18-Nov-12

AECOM

Pressure Instrument

Differential Pressure Line to Atmosphere

NO.	BY	DATE	REVISION

DATA SHEET NO.		REV.
PIT-1445		A
SHEET	OF	DATE
1	1	1-17-13
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project:	RLWTF							
TAG NO:	LLW-PIT-1445	Hookup Drawings:		Loop Wiring Diagrams:	E-6288			
		Spec No:	40 9100	Line / Vessel Number:	LLW-282-SS150			
Asset No:		P&ID:	D-6022	Line ID:	1.61"	Size:	1.5"	Schedule: N/A
Service Description:	RO Permeate From P-1407 to IXM Filter FLT-1405			Manufacturer:	Yokogawa			
				Model:	EJA530AEBH#7N02EL/N4T06			
Safety Class:	NS			Quality Assurance Level	ML-4			

PROCESS CONDITIONS

	Hi Pressure Connection:					Low Pressure Connection					Units:
Fluid:	LLW RO Permeate					Fluid:	Atmosphere				
Fluid Density @ Operating Temp:	0.0361					Fluid Density@ Operating Temp:	N/A				lbm/in3
Viscosity @ Operating Temp:	N/A					Viscosity @ Operating Temp:	N/A				N/A
Pressure:						Pressure:					
Oper:	45	Design:	100	H2OTst:	150	Oper:	N/A	Design:	N/A	H2OTst: N/A	psig
Temperature:						Temperature:					
Min:	32	Normal:	75	Max:	125	Min:	N/A	Normal:	N/A	Max: N/A	F
% solids:	N/A	% Quality:	N/A			% solids:	N/A	% Quality:	N/A		
Service:	N/A	Critical:	N/A	Pulsating:	N/A	Service:	N/A	Critical:	N/A	Pulsating: N/A	
Area Classification:	N/A					Ambient Temperature Requireme	N/A				

ELEMENT

Type:	N/A		
Fill Fluid:	Silicone Oil		
Min Span:	14.5 psi	Max Span:	290 psi
Diaphragm/Wetted Material:	Hastelloy C276		
Vent/Drain Location:	N/A		
Vent/Drain Material:	N/A		
Process Connection:	1/2" NPT		

TRANSMITTER

Voltage:	24V dc				
Power Wiring:	Loop	Signal Type:	4-20mA		
Communication Protocc	HART	Location:	Local		
Smart:	Yes	Indicate:	Yes	Isolate:	N/A
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP	6	IP2:	7
Factory Calibration:	Yes				
Ambient Temperature Compensation:	+/- [0.15%span + 0.15%Max]				
Characteristic:	N/A	Calibrated Range:	0-75 psig		
Over Range:	580 psig	Zero Elevation:	N/A		
Accuracy:	+/-0.2% span	Gasket Material:	BUNA		
Conduit Connection:	1/2" NPT	NACE:	N/A		
Element Connection:	none	SS Tag:	Yes		
Body Max Pressure Rating:	580 psig				
Body/Flange Material:	Cast Aluminum				
Mounting:	Direct Mount				

SEAL DIAPHRAM & CAPILLARY

Length:	N/A	ID:	N/A		
Armor:	N/A				
Fill Fluid	N/A	Max Response Time:	N/A		
SG @ 60 °F:	N/A	Capilary Material:	N/A		
Diaphragm:	Hi Press:		Low Press:		
Size & Type:	N/A		N/A		
Thickness:	N/A		N/A		
Material:	N/A		N/A		
Flush Ring:	N/A		N/A		
Temperature Rating:	N/A				
Max Temperature:	N/A				
Pressure Rating:	N/A				
Max Pressure:	N/A				
Manufacturer:	N/A				
Model:	N/A				

MANIFOLD

Type:	N/A				
Material:	N/A				
Transmitter Connection:	N/A				
Process Connection:	N/A				
Manufacturer:	N/A				
Model:	N/A				

NOTES

EJA530A - Guage Pressure Transmitter
E - 4-20 mA DC with Hart protocol
B - 14.5 - 290 psi
H# - Hastelloy C276 or ASTM N10 276 for process connection and diaphragm
7 - 1/2" NPT male
N - Always N
0 - Always 0
2 - 1/2" NPT Female, 2 electrical connections without blind plug
E - Digital indicator with range setting switch
L - SUS316 2" Pipe mounting bracket
N4 - Wired stainless steel tag plate
T06 - Pressure leak test 2 MPa (20Kgf/cm2)

16-Nov-12

AECOM

Pressure Instrument

Differential Pressure Line to Atmosphere

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
PIT-1516			A
SHEET	OF	DATE	
1	1	1-17-13	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project:	RLWTF								
TAG NO:	LLW-PIT-1516	Hookup Drawings:		Loop Wiring Diagrams:	E-6177				
		Spec No:	40 9100	Line / Vessel Number:	LLW-291-SS150				
Asset No:		P&ID:	D-6411	Line ID:	3.07"	Size:	3"	Schedule:	N/A
Service Description:	Treated Influent Inlet To P-1503			Manufacturer:	Yokogawa				
				Model:	EJA530AEAH#7N02EL/N4T06				
Safety Class:	NS			Quality Assurance Level	ML-4				

PROCESS CONDITIONS

Hi Pressure Connection:						Low Pressure Connection						Units:
Fluid:	Treated Influent					Fluid:	Atmosphere					
Fluid Density @ Operating Temp:	0 0361					Fluid Density@ Operating Temp:	N/A					lbm/in3
Viscosity @ Operating Temp:	N/A					Viscosity @ Operating Temp:	N/A					N/A
Pressure:						Pressure:						
Oper:	45	Design:	100	H2OTst:	150	Oper:	N/A	Design:	N/A	H2OTst:	N/A	psig
Temperature:						Temperature:						
Min:	32	Normal:	75	Max:	125	Min:	N/A	Normal:	N/A	Max:	N/A	F
% solids:	N/A	% Quality:	N/A			% solids:	N/A	% Quality:	N/A			
Service:	N/A	Critical:	N/A	Pulsating:	N/A	Service:	N/A	Critical:	N/A	Pulsating:	N/A	
Area Classification:	N/A					Ambient Temperature Requiremer	N/A					

ELEMENT

Type:	N/A
Fill Fluid:	Silicone Oil
Min Span:	1.45 psi
Max Span:	29 psi
Diaphragm/Wetted Material:	Hastelloy C276
Vent/Drain Location:	N/A
Vent/Drain Material:	N/A
Process Connection:	1/2" NPT

TRANSMITTER

Voltage:	24V dc				
Power Wiring:	Loop	Signal Type:	4-20mA		
Communication Protoc	HART	Location:	Local		
Smart:	Yes	Indicate:	Yes	Isolate:	N/A
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP	6	IP2:	7
Factory Calibration:	Yes				
Ambient Temperature Compensation:	+/- [0.15%span + 0.15%Max]				
Characteristic:	N/A	Calibrated Range:	0-75 psig		
Over Range:	580 psig	Zero Elevation:	N/A		
Accuracy:	+/-0.2% span	Gasket Material:	BUNA		
Conduit Connection:	1/2" NPT	NACE:	N/A		
Element Connection:	none	SS Tag:	Yes		
Body Max Pressure Rating:	580 psig				
Body/Flange Material:	Cast Aluminum				
Mounting:	Direct Mount				

SEAL DIAPHRAM & CAPILLARY

Length:	N/A	ID:	N/A	
Armor:	N/A			
Fill Fluid:	N/A	Max Response Time:	N/A	
SG @ 60 °F:	N/A	Capilary Material:	N/A	
Diaphragm:	Hi Press:		Low Press:	
Size & Type:	N/A		N/A	
Thickness:	N/A		N/A	
Material:	N/A		N/A	
Flush Ring:	N/A		N/A	
Temperature Rating:	N/A			
Max Temperature:	N/A			
Pressure Rating:	N/A			
Max Pressure:	N/A			
Manufacturer:	N/A			
Model:	N/A			

MANIFOLD

Type:	N/A
Material:	N/A
Transmitter Connection:	N/A
Process Connection:	N/A
Manufacturer:	N/A
Model:	N/A

NOTES

EJA530A - Guage Pressure Transmitter
E - 4-20 mA DC with Hart protocol
A - 1.45 - 29 psi
H# - Hastelloy C276 or ASTM N10 276 for process connection and diaphragm
7 - 1/2" NPT male
N - Always N
0 - Always 0
2 - 1/2" NPT Female, 2 electrical connections without blind plug
E - Digital indicator with range setting switch
L - SUS316 2" Pipe mounting bracket
N4 - Wired stainless steel tag plate
T06 - Pressure leak test 2 MPa (20Kgf/cm2)

18-Nov-12

AECOM

Pressure Instrument

Differential Pressure Line to Atmosphere

NO	BY	DATE	REVISION

DATA SHEET NO.			REV.
PIT-1517			A
SHEET	OF	DATE	
1	1	1-17-13	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project:	RLWTF								
TAG NO:	LLW-PIT-1517	Hookup Drawings:		Loop Wiring Diagrams:	E-6391				
		Spec No:	40 9100	Line / Vessel Number:	LLW-303-SS150				
Asset No:		P&ID:	D-6411	Line ID:	3.07"	Size:	3"	Schedule:	N/A
Service Description:	Treated Effluent Inlet From P-1503 (Outlet)			Manufacturer:	Yokogawa				
				Model:	EJA530AEBH#7N02EL/N4T06				
Safety Class:	NS			Quality Assurance Level	ML-4				

PROCESS CONDITIONS

	Hi Pressure Connection:					Low Pressure Connection					Units:
Fluid:	Treated Effluent					Fluid:	Atmosphere				
Fluid Density @ Operating Temp:	0.0361					Fluid Density@ Operating Temp:	N/A				lbm/in3
Viscosity @ Operating Temp:	N/A					Viscosity @ Operating Temp:	N/A				N/A
Pressure:						Pressure:					
Oper:	45	Design:	100	H2OTst:	150	Oper:	N/A	Design:	N/A	H2OTst:	N/A	psig
Temperature:						Temperature:					
Min:	32	Normal:	75	Max:	125	Min:	N/A	Normal:	N/A	Max:	N/A	F
% solids:	N/A	% Quality:	N/A			% solids:	N/A	% Quality:	N/A		
Service:	N/A	Critical:	N/A	Pulsating:	N/A	Service:	N/A	Critical:	N/A	Pulsating:	N/A
Area Classification:	N/A					Ambient Temperature Requireme	N/A				

ELEMENT

Type:	N/A		
Fill Fluid:	Silicone Oil		
Min Span:	14.5 psi	Max Span:	290 psi
Diaphragm/Wetted Material:	Hastelloy C276		
Vent/Drain Location:	N/A		
Vent/Drain Material:	N/A		
Process Connection:	1/2" NPT		

TRANSMITTER

Voltage:	24V dc				
Power Wiring:	Loop	Signal Type:	4-20mA		
Communication Protocc	HART	Location:	Local		
Smart:	Yes	Indicate:	Yes	Isolate:	N/A
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP	6	IP2:	7
Factory Calibration:	Yes				
Ambient Temperature Compensation:	+/- [0.15%span + 0.15%Max]				
Characteristic:	N/A	Calibrated Range:	0-75 psig		
Over Range:	580 psig	Zero Elevation:	N/A		
Accuracy:	+/-0.2% span	Gasket Material:	BUNA		
Conduit Connection:	1/2" NPT	NACE:	N/A		
Element Connection:	none	SS Tag:	Yes		
Body Max Pressure Rating:	580 psig				
Body/Flange Material:	Cast Aluminum				
Mounting:	Direct Mount				

SEAL DIAPHRAM & CAPILLARY

Length:	N/A	ID:	N/A
Armor:	N/A		
Fill Fluid:	N/A	Max Response Time:	N/A
SG @ 60 °F:	N/A	Capilary Material:	N/A

Diaphragm:	Hi Press:	Low Press:
Size & Type:	N/A	N/A
Thickness:	N/A	N/A
Material:	N/A	N/A
Flush Ring:	N/A	N/A

Temperature Rating:	N/A
Max Temperature:	N/A
Pressure Rating:	N/A
Max Pressure:	N/A
Manufacturer:	N/A
Model:	N/A

MANIFOLD

Type:	N/A
Material:	N/A
Transmitter Connection	N/A
Process Connection:	N/A
Manufacturer:	N/A
Model:	N/A

NOTES

EJA530A - Guage Pressure Transmitter
E - 4-20 mA DC with Hart protocol
B - 14.5 - 290 psi
H# - Hastelloy C276 or ASTM N10 276 for process connection and diaphragm
7 - 1/2" NPT male
N - Always N
0 - Always 0
2 - 1/2" NPT Female, 2 electrical connections without blind plug
E - Digital indicator with range setting switch
L - SUS316 2" Pipe mounting bracket
N4 - Wired stainless steel tag plate
T06 - Pressure leak test 2 MPa (20Kgf/cm2)

18-Nov-12

AECOM

Pressure Instrument

Differential Pressure Line to Atmosphere

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
PIT-1703			A
SHEET	OF	DATE	
1	1	1-17-13	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project:	RLWTF								
TAG NO:	LLW-PIT-1703	Hookup Drawings:		Loop Wiring Diagrams:	E-6177				
		Spec No:	40 9100	Line / Vessel Number:	LLW-314-SS150				
Asset No:		P&ID:	D-6012	Line ID:	1.61"	Size:	1.5"	Schedule:	N/A
Service Description:	Reacted Influent Inlet To P-1701			Manufacturer:	Yokogawa				
				Model:	EJA530AEAH#7N02EL/N4T06				
Safety Class:	NS			Quality Assurance Level	ML-4				

PROCESS CONDITIONS

	Hi Pressure Connection:					Low Pressure Connection					Units:
Fluid:	Reacted Influent					Fluid:	Atmosphere				
Fluid Density @ Operating Temp:	0.0361					Fluid Density@ Operating Temp:	N/A				lbm/in3
Viscosity @ Operating Temp:	N/A					Viscosity @ Operating Temp:	N/A				N/A
Pressure:						Pressure:					
Oper:	45	Design:	100	H2OTst:	150	Oper:	N/A	Design:	N/A	H2OTst:	N/A psig
Temperature:						Temperature:					
Min:	32	Normal:	75	Max:	125	Min:	N/A	Normal:	N/A	Max:	N/A F
% solids:	N/A	% Quality:	N/A			% solids:	N/A	% Quality:	N/A		
Service:	N/A	Critical:	N/A	Pulsating:	N/A	Service:	N/A	Critical:	N/A	Pulsating:	N/A
Area Classification:	N/A					Ambient Temperature Requirement:	N/A				

ELEMENT

Type:	N/A		
Fill Fluid:	Silicone Oil		
Min Span:	1.45 psi	Max Span:	29 psi
Diaphragm/Wetted Material:	Hastelloy C276		
Vent/Drain Location:	N/A		
Vent/Drain Material:	N/A		
Process Connection:	1/2" NPT		

TRANSMITTER

Voltage:	24V dc				
Power Wiring:	Loop	Signal Type:	4-20mA		
Communication Protocol:	HART	Location:	Local		
Smart:	Yes	Indicate:	Yes	Isolate:	N/A
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP:	6	IP2:	7
Factory Calibration:	Yes				
Ambient Temperature Compensation:	+/- [0.15%span + 0.15%Max]				
Characteristic:	N/A	Calibrated Range:	0-75 psig		
Over Range:	580 psig	Zero Elevation:	N/A		
Accuracy:	+/-0.2% span	Gasket Material:	BUNA		
Conduit Connection:	1/2" NPT	NACE:	N/A		
Element Connection:	none	SS Tag:	Yes		
Body Max Pressure Rating:	580 psig				
Body/Flange Material:	Cast Aluminum				
Mounting:	Direct Mount				

SEAL DIAPHRAM & CAPILLARY

Length:	N/A	ID:	N/A		
Armor:	N/A				
Fill Fluid:	N/A	Max Response Time:	N/A		
SG @ 60 °F:	N/A	Capilary Material:	N/A		
Diaphragm:	Hi Press:		Low Press:		
Size & Type:	N/A		N/A		
Thickness:	N/A		N/A		
Material:	N/A		N/A		
Flush Ring:	N/A		N/A		
Temperature Rating:	N/A				
Max Temperature:	N/A				
Pressure Rating:	N/A				
Max Pressure:	N/A				
Manufacturer:	N/A				
Model:	N/A				

MANIFOLD

Type:	N/A				
Material:	N/A				
Transmitter Connection:	N/A				
Process Connection:	N/A				
Manufacturer:	N/A				
Model:	N/A				

NOTES

EJA530A - Guage Pressure Transmitter
E - 4-20 mA DC with Hart protocol
A - 1.45 - 29 psi
H# - Hastelloy C276 or ASTM N10 276 for process connection and diaphragm
7 - 1/2" NPT male
N - Always N
0 - Always 0
2 - 1/2" NPT Female, 2 electrical connections without blind plug
E - Digital indicator with range setting switch
L - SUS316 2" Pipe mounting bracket
N4 - Wired stainless steel tag plate
T06 - Pressure leak test 2 MPa (20Kgf/cm2)

16-Nov-12

AECOM

Pressure Instrument

Differential Pressure Line to Atmosphere

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
PIT-1704			A
SHEET	OF	DATE	
1	1	1-17-13	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project:	RLWTF								
TAG NO:	LLW-PIT-1704	Hookup Drawings:		Loop Wiring Diagrams:	E-6305				
		Spec No:	40 9100	Line / Vessel Number:	LLW-153-SS150				
Asset No:		P&ID:	D-6024	Line ID:	0.61"	Size:	0.5"	Schedule:	N/A
Service Description:	MicroFilter Sludge from P-1709 to Sludge Thickening Tank TK-1702			Manufacturer:	Yokogawa				
				Model:	EJA530AEBH#7N02EL/N4T06				
Safety Class:	NS			Quality Assurance Level	ML-4				

PROCESS CONDITIONS

	Hi Pressure Connection:					Low Pressure Connection					Units:
Fluid:	MicroFilter Sludge					Fluid:	Atmosphere				
Fluid Density @ Operating Temp:	0.0361					Fluid Density@ Operating Temp:	N/A				lbm/in3
Viscosity @ Operating Temp:	N/A					Viscosity @ Operating Temp:	N/A				N/A
Pressure:						Pressure:					
Oper:	45	Design:	100	H2OTst:	150	Oper:	N/A	Design:	N/A	H2OTst:	N/A	psig
Temperature:						Temperature:					
Min:	32	Normal:	75	Max:	125	Min:	N/A	Normal:	N/A	Max:	N/A	F
% solids:	N/A	% Quality:	N/A			% solids:	N/A	% Quality:	N/A		
Service:	N/A	Critical:	N/A	Pulsating:	N/A	Service:	N/A	Critical:	N/A	Pulsating:	N/A
Area Classification:	N/A					Ambient Temperature Requiremer	N/A				

ELEMENT

Type:	N/A		
Fill Fluid:	Silicone Oil		
Min Span:	14.5 psi	Max Span:	290 psi
Diaphragm/Wetted Material:	Hastelloy C276		
Vent/Drain Location:	N/A		
Vent/Drain Material:	N/A		
Process Connection:	1/2" NPT		

TRANSMITTER

Voltage:	24V dc				
Power Wiring:	Loop	Signal Type:	4-20mA		
Communication Protoc	HART	Location:	Local		
Smart:	Yes	Indicate:	Yes	Isolate:	N/A
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP	6	IP2:	7
Factory Calibration:	Yes				
Ambient Temperature Compensation:	+/- [0.15%span + 0.15%Max]				
Characteristic:	N/A	Calibrated Range:	0-75 psig		
Over Range:	580 psig	Zero Elevation:	N/A		
Accuracy:	+/-0.2% span	Gasket Material:	BUNA		
Conduit Connection:	1/2" NPT	NACE:	N/A		
Element Connection:	none	SS Tag:	Yes		
Body Max Pressure Rating:	580 psig				
Body/Flange Material:	Cast Aluminum				
Mounting:	Direct Mount				

SEAL DIAPHRAM & CAPILLARY

Length:	N/A	ID:	N/A		
Armor:	N/A				
Fill Fluid:	N/A	Max Response Time:	N/A		
SG @ 60 °F:	N/A	Capilary Material:	N/A		
Diaphragm:	Hi Press:		Low Press:		
Size & Type:	N/A		N/A		
Thickness:	N/A		N/A		
Material:	N/A		N/A		
Flush Ring:	N/A		N/A		
Temperature Rating:	N/A				
Max Temperature:	N/A				
Pressure Rating:	N/A				
Max Pressure:	N/A				
Manufacturer:	N/A				
Model:	N/A				

MANIFOLD

Type:	N/A		
Material:	N/A		
Transmitter Connection	N/A		
Process Connection:	N/A		
Manufacturer:	N/A		
Model:	N/A		

NOTES

EJA530A - Guage Pressure Transmitter
E - 4-20 mA DC with Hart protocol
B - 14.5 - 290 psi
H# - Hastelloy C276 or ASTM N10 276 for process connection and diaphragm
7 - 1/2" NPT male
N - Always N
0 - Always 0
2 - 1/2" NPT Female, 2 electrical connections without blind plug
E - Digital indicator with range setting switch
L - SUS316 2" Pipe mounting bracket
N4 - Wired stainless steel tag plate
T06 - Pressure leak test 2 MPa (20Kgf/cm2)

18-Nov-12

AECOM

Pressure Instrument

Differential Pressure Line to Atmosphere

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
PIT-1712			A
SHEET	OF	DATE	
1	1	1-17-13	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project:	RLWTF							
TAG NO:	LLW-PIT-1712	Hookup Drawings:		Loop Wiring Diagrams:	E-6318			
		Spec No	40 9100	Line / Vessel Number:	LLW-165-SS150			<-
Asset No:		P&ID:	D-6025	Line ID:	0.61"	Size:	0.5"	Schedule: N/A <-
Service Description:	Thickened Sludge from P-1702 to The Rotary Press			Manufacturer:	Yokogawa			<-
				Model:	EJA530AEBH#7N02EL/N4T06			<-
Safety Class:	NS			Quality Assurance Level	ML-4			<-

PROCESS CONDITIONS

Hi Pressure Connection:						Low Pressure Connection						Units:
Fluid:	Thickened Sludge					Fluid:	Atmosphere					
Fluid Density @ Operating Temp:	0.0361					Fluid Density@ Operating Temp:	N/A					lbm/in3
Viscosity @ Operating Temp:	N/A					Viscosity @ Operating Temp:	N/A					N/A
Pressure:						Pressure:						
Oper:	45	Design:	100	H2OTst:	150	Oper:	N/A	Design:	N/A	H2OTst:	N/A	psig
Temperature:						Temperature:						
Min:	32	Normal:	75	Max:	125	Min:	N/A	Normal:	N/A	Max:	N/A	F
% solids:	N/A	% Quality:	N/A			% solids	N/A	% Quality:	N/A			
Service:	N/A	Critical:	N/A	Pulsating:	N/A	Service:	N/A	Critical:	N/A	Pulsating:	N/A	
Area Classification:	N/A					Ambient Temperature Requireme	N/A					

ELEMENT

Type:	N/A		
Fill Fluid:	Silicone Oil		
Min Span:	14.5 psi	Max Span:	290 psi
Diaphragm/Wetted Material:	Hastelloy C276		
Vent/Drain Location:	N/A		
Vent/Drain Material:	N/A		
Process Connection:	1/2" NPT		

TRANSMITTER

Voltage:	24V dc				
Power Wiring:	Loop	Signal Type:	4-20mA		
Communication Protocc	HART	Location:	Local		
Smart:	Yes	Indicate:	Yes	Isolate:	N/A
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP	6	IP2:	7
Factory Calibration:	Yes				
Ambient Temperature Compensation:	+/- [0.15%span + 0.15%Max]				
Characteristic:	N/A	Calibrated Range:	0-75 psig		
Over Range:	580 psig	Zero Elevation:	N/A		
Accuracy:	+/-0.2% span	Gasket Material:	BUNA		
Conduit Connection:	1/2" NPT	NACE:	N/A		
Element Connection:	none	SS Tag:	Yes		
Body Max Pressure Rating:	580 psig				
Body/Flange Material:	Cast Aluminum				
Mounting:	Direct Mount				

SEAL DIAPHRAM & CAPILLARY

Length:	N/A	ID:	N/A	
Armor:	N/A			
Fill Fluid:	N/A	Max Response Time:	N/A	
SG @ 60 °F:	N/A	Capilary Material:	N/A	
Diaphragm:	Hi Press:		Low Press:	
Size & Type:	N/A		N/A	
Thickness:	N/A		N/A	
Material:	N/A		N/A	
Flush Ring:	N/A		N/A	
Temperature Rating:	N/A			
Max Temperature:	N/A			
Pressure Rating:	N/A			
Max Pressure:	N/A			
Manufacturer:	N/A			
Model:	N/A			

MANIFOLD

Type:	N/A
Material:	N/A
Transmitter Connection:	N/A
Process Connection:	N/A
Manufacturer:	N/A
Model:	N/A

NOTES

EJA530A - Guage Pressure Transmitter
E - 4-20 mA DC with Hart protocol
B - 14.5 - 290 psi
H# - Hastelloy C276 or ASTM N10 276 for process connection and diaphragm
7 - 1/2" NPT male
N - Always N
0 - Always 0
2 - 1/2" NPT Female, 2 electrical connections without blind plug
E - Digital indicator with range setting switch
L - SUS316 2" Pipe mounting bracket
N4 - Wired stainless steel tag plate
T06 - Pressure leak test 2 MPa (20Kgf/cm2)

16-Nov-12

AECOM

Pressure Instrument

Differential Pressure Line to Atmosphere

NO.	BY	DATE	REVISION

DATA SHEET NO.		REV.
PIT-1715		A
SHEET	OF	DATE
1	1	1-17-13

BY	CHK'D	PROC.	APPR.
NCC	AME		

P.O.

REQ.

Project: RLWTF

TAG NO: LLW-PIT-1715

Hookup Drawings:

Spec No: 40 9100

P&ID: D-6025

Loop Wiring Diagrams: E-6319

Line / Vessel Number: LLW-018-SS150

Line ID: 0.62" Size: 0.5" Schedule: N/A

Asset No:

Service Description: Thickened Sludge Inlet To P-1702

Manufacturer: Yokogawa

Model: EJA530AEAH#7N02EL/N4T06

Safety Class: NS

Quality Assurance Level: ML-4

PROCESS CONDITIONS

	Hi Pressure Connection:	Low Pressure Connection	Units:
Fluid:	Thickened Sludge	Atmosphere	
Fluid Density @ Operating Temp:	0.0361	N/A	lbm/in3
Viscosity @ Operating Temp:	N/A	N/A	N/A
Pressure:			
Oper:	45	N/A	psig
Design:	100	N/A	
H2OTst:	150	N/A	
Temperature:			
Min:	32	N/A	F
Normal:	75	N/A	
Max:	125	N/A	
% solids:	N/A	N/A	
% Quality:	N/A	N/A	
Service:	N/A	N/A	
Critical:	N/A	N/A	
Pulsating:	N/A	N/A	
Area Classification:	N/A		
Ambient Temperature Requireme		N/A	

ELEMENT

Type:	N/A
Fill Fluid:	Silicone Oil
Min Span:	1.45 psi
Max Span:	29 psi
Diaphragm/Wetted Material:	Hastelloy C276
Vent/Drain Location:	N/A
Vent/Drain Material:	N/A
Process Connection:	1/2" NPT

TRANSMITTER

Voltage:	24V dc		
Power Wiring:	Loop	Signal Type:	4-20mA
Communication Protocc	HART	Location:	Local
Smart:	Yes	Indicate:	Yes
Isolate:	N/A		
Electrical Protection:	N/A	Temperature Category:	N/A
Gas Group:	N/A	Enclosure Protection IP	6
IP2:	7		
Factory Calibration:	Yes		
Ambient Temperature Compensation:	+/- [0.15%span + 0.15%Max]		
Characteristic:	N/A	Calibrated Range:	0-75 psig
Over Range:	580 psig	Zero Elevation:	N/A
Accuracy:	+/-0.2% span	Gasket Material:	BUNA
Conduit Connection:	1/2" NPT	NACE:	N/A
Element Connection:	none	SS Tag:	Yes
Body Max Pressure Rating:	580 psig		
Body/Flange Material:	Cast Aluminum		
Mounting:	Direct Mount		

SEAL DIAPHRAM & CAPILLARY

Length:	N/A	ID:	N/A
Armor:	N/A		
Fill Fluid:	N/A	Max Response Time:	N/A
SG @ 60 °F:	N/A	Capilary Material:	N/A

Diaphragm:	Hi Press:	Low Press:
Size & Type:	N/A	N/A
Thickness:	N/A	N/A
Material:	N/A	N/A
Flush Ring:	N/A	N/A

Temperature Rating:	N/A
Max Temperature:	N/A
Pressure Rating:	N/A
Max Pressure:	N/A
Manufacturer:	N/A
Model:	N/A

MANIFOLD

Type:	N/A
Material:	N/A
Transmitter Connection:	N/A
Process Connection:	N/A
Manufacturer:	N/A
Model:	N/A

NOTES

EJA530A - Guage Pressure Transmitter
E - 4-20 mA DC with Hart protocol
A - 1.45 - 29 psi
H# - Hastelloy C276 or ASTM N10 276 for process connection and diaphragm
7 - 1/2" NPT male
N - Always N
0 - Always 0
2 - 1/2" NPT Female, 2 electrical connections without blind plug
E - Digital indicator with range setting switch
L - SUS316 2" Pipe mounting bracket
N4 - Wired stainless steel tag plate
T06 - Pressure leak test 2 MPa (20Kgf/cm2)

16-Nov-12

AECOM

Pressure Instrument

Differential Pressure Line to Atmosphere

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
PIT-1720			A
SHEET	OF	DATE	
1	1	1-17-13	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project:	RLWTF								
TAG NO:	LLW-PIT-1720	Hookup Drawings:		Loop Wiring Diagrams:	E-6330				
		Spec No:	40 9100	Line / Vessel Number:	LLW-179-SS150				
Asset No:		P&ID:	D-6027	Line ID:	1.07"	Size:	1"	Schedule:	N/A
Service Description:	Thickener Decant from P-1703 to Recycle			Manufacturer:	Yokogawa				
				Model:	EJA530AEBH#7N02EL/N4T06				
Safety Class:	NS			Quality Assurance Level	ML-4				

PROCESS CONDITIONS

	Hi Pressure Connection:					Low Pressure Connection					Units:
Fluid:	Sludge Thickener Decant					Fluid:	Atmosphere				
Fluid Density @ Operating Temp:	0.0361					Fluid Density@ Operating Temp:	N/A				lbm/in3
Viscosity @ Operating Temp:	N/A					Viscosity @ Operating Temp:	N/A				N/A
Pressure:						Pressure:					
Oper:	45	Design:	100	H2OTst:	150	Oper:	N/A	Design:	N/A	H2OTst:	N/A	psig
Temperature:						Temperature:					
Min:	32	Normal:	75	Max:	125	Min:	N/A	Normal:	N/A	Max:	N/A	F
% solids:	N/A	% Quality:	N/A			% solids:	N/A	% Quality:	N/A		
Service:	N/A	Critical:	N/A	Pulsating:	N/A	Service:	N/A	Critical:	N/A	Pulsating:	N/A	
Area Classification:	N/A					Ambient Temperature Requireme	N/A				

ELEMENT

Type:	N/A		
Fill Fluid:	Silicone Oil		
Min Span:	14.5 psi	Max Span:	290 psi
Diaphragm/Wetted Material:	Hastelloy C276		
Vent/Drain Location:	N/A		
Vent/Drain Material:	N/A		
Process Connection:	1/2" NPT		

TRANSMITTER

Voltage:	24V dc				
Power Wiring:	Loop	Signal Type:	4-20mA		
Communication Protocc	HART	Location:	Local		
Smart:	Yes	Indicate:	Yes	Isolate:	N/A
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP	6	IP2:	7
Factory Calibration:	Yes				
Ambient Temperature Compensation:	+/- [0.15%span + 0.15%Max]				
Characteristic:	N/A	Calibrated Range:	0-75 psig		
Over Range:	580 psig	Zero Elevation:	N/A		
Accuracy:	+/-0.2% span	Gasket Material:	BUNA		
Conduit Connection:	1/2" NPT	NACE:	N/A		
Element Connection:	none	SS Tag:	Yes		
Body Max Pressure Rating:	580 psig				
Body/Flange Material:	Cast Aluminum				
Mounting:	Direct Mount				

SEAL DIAPHRAM & CAPILLARY

Length:	N/A	ID:	N/A
Armor:	N/A		
Fill Fluid:	N/A	Max Response Time:	N/A
SG @ 60 °F:	N/A	Capilary Material:	N/A

Diaphragm:	Hi Press:	Low Press:
Size & Type:	N/A	N/A
Thickness:	N/A	N/A
Material:	N/A	N/A
Flush Ring:	N/A	N/A

Temperature Rating:	N/A
Max Temperature:	N/A
Pressure Rating:	N/A
Max Pressure:	N/A
Manufacturer:	N/A
Model:	N/A

MANIFOLD

Type:	N/A
Material:	N/A
Transmitter Connection:	N/A
Process Connection:	N/A
Manufacturer:	N/A
Model:	N/A

NOTES

EJA530A - Guage Pressure Transmitter
E - 4-20 mA DC with Hart protocol
B - 14.5 - 290 psi
H# - Hastelloy C276 or ASTM N10 276 for process connection and diaphragm
7 - 1/2" NPT male
N - Always N
0 - Always 0
2 - 1/2" NPT Female, 2 electrical connections without blind plug
E - Digital indicator with range setting switch
L - SUS316 2" Pipe mounting bracket
N4 - Wired stainless steel tag plate
T06 - Pressure leak test 2 MPa (20Kgf/cm2)

16-Nov-12

AECOM

Pressure Instrument

Differential Pressure Line to Atmosphere

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
PIT-1725			A
SHEET	OF	DATE	
1	1	1-17-13	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project:	RLWTF							
TAG NO:	LLW-PIT-1725	Hookup Drawings:		Loop Wiring Diagrams:	E-6342			
		Spec No:	40 9100	Line / Vessel Number:	LLW-191-SS150			
Asset No:		P&ID:	D-6028	Line ID:	0.62"	Size:	0.5"	Schedule: N/A
Service Description:	LLW Evaporator Feed from TK-1705 to the Evaporators			Manufacturer:	Yokogawa			
				Model:	EJA530AEBH#7N02EL/N4T06			
Safety Class:	NS			Quality Assurance Level	ML-4			

PROCESS CONDITIONS

	Hi Pressure Connection:					Low Pressure Connection					Units:
Fluid:	Evaporator Feed					Fluid:	Atmosphere				
Fluid Density @ Operating Temp:	0.0361					Fluid Density@ Operating Temp:	N/A				lbm/in3
Viscosity @ Operating Temp:	N/A					Viscosity @ Operating Temp:	N/A				N/A
Pressure:						Pressure:					
Oper:	45	Design:	100	H2OTst:	150	Oper:	N/A	Design:	N/A	H2OTst: N/A	psig
Temperature:						Temperature:					
Min:	32	Normal:	75	Max:	125	Min:	N/A	Normal:	N/A	Max: N/A	F
% solids:	N/A	% Quality:	N/A			% solids:	N/A	% Quality:	N/A		
Service:	N/A	Critical:	N/A	Pulsating:	N/A	Service:	N/A	Critical:	N/A	Pulsating: N/A	
Area Classification:	N/A					Ambient Temperature Requirem	N/A				

ELEMENT

Type:	N/A		
Fill Fluid:	Silicone Oil		
Min Span:	14.5 psi	Max Span:	290 psi
Diaphragm/Wetted Material:	Hastelloy C276		
Vent/Drain Location:	N/A		
Vent/Drain Material:	N/A		
Process Connection:	1/2" NPT		

TRANSMITTER

Voltage:	24V dc				
Power Wiring:	Loop	Signal Type:	4-20mA		
Communication Protocc	HART	Location:	Local		
Smart:	Yes	Indicate:	Yes	Isolate:	N/A
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP	6	IP2:	7
Factory Calibration:	Yes				
Ambient Temperature Compensation:	+/- [0.15%span + 0.15%Max]				
Characteristic:	N/A	Calibrated Range:	0-75 psig		
Over Range:	580 psig	Zero Elevation:	N/A		
Accuracy:	+/-0.2% span	Gasket Material:	BUNA		
Conduit Connection:	1/2" NPT	NACE:	N/A		
Element Connection:	none	SS Tag:	Yes		
Body Max Pressure Rating:	580 psig				
Body/Flange Material:	Cast Aluminum				
Mounting:	Direct Mount				

SEAL DIAPHRAM & CAPILLARY

Length:	N/A	ID:	N/A
Armor:	N/A		
Fill Fluid:	N/A	Max Response Time:	N/A
SG @ 60 °F:	N/A	Capilary Material:	N/A
Diaphragm:	Hi Press:		Low Press:
Size & Type:	N/A		N/A
Thickness:	N/A		N/A
Material:	N/A		N/A
Flush Ring:	N/A		N/A
Temperature Rating:	N/A		
Max Temperature:	N/A		
Pressure Rating:	N/A		
Max Pressure:	N/A		
Manufacturer:	N/A		
Model:	N/A		

MANIFOLD

Type:	N/A
Material:	N/A
Transmitter Connection:	N/A
Process Connection:	N/A
Manufacturer:	N/A
Model:	N/A

NOTES

EJA530A - Guage Pressure Transmitter
E - 4-20 mA DC with Hart protocol
B - 14.5 - 290 psi
H# - Hastelloy C276 or ASTM N10 276 for process connection and diaphragm
7 - 1/2" NPT male
N - Always N
0 - Always 0
2 - 1/2" NPT Female, 2 electrical connections without blind plug
E - Digital indicator with range setting switch
L - SUS316 2" Pipe mounting bracket
N4 - Wired stainless steel tag plate
T06 - Pressure leak test 2 MPa (20Kgf/cm2)

16-Nov-12

AECOM

Pressure Instrument

Differential Pressure Line to Atmosphere

DATA SHEET NO.	REV.
PIT-1725	A

NO.	BY	DATE	REVISION

SHEET	OF	DATE
1	1	1-17-13

BY	CHK'D	PROC.	APPR.
NCC	AME		

P.O.

REQ.

Project:	RLWTF								
TAG NO:	LLW-PIT-1732	Hookup Drawings:		Loop Wiring Diagrams:	E-6367				
		Spec No	40 9100	Line / Vessel Number:	LLW-397-SS150				
Asset No:		P&ID:	D-6030	Line ID:	1.07"	Size:	1"	Schedule:	N/A
Service Description:	LLW Evaporator Condensate from TK-1706			Manufacturer:	Yokogawa				
				Model:	EJA530AEBH#7N02EL/N4T06				
Safety Class:	NS			Quality Assurance Level	ML-4				

PROCESS CONDITIONS

	Hi Pressure Connection:					Low Pressure Connection					Units:
Fluid:	Evaporator Condensate					Fluid:	Atmosphere				
Fluid Density @ Operating Temp:	0.0361					Fluid Density@ Operating Temp:	N/A				lbm/in3
Viscosity @ Operating Temp:	N/A					Viscosity @ Operating Temp:	N/A				N/A
Pressure:						Pressure:					
Oper:	45	Design:	100	H2OTst:	150	Oper:	N/A	Design:	N/A	H2OTst:	N/A	psig
Temperature:						Temperature:					
Min:	32	Normal:	75	Max:	125	Min:	N/A	Normal:	N/A	Max:	N/A	F
% solids:	N/A	% Quality:	N/A			% solids:	N/A	% Quality:	N/A		
Service:	N/A	Critical:	N/A	Pulsating:	N/A	Service:	N/A	Critical:	N/A	Pulsating:	N/A	
Area Classification:	N/A					Ambient Temperature Requireme	N/A				

ELEMENT

Type:	N/A		
Fill Fluid:	Silicone Oil		
Min Span:	14.5 psi	Max Span:	290 psi
Diaphragm/Wetted Material:	Hastelloy C276		
Vent/Drain Location:	N/A		
Vent/Drain Material:	N/A		
Process Connection:	1/2" NPT		

TRANSMITTER

Voltage:	24V dc				
Power Wiring:	Loop	Signal Type:	4-20mA		
Communication Protoc	HART	Location:	Local		
Smart:	Yes	Indicate:	Yes	Isolate:	N/A
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP	6	IP2:	7
Factory Calibration:	Yes				
Ambient Temperature Compensation:	+/- [0.15%span + 0.15%Max]				
Characteristic:	N/A	Calibrated Range:	0-75 psig		
Over Range:	580 psig	Zero Elevation:	N/A		
Accuracy:	+/-0.2% span	Gasket Material:	BUNA		
Conduit Connection:	1/2" NPT	NACE:	N/A		
Element Connection:	none	SS Tag:	Yes		
Body Max Pressure Rating:	580 psig				
Body/Flange Material:	Cast Aluminum				
Mounting:	Direct Mount				

SEAL DIAPHRAM & CAPILLARY

Length:	N/A	ID:	N/A		
Armor:	N/A				
Fill Fluid:	N/A	Max Response Time:	N/A		
SG @ 60 °F:	N/A	Capilary Material:	N/A		
Diaphragm:	Hi Press:		Low Press:		
Size & Type:	N/A		N/A		
Thickness:	N/A		N/A		
Material:	N/A		N/A		
Flush Ring:	N/A		N/A		
Temperature Rating:	N/A				
Max Temperature:	N/A				
Pressure Rating:	N/A				
Max Pressure:	N/A				
Manufacturer:	N/A				
Model:	N/A				

MANIFOLD

Type:	N/A		
Material:	N/A		
Transmitter Connection	N/A		
Process Connection:	N/A		
Manufacturer:	N/A		
Model:	N/A		

NOTES

EJA530A - Guage Pressure Transmitter
E - 4-20 mA DC with Hart protocol
B - 14.5 - 290 psi
H# - Hastelloy C276 or ASTM N10 276 for process connection and diaphragm
7 - 1/2" NPT male
N - Always N
0 - Always 0
2 - 1/2" NPT Female, 2 electrical connections without blind plug
E - Digital indicator with range setting switch
L - SUS316 2" Pipe mounting bracket
N4 - Wired stainless steel tag plate
T06 - Pressure leak test 2 MPa (20Kgf/cm2)

16-Nov-12

AECOM

Pressure Instrument

Differential Pressure Line to Atmosphere

NO.	BY	DATE	REVISION

DATA SHEET NO.		REV.
PIT-1732		A
SHEET	OF	DATE
1	1	1-17-13
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project:	RLWTF									
TAG NO:	CA-PIT-5407	Hookup Drawings:		Loop Wiring Diagrams:	M-6367					
		Spec No:	40 9100	Line / Vessel Number:	LLW-397-SS150					<-
Asset No:		P&ID:	P-6202	Line ID:	0.62"	Size:	0.5"	Schedule:	N/A	<-
Service Description:	Compressed Air to Building 230			Manufacturer:	Yokogawa					<-
				Model:	EJA530AEBH#7N02EL/N4T06					<-
Safety Class:	NS			Quality Assurance Level	ML-4					<-

PROCESS CONDITIONS

Hi Pressure Connection:						Low Pressure Connection						Units:
Fluid:	Compressed Air					Fluid:	Atmosphere					
Fluid Density @ Operating Temp:	0.585 @ 70 F and 100psig					Fluid Density@ Operating Temp:	N/A					lbm/in3
Viscosity @ Operating Temp:	N/A					Viscosity @ Operating Temp:	N/A					N/A
Pressure:						Pressure:						
Oper:	1285	Design:	150	H2OTst:	150	Oper:	N/A	Design:	N/A	H2OTst:	N/A	psig
Temperature:						Temperature:						
Min:	32	Normal:	75	Max:	90	Min:	N/A	Normal:	N/A	Max:	N/A	F
% solids	N/A	% Quality:	N/A			% solids	N/A	% Quality:	N/A			
Service:	N/A	Critical:	N/A	Pulsating:	N/A	Service:	N/A	Critical:	N/A	Pulsating:	N/A	
Area Classification:	N/A					Ambient Temperature Requirement	N/A					

ELEMENT

Type:	N/A		
Fill Fluid:	Silicone Oil		
Min Span:	14.5 psi	Max Span:	290 psi
Diaphragm/Wetted Material:	Hastelloy C276		
Vent/Drain Location:	N/A		
Vent/Drain Material:	N/A		
Process Connection:	1/2" NPT		

TRANSMITTER

Voltage:	24V dc				
Power Wiring:	Loop	Signal Type:	4-20mA		
Communication Protocol:	HART	Location:	Local		
Smart:	Yes	Indicate:	Yes	Isolate:	N/A
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP:	6	IP2:	7
Factory Calibration:	Yes				
Ambient Temperature Compensation:	+/- [0.15%span + 0.15%Max]				
Characteristic:	N/A	Calibrated Range:	0-200 psig		
Over Range:	580 psig	Zero Elevation:	N/A		
Accuracy:	+/-0.2% span	Gasket Material:	BUNA		
Conduit Connection:	1/2" NPT	NACE:	N/A		
Element Connection:	none	SS Tag:	Yes		
Body Max Pressure Rating:	580 psig				
Body/Flange Material:	Cast Aluminum				
Mounting:	Direct Mount				

SEAL DIAPHRAM & CAPILLARY

Length:	N/A	ID:	N/A	
Armor:	N/A			
Fill Fluid:	N/A	Max Response Time:	N/A	
SG @ 60 °F:	N/A	Capilary Material:	N/A	
Diaphragm:	Hi Press:		Low Press:	
Size & Type:	N/A		N/A	
Thickness:	N/A		N/A	
Material:	N/A		N/A	
Flush Ring:	N/A		N/A	
Temperature Rating:	N/A			
Max Temperature:	N/A			
Pressure Rating:	N/A			
Max Pressure:	N/A			
Manufacturer:	N/A			
Model:	N/A			

MANIFOLD

Type:	N/A
Material:	N/A
Transmitter Connection:	N/A
Process Connection:	N/A
Manufacturer:	N/A
Model:	N/A

NOTES

EJA530A - Guage Pressure Transmitter
E - 4-20 mA DC with Hart protocol
B - 14.5 - 290 psi
H# - Hastelloy C276 or ASTM N10 276 for process connection and diaphragm
7 - Process Connection: 1/2" NPT male
N - Always N
0 - Always 0
2 - 1/2" NPT Female, 2 electrical connections without blind plug
E - Digital indicator with range setting switch
L - SUS316 2" Pipe mounting bracket
N4 - Wired stainless steel tag plate
T06 - Pressure leak test 2 MPa (20Kgf/cm2)

27-Dec-12

AECOM

Pressure Instrument

Differential Pressure Line to Atmosphere

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
PIT-5603			A
SHEET	OF	DATE	
1	1	1-17-13	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project:	RLWTF							
TAG NO:	NPWC-PIT-5603	Hookup Drawings:		Loop Wiring Diagrams:	M-6456			
		Spec No:	40 9100	Line / Vessel Number:	NPWC-229-CS-2"			<-
Asset No:		P&ID:	P-6201	Line ID:	2.07"	Size:	2"	Schedule: N/A <-
Service Description:	Non-Potable Water, Cold Supply			Manufacturer:	Yokogawa			<-
				Model:	EJA530AEBH#7N02EL/N4T06			<-
Safety Class:	NS			Quality Assurance Level	ML-4			<-

PROCESS CONDITIONS

	Hi Pressure Connection:					Low Pressure Connection					Units:
Fluid:	Non-Potable Water					Fluid:	Atmosphere				
Fluid Density @ Operating Temp:	62.31 @ 70 F and 14.7psia					Fluid Density@ Operating Temp:	N/A				lbm/ft3
Viscosity @ Operating Temp:	N/A					Viscosity @ Operating Temp:	N/A				N/A
Pressure:						Pressure:					
Oper:	60	Design:	100	H2OTst:	150	Oper:	N/A	Design:	N/A	H2OTst: N/A	psig
Temperature:						Temperature:					
Min:	32	Normal:	75	Max:	125	Min:	N/A	Normal:	N/A	Max: N/A	F
% solids:	N/A	% Quality:	N/A			% solids:	N/A	% Quality:	N/A		
Service:	N/A	Critical:	N/A	Pulsating:	N/A	Service:	N/A	Critical:	N/A	Pulsating: N/A	
Area Classification:	N/A					Ambient Temperature Requirem	N/A				

ELEMENT

Type:	N/A		
Fill Fluid:	Silicone Oil		
Min Span:	14.5 psi	Max Span:	290 psi
Diaphragm/Wetted Material:	Hastelloy C276		
Vent/Drain Location:	N/A		
Vent/Drain Material:	N/A		
Process Connection:	1/2" NPT		

TRANSMITTER

Voltage:	24V dc				
Power Wiring:	Loop	Signal Type:	4-20mA		
Communication Protocol:	HART	Location:	Local		
Smart:	Yes	Indicate:	Yes	Isolate:	N/A
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP:	6	IP2:	7
Factory Calibration:	Yes				
Ambient Temperature Compensation:	+/- [0.15%span + 0.15%Max]				
Characteristic:	N/A	Calibrated Range:	0-120 psig		
Over Range:	580 psig	Zero Elevation:	N/A		
Accuracy:	+/-0.2% span	Gasket Material:	BUNA		
Conduit Connection:	1/2" NPT	NACE:	N/A		
Element Connection:	none	SS Tag:	Yes		
Body Max Pressure Rating:	580 psig				
Body/Flange Material:	Cast Aluminum				
Mounting:	Direct Mount				

SEAL DIAPHRAM & CAPILLARY

Length:	N/A	ID:	N/A	
Armor:	N/A			
Fill Fluid:	N/A	Max Response Time:	N/A	
SG @ 60 °F:	N/A	Capilary Material:	N/A	
Diaphragm:	Hi Press:		Low Press:	
Size & Type:	N/A		N/A	
Thickness:	N/A		N/A	
Material:	N/A		N/A	
Flush Ring:	N/A		N/A	
Temperature Rating:	N/A			
Max Temperature:	N/A			
Pressure Rating:	N/A			
Max Pressure:	N/A			
Manufacturer:	N/A			
Model:	N/A			

MANIFOLD

Type:	N/A
Material:	N/A
Transmitter Connection:	N/A
Process Connection:	N/A
Manufacturer:	N/A
Model:	N/A

NOTES

EJA530A - Guage Pressure Transmitter
E - 4-20 mA DC with Hart protocol
B - 14.5 - 290 psi
H# - Hastelloy C276 or ASTM N10 276 for process connection and diaphragm
7 - Process Connection: 1/2" NPT male
N - Always N
0 - Always 0
2 - 1/2" NPT Female, 2 electrical connections without blind plug
E - Digital indicator with range setting switch
L - SUS316 2" Pipe mounting bracket
N4 - Wired stainless steel tag plate
T06 - Pressure leak test 2 MPa (20Kgf/cm2)

27-Dec-12 <-

AECOM

Pressure Instrument

Differential Pressure Line to Atmosphere

DATA SHEET NO.	REV.
PIT-5804	A

SHEET	OF	DATE
1	1	1-17-13

NO.	BY	DATE	REVISION

BY	CHK'D	PROC.	APPR.
NCC	AME		

P.O. REQ.

Project:	RLWTF								
TAG NO:	NGL-PIT-5804	Hookup Drawings:		Loop Wiring Diagrams:	M-6445				
		Spec No:	40 9100	Line / Vessel Number:	NG-003-CS150				
Asset No:		P&ID:	P-6200	Line ID:	0.62"	Size:	0.5"	Schedule:	N/A
Service Description:	Natural Gas Supply			Manufacturer:	Yokogawa				
				Model:	EJA530AEBH#7N02EL/N4T06				
Safety Class:	NS			Quality Assurance Level	ML-4				

PROCESS CONDITIONS

Hi Pressure Connection:						Low Pressure Connection						Units:
Fluid:	Natural Gas					Fluid:	Atmosphere					
Fluid Density @ Operating Temp:	0.044 - 0.056 @ STP					Fluid Density@ Operating Temp:	N/A					lbm/ft3
Viscosity @ Operating Temp:	N/A					Viscosity @ Operating Temp:	N/A					N/A
Pressure:						Pressure:						
Oper:	14 in wc	Design:	150 psig	H2OTst:	150 psig	Oper:	N/A	Design:	N/A	H2OTst:	N/A	psig
Temperature:						Temperature:						
Min:	32	Normal:	75	Max:	125	Min:	N/A	Normal:	N/A	Max:	N/A	F
% solids:	N/A	% Quality:	N/A			% solids	N/A	% Quality:	N/A			
Service:	N/A	Critical:	N/A	Pulsating:	N/A	Service:	N/A	Critical:	N/A	Pulsating:	N/A	
Area Classification:	N/A					Ambient Temperature Requirem	N/A					

ELEMENT

Type:	N/A		
Fill Fluid:	Silicone Oil		
Min Span:	14.5 psi	Max Span:	290 psi
Diaphragm/Wetted Material:	Hastelloy C276		
Vent/Drain Location:	N/A		
Vent/Drain Material:	N/A		
Process Connection:	1/2" NPT		

TRANSMITTER

Voltage:	24V dc				
Power Wiring:	Loop	Signal Type:	4-20mA		
Communication Protoc	HART	Location:	Local		
Smart:	Yes	Indicate:	Yes	Isolate:	N/A
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP	6	IP2:	7
Factory Calibration:	Yes				
Ambient Temperature Compensation:	+/- [0.15%span + 0.15%Max]				
Characteristic:	N/A	Calibrated Range:	0-120 psig		
Over Range:	580 psig	Zero Elevation:	N/A		
Accuracy:	+/-0.2% span	Gasket Material:	BUNA		
Conduit Connection:	1/2" NPT	NACE:	N/A		
Element Connection:	none	SS Tag:	Yes		
Body Max Pressure Rating:	580 psig				
Body/Flange Material:	Cast Aluminum				
Mounting:	Direct Mount				

SEAL DIAPHRAM & CAPILLARY

Length:	N/A	ID:	N/A		
Armor:	N/A				
Fill Fluid:	N/A	Max Response Time:	N/A		
SG @ 60 °F:	N/A	Capilary Material:	N/A		
Diaphragm:	Hi Press:		Low Press:		
Size & Type:	N/A		N/A		
Thickness:	N/A		N/A		
Material:	N/A		N/A		
Flush Ring:	N/A		N/A		
Temperature Rating:	N/A				
Max Temperature:	N/A				
Pressure Rating:	N/A				
Max Pressure:	N/A				
Manufacturer:	N/A				
Model:	N/A				

MANIFOLD

Type:	N/A		
Material:	N/A		
Transmitter Connection:	N/A		
Process Connection:	N/A		
Manufacturer:	N/A		
Model:	N/A		

NOTES

EJA530A - Guage Pressure Transmitter
E - 4-20 mA DC with Hart protocol
B - 14.5 - 290 psi
H# - Hastelloy C276 or ASTM N10 276 for process connection and diaphragm
7 - Process Connection: 1/2" NPT male
N - Always N
0 - Always 0
2 - 1/2" NPT Female, 2 electrical connections without blind plug
E - Digital indicator with range setting switch
L - SUS316 2" Pipe mounting bracket
N4 - Wired stainless steel tag plate
T06 - Pressure leak test 2 MPa (20Kgf/cm2)

27-Dec-12

AECOM

Pressure Instrument

Differential Pressure Line to Atmosphere

DATA SHEET NO.	REV.
PIT-5946	A

SHEET	OF	DATE
1	1	1-17-13

NO.	BY	DATE	REVISION

BY	CHK'D	PROC.	APPR.
NCC	AME		

P.O.

REQ.

Project:	RLWTF						
TAG NO:	P10-PT-5946	Hookup Drawings:		Loop Wiring Diagrams:	M-6436		
		Spec No:	40 9100	Line / Vessel Number:	P10-1/2"-SS		
Asset No:		P&ID:	P-6102	Line ID: 0.67"	Size: 0.5"	Schedule:	N/A
Service Description:	P10 Gas Supply			Manufacturer:	Yokogawa		
				Model:	EJA530AEDH#7N02EL/N4T06		
Safety Class:	NS			Quality Assurance Level	ML-4		

PROCESS CONDITIONS

	Hi Pressure Connection:		Low Pressure Connection		Units:
Fluid:	P10 (90% Argon, 10% Methane)		Fluid:	Atmosphere	
Fluid Density @ Operating Temp:	81 @ 70 F and 14,7psia		Fluid Density@ Operating Temp:	N/A	lbm/ft3
Viscosity @ Operating Temp:	0.02 cP		Viscosity @ Operating Temp:	N/A	N/A
Pressure:			Pressure:		
Oper: 2400	Design: 3000	H2OTst: N/A	Oper: N/A	Design: N/A	H2OTst: N/A psig
Temperature:			Temperature:		
Min: 32	Normal: 75	Max: 125	Min: N/A	Normal: N/A	Max: N/A F
% solids: N/A	% Quality: N/A		% solids: N/A	% Quality: N/A	
Service: N/A	Critical: N/A	Pulsating: N/A	Service: N/A	Critical: N/A	Pulsating: N/A
Area Classification:	N/A		Ambient Temperature Requirem	N/A	

ELEMENT

Type:	N/A
Fill Fluid:	Silicone Oil
Min Span: 14.5 psi	Max Span: 290 psi
Diaphragm/Wetted Material:	Hastelloy C276
Vent/Drain Location:	N/A
Vent/Drain Material:	N/A
Process Connection:	1/2" NPT

TRANSMITTER

Voltage:	24V dc		
Power Wiring:	Loop	Signal Type:	4-20mA
Communication Protocc	HART	Location:	Local
Smart: Yes	Indicate: Yes	Isolate:	N/A
Electrical Protection:	N/A	Temperature Category:	N/A
Gas Group: N/A	Enclosure Protection IP 6	IP2:	7
Factory Calibration:	Yes		
Ambient Temperature Compensation:	+/- [0.15%span + 0.15%Max]		
Characteristic:	N/A	Calibrated Range:	0-120 psig
Over Range:	580 psig	Zero Elevation:	N/A
Accuracy:	+/-0.2% span	Gasket Material:	BUNA
Conduit Connection:	1/2" NPT	NACE:	N/A
Element Connection:	none	SS Tag:	PT-5946
Body Max Pressure Rating:	580 psig		
Body/Flange Material:	Cast Aluminum		
Mounting:	Direct Mount		

SEAL DIAPHRAM & CAPILLARY

Length:	N/A	ID:	N/A
Armor:	N/A		
Fill Fluid:	N/A	Max Response Time:	N/A
SG @ 60 °F:	N/A	Capilary Material:	N/A

Diaphragm:	Hi Press:	Low Press:
Size & Type:	N/A	N/A
Thickness:	N/A	N/A
Material:	N/A	N/A
Flush Ring:	N/A	N/A
Temperature Rating:	N/A	
Max Temperature:	N/A	
Pressure Rating:	N/A	
Max Pressure:	N/A	
Manufacturer:	N/A	
Model:	N/A	

MANIFOLD

Type:	N/A
Material:	N/A
Transmitter Connection:	N/A
Process Connection:	N/A
Manufacturer:	N/A
Model:	N/A

NOTES

EJA530A - Guage Pressure Transmitter
E - 4-20 mA DC with Hart protocol
D - 720 to 7200 psi
H# - Hastelloy C276 or ASTM N10 276 for process connection and diaphragm
7 - Process Connection: 1/2" NPT male (Provide 1/2" x 1/4" reducing Tee)
N - Always N
0 - Always 0
2 - 1/2" NPT Female, 2 electrical connections without blind plug
E - Digital indicator with range setting switch
L - SUS316 2" Pipe mounting bracket
N4 - Wired stainless steel tag plate
T06 - Pressure leak test 2 MPa (20Kgf/cm2)

3-Jan-13

AECOM

Pressure Instrument

Differential Pressure Line to Atmosphere

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
PIT-5951			A
SHEET	OF	DATE	
1	1	1-17-13	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project:	RLWTF						
TAG NO:	AR-PT-5951	Hookup Drawings:		Loop Wiring Diagrams:	M-6437		
		Spec No:	40 9100	Line / Vessel Number:	AR-1/2"-SS		
Asset No:		P&ID:	P-6102	Line ID: 0.67"	Size: 0.5"	Schedule:	N/A
Service Description:	Argon Gas Supply			Manufacturer:	Yokogawa		
				Model:	EJA530AEBH#7N02EL/N4T06		
Safety Class:	NS			Quality Assurance Level	ML-4		

PROCESS CONDITIONS

Hi Pressure Connection:						Low Pressure Connection						Units:
Fluid:	Argon					Fluid:	Atmosphere					
Fluid Density @ Operating Temp:	87 @ 70 F and 14.7psia					Fluid Density@ Operating Temp:	N/A					lbm/ft3
Viscosity @ Operating Temp:	0.02 cP					Viscosity @ Operating Temp:	N/A					N/A
Pressure:						Pressure:						
Oper:	70	Design:	100	H2OTst:	150	Oper:	N/A	Design:	N/A	H2OTst:	N/A	psig
Temperature:						Temperature:						
Min:	32	Normal:	75	Max:	125	Min:	N/A	Normal:	N/A	Max:	N/A	F
% solids:	N/A	% Quality:	N/A			% solids:	N/A	% Quality:	N/A			
Service:	N/A	Critical:	N/A	Pulsating:	N/A	Service:	N/A	Critical:	N/A	Pulsating:	N/A	
Area Classification:	N/A					Ambient Temperature Requirem	N/A					

ELEMENT

Type:	N/A
Fill Fluid:	Silicone Oil
Min Span:	14.5 psi
Max Span:	290 psi
Diaphragm/Wetted Material:	Hastelloy C276
Vent/Drain Location:	N/A
Vent/Drain Material:	N/A
Process Connection:	1/2" NPT

TRANSMITTER

Voltage:	24V dc				
Power Wiring:	Loop	Signal Type:	4-20mA		
Communication Protocol:	HART	Location:	Local		
Smart:	Yes	Indicate:	Yes	Isolate:	N/A
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP:	6	IP2:	7
Factory Calibration:	Yes				
Ambient Temperature Compensation:	+/- [0.15%span + 0.15%Max]				
Characteristic:	N/A	Calibrated Range:	0-120 psig		
Over Range:	580 psig	Zero Elevation:	N/A		
Accuracy:	+/-0.2% span	Gasket Material:	BUNA		
Conduit Connection:	1/2" NPT	NACE:	N/A		
Element Connection:	none	SS Tag:	PT-5951		
Body Max Pressure Rating:	580 psig				
Body/Flange Material:	Cast Aluminum				
Mounting:	Direct Mount				

SEAL DIAPHRAM & CAPILLARY

Length:	N/A	ID:	N/A
Armor:	N/A		
Fill Fluid:	N/A	Max Response Time:	N/A
SG @ 60 °F:	N/A	Capilary Material:	N/A
Diaphragm:	Hi Press:		Low Press:
Size & Type:	N/A		N/A
Thickness:	N/A		N/A
Material:	N/A		N/A
Flush Ring:	N/A		N/A
Temperature Rating:	N/A		
Max Temperature:	N/A		
Pressure Rating:	N/A		
Max Pressure:	N/A		
Manufacturer:	N/A		
Model:	N/A		

MANIFOLD

Type:	N/A
Material:	N/A
Transmitter Connection:	N/A
Process Connection:	N/A
Manufacturer:	N/A
Model:	N/A

NOTES

EJA530A - Guage Pressure Transmitter
E - 4-20 mA DC with Hart protocol
B - 14.5 - 290 psi
H# - Hastelloy C276 or ASTM N10 276 for process connection and diaphragm
7 - Process Connection: 1/2" NPT male (Provide 1/2" x 1/4" reducing Tee)
N - Always N
0 - Always 0
2 - 1/2" NPT Female, 2 electrical connections without blind plug
E - Digital indicator with range setting switch
L - SUS316 2" Pipe mounting bracket
N4 - Wired stainless steel tag plate
T06 - Pressure leak test 2 MPa (20Kgf/cm2)

3-Jan-13

AECOM

Pressure Instrument

Differential Pressure Line to Atmosphere

NO	BY	DATE	REVISION

DATA SHEET NO			REV
PIT-5953			A
SHEET	OF	DATE	
1	1	1-17-13	
BY	CHK'D	PROC	APPR
NCC	AME		
P.O.			
REQ.			

Project:	RLWTF						
TAG NO:	AR-PT-5953	Hookup Drawings:		Loop Wiring Diagrams:	M-6438		
		Spec No	40 9100	Line / Vessel Number:	AR-1/2"-SS		
Asset No:		P&ID:	P-6102	Line ID: 0.67"	Size: 0.5"	Schedule:	N/A
Service Description:	Argon Gas Supply			Manufacturer:	Yokogawa		
				Model:	EJA530AEBH#7N02EL/N4T06		
Safety Class:	NS			Quality Assurance Level	ML-4		

PROCESS CONDITIONS

	Hi Pressure Connection:		Low Pressure Connection		Units:
Fluid:	Argon		Atmosphere		
Fluid Density @ Operating Temp:	87 @ 70 F and 14.7psia		Fluid Density@ Operating Temp:	N/A	lbm/ft3
Viscosity @ Operating Temp:	0.02 cP		Viscosity @ Operating Temp:	N/A	N/A
	Pressure:			Pressure:	
Oper:	70	Design: 100 H2OTst: 150	Oper: N/A	Design: N/A H2OTst: N/A	psig
	Temperature:			Temperature:	
Min:	32	Normal: 75 Max: 125	Min: N/A	Normal: N/A Max: N/A	F
% solids:	N/A	% Quality: N/A	% solids: N/A	% Quality: N/A	
Service:	N/A	Critical: N/A Pulsating: N/A	Service: N/A	Critical: N/A Pulsating: N/A	
Area Classification:	N/A		Ambient Temperature Requirem	N/A	

ELEMENT

Type:	N/A
Fill Fluid:	Silicone Oil
Min Span:	14.5 psi — Max Span: 290 psi
Diaphragm/Wetted Material:	Hastelloy C276
Vent/Drain Location:	N/A
Vent/Drain Material:	N/A
Process Connection:	1/2" NPT

TRANSMITTER

Voltage:	24V dc		
Power Wiring:	Loop	Signal Type:	4-20mA
Communication Protoc	HART	Location:	Local
Smart: Yes	Indicate: Yes	Isolate:	N/A
Electrical Protection:	N/A	Temperature Category:	N/A
Gas Group: N/A	Enclosure Protection IP: 6	IP2:	7
Factory Calibration:	Yes		
Ambient Temperature Compensation:	+/- [0.15%span + 0.15%Max]		
Characteristic:	N/A	Calibrated Range:	0-120 psig
Over Range:	580 psig	Zero Elevation:	N/A
Accuracy:	+/-0.2% span	Gasket Material:	BUNA
Conduit Connection:	1/2" NPT	NACE:	N/A
Element Connection:	none	SS Tag:	PT-5953
Body Max Pressure Rating:	580 psig		
Body/Flange Material:	Cast Aluminum		
Mounting:	Direct Mount		

SEAL DIAPHRAM & CAPILLARY

Length:	N/A	ID:	N/A	
Armor:	N/A			
Fill Fluid:	N/A	Max Response Time:	N/A	
SG @ 60 °F:	N/A	Capilary Material:	N/A	
Diaphragm:	Hi Press:		Low Press:	
Size & Type:	N/A		N/A	
Thickness:	N/A		N/A	
Material:	N/A		N/A	
Flush Ring:	N/A		N/A	
Temperature Rating:	N/A			
Max Temperature:	N/A			
Pressure Rating:	N/A			
Max Pressure:	N/A			
Manufacturer:	N/A			
Model:	N/A			

MANIFOLD

Type:	N/A
Material:	N/A
Transmitter Connection:	N/A
Process Connection:	N/A
Manufacturer:	N/A
Model:	N/A

NOTES

EJA530A - Guage Pressure Transmitter
E - 4-20 mA DC with Hart protocol
B - 14.5 - 290 psi
H# - Hastelloy C276 or ASTM N10 276 for process connection and diaphragm
7 - Process Connection: 1/2" NPT male (Provide 1/2" x 1/4" reducing Tee)
N - Always N
0 - Always 0
2 - 1/2" NPT Female, 2 electrical connections without blind plug
E - Digital indicator with range setting switch
L - SUS316 2" Pipe mounting bracket
N4 - Wired stainless steel tag plate
T06 - Pressure leak test 2 MPa (20Kgf/cm2)

3-Jan-13

AECOM

Temperature Instruments

Transmitters, Thermowells, RTDs, TCs

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
TE-1303			A
SHEET	OF	DATE	
1	1	1-17-13	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project:	RLWTF						
TAG NO:	LLW-TE-1303	Hookup Drawings:	N/A	Loop Wiring Diagrams:	M-6220		
		Spec No	40 9100	Line / Vessel Number:	LLW-180-SS150		
Asset No:		P&ID:	D-6016	Line ID:	2.07"	Size: 2"	Schedule: 40
Service Description:	Reverse Osmosis pH adjustment tank inlet			Manufacturer:	WIKA		
				Model:	TR10-C-I-SZZ2SZ-1-ZSBAK-040-DBK-C1-P-00175-1T		
Safety class:	NS			Quality Assurance Level	ML-4		

PROCESS CONDITIONS

Pressure:						Units	Fluid:	LLW
Oper:	45	Design:	100	H2OTst:	150	psig	Area Classification:	N/A
Temperature:							Ambient Temperature Requirements:	32 - 125
Min:	N/A	Normal:	75	Max:	125	deg F	Service: MF Filtrate	Critical: N/A
Flow:								
Min:	N/A	Normal:	N/A	Max:	N/A	gpm		

THERMOWELL

Tag Name:	LLW-TW-1303		
Type:	Integral to RTD Assembly	NACE:	N/A
Process Connection:	1/2 in NPT		
Element Connection:	1/2 in NPT		
Vibration Calculation:	N/A		
Max Pressure Rating:	≥ 2 x Max Pressure		
Material:	316L SS		
Well ID:	0.26 in	Well OD:	0.5 in
Insertion Length:	1.75 in	Tip Diameter:	0.25 in
Stem Length:	3.5 in	Tip Thickness:	0.5 in
Root Diameter:	N/A	Head Length:	1.75 in
LAG Length:	N/A	Immersion Length:	1.75 in
Manufacturer:	WIKA		
Model:	Integral to RTD Assembly		

TRANSMITTER

Voltage:	N/A				
Power Wiring:	N/A		Signal Type:	N/A	
Comm. Protocol:	N/A		Location:	N/A	
Smart:	No	Indicate: N/A	Isolate:	N/A	
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP:	N/A	IP2:	N/A
Temp Comp:	Yes	RTD Constant:	TBD		
Factory Calibration:	N/A				
T/C Burnout:	N/A				
Operating temp	N/A	Humidity:	N/A		
Calibrated Range:	N/A				
Body Material:	N/A				
SS Tag:	N/A				
Accuracy:	N/A				

ELEMENT

Tag Name:	LLW-TE-1303		
Type:	RTD	Probe Length:	3 in
Single/Duplex	Single	Fixed/Adjustable:	N/A
Range Limits:	-58 to 482F	Ice Pt Resistance:	
Sensor Length:	6 in	Temp Element	100 ohm Pt, α=0.00385
Probe Diameter:	1/4 in		
Sensor Material:	316SS		
No. of Lead Wire Terminations:	3	Lead Length:	144 in
Spring Loaded:	Yes	Grounded Junction:	N/A
Process Connection:	1/2 in NPT		
Manufacturer:	WIKA		
Model:	Integral to RTD Assembly		

CONNECTION HEAD

Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP:	6	IP2:	7
Material:	Cast Aluminum Epoxy				
Style:	General Purpose Termination Head				
Sensor connection:	RTD				
Conduit Connection:	1/2 in NPT				
Termination Strip:	Three pole crastin				
Manufacturer:	WIKA				
Model:	Integral to RTD Assembly				

2

Furnish with mounting accessories required for wall mount configuration
Thermowell model TR10
C - DIN RTD assembly with threaded protection tube [TR201]
I - Imperial measurement units
S - Self-gripping spring
Z-Z - Without Explosion-proof approval - Without flame path fitting
2-S - Connection head 4000S (Stainless steel) - Cable entry 1/2" NPT
Z-1 - Without Head instrument connection - Crastin terminal block
Z-S - Without neck extension - Neck material 316 SS (1.4401)
B-A - Compression Fitting w/SS ferrule - Material: Stainless Steel 316
K-040 1/2" NPT - Neck length (4")
D-B-K Element Pt100, Class B - Single 3 wire - (-50 - 250C) (-58 - 482F)
C-1 - General purpose tip construction - 1/4" Sensor diameter
P-.00175 Stainless Steel sheath - 1 3/4" insertion length (A-dimension)
1-T Quality certificates (NRTL) - Stainless Steel tag wired to assembly

AECOM

Temperature Instruments

Transmitters, Thermowells, RTDs, TCs

NO.	BY	DATE	REVISION

DATA SHEET NO.		REV.
TE-1740		A
SHEET	OF	DATE
1	1	1-17-13

BY	CHK'D	PROC.	APPR.
NCC	AME		

P.O.

REQ.

Project:	RLWTF						
TAG NO:	LLW-TE-1740	Hookup Drawings:	N/A	Loop Wiring Diagrams:	M-6358		
		Spec No:	40 9100	Line / Vessel Number:	EVAP-1701		
Asset No:		P&ID:	D-6029	Line ID: N/A	Size: N/A	Schedule:	N/A
Service Description:	Condenser 1			Manufacturer:	WIKA		
				Model:	TR10-F-I-SZZ2SZ-1-ZSBAK-040-DBK-C1-P-00175-1T		
Safety class:	NS			Quality Assurance Level	ML-4		

PROCESS CONDITIONS

Pressure:						Units	Fluid:	LLW
Oper:	45	Design:	100	H2OTst:	150	psig	Area Classification:	N/A
Temperature:							Ambient Temperature Requirements:	32 - 125
Min:	N/A	Normal:	75	Max:	125	deg F	Service: Evaporator Condensate	Critical: N/A
Flow:								
Min:	N/A	Normal:	N/A	Max:	N/A	gpm		

THERMOWELL

Tag Name:	LLW-TW-1740		
Type:	Integral to RTD Assembly	NACE:	N/A
Process Connection:	150# 1" Flange		
Element Connection:	1/2 in NPT		
Vibration Calculation:	N/A		
Max Pressure Rating:	≥ 2 x Max Pressure		
Material:	316L SS		
Well ID:	0.26 in	Well OD:	0.5 in
Insertion Length:	1.75 in	Tip Diameter:	0.25 in
Stem Length:	3.5 in	Tip Thickness:	0.5 in
Root Diameter:	N/A	Head Length:	1.75 in
LAG Length:	N/A	Immersion Length:	1.75 in
Manufacturer:	WIKA		
Model:	Integral to RTD Assembly		

TRANSMITTER

Voltage:	N/A				
Power Wiring:	N/A	Signal Type:	N/A		
Comm. Protocol:	N/A	Location:	N/A		
Smart:	No	Indicate:	N/A	Isolate:	N/A
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1:	N/A	IP2:	N/A
Temp Comp:	Yes	RTD Constant:	TBD		
Factory Calibration:	N/A				
T/C Burnout:	N/A				
Operating temp	N/A	Humidity:	N/A		
Calibrated Range:	N/A				
Body Material:	N/A				
SS Tag:	N/A				
Accuracy:	N/A				

ELEMENT

Tag Name:	LLW-TE-1740		
Type:	RTD	Probe Length:	3 in
Single/Duplex:	Single	Fixed/Adjustable:	N/A
Range Limits:	-58 to 482F	Ice Pt Resistance:	
Sensor Length:	6 in	Temp Element	100 ohm Pt, α=0.00385
Probe Diameter:	1/4 in		
Sensor Material:	316SS		
No. of Lead Wire Terminations:	3	Lead Length:	144 in
Spring Loaded:	Yes	Grounded Junction:	N/A
Process Connection:	1/2 in NPT		
Manufacturer:	WIKA		
Model:	Integral to RTD Assembly		

CONNECTION HEAD

Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1:	6	IP2:	7
Material:	Cast Aluminum Epoxy				
Style:	General Purpose Termination Head				
Sensor connection:	RTD				
Conduit Connection:	1/2 in NPT				
Termination Strip:	Three pole crastin				
Manufacturer:	WIKA				
Model:	Integral to RTD Assembly				

2

Furnish with mounting accessories required for wall mount configuration
Thermowell model TR10
C - DIN RTD assembly with threaded protection tube [TR201]
I - Imperial measurement units
S - Self-gripping spring
Z-Z - Without Explosion-proof approval - Without flame path fitting
2-S - Connection head 4000S (Stainless steel) - Cable entry 1/2" NPT
Z-1 - Without Head instrument connection - Crastin terminal block
Z-S - Without neck extension - Neck material 316 SS (1.4401)
B-A - Compression Fitting w/SS ferrule - Material: Stainless Steel 316
K-040 1/2" NPT - Neck length (4")
D-B-K Element Pt100, Class B - Single 3 wire - (-50 - 250C) (-58 - 482F)
C-1 - General purpose tip construction - 1/4" Sensor diameter
P-.00175 Stainless Steel sheath - 1 3/4" insertion length (A-dimension)
1-T Quality certificates (NRTL) - Stainless Steel tag wired to assembly

AECOM

Temperature Instruments

Transmitters, Thermowells, RTDs, TCs

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
TE-1741			A
SHEET	OF	DATE	
1	1	1-17-13	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project:	RLWTF
TAG NO:	LLW-TE-1741
Asset No:	
Service Description:	Evaporator 1
Safety class:	NS

Hookup Drawings:	N/A
Spec No:	40 9100
P&ID:	D-6029
Quality Assurance Level	ML-4

Loop Wiring Diagrams:	M-6359								
Line / Vessel Number:	EVAP-1701								
Line ID:	N/A	Size:	N/A	Schedule:	N/A				
Manufacturer:	WIKA								
Model:	TR10-F-I-SZZ2SZ-1-ZSBAK-040-DBK-C1-P-00175-1T								

PROCESS CONDITIONS

Pressure:						Units	Fluid:	LLW
Oper:	45	Design:	100	H2OTst:	150	psig	Area Classification:	N/A
Temperature:							Ambient Temperature Requirements:	32 - 125
Min:	N/A	Normal:	75	Max:	125	deg F	Service: Evaporator Condensate	Critical: N/A
Flow:								
Min:	N/A	Normal:	N/A	Max:	N/A	gpm		

THERMOWELL

Tag Name:	LLW-TW-1741		
Type:	Integral to RTD Assembly	NACE:	N/A
Process Connection:	150# 1" Flange		
Element Connection:	1/2 in NPT		
Vibration Calculation:	N/A		
Max Pressure Rating:	≥ 2 x Max Pressure		
Material:	316L SS		
Well ID:	0.26 in	Well OD:	0.5 in
Insertion Length:	1.75 in	Tip Diameter:	0.25 in
Stem Length:	3.5 in	Tip Thickness:	0.5 in
Root Diameter:	N/A	Head Length:	1.75 in
LAG Length:	N/A	Immersion Length:	1.75 in
Manufacturer:	WIKA		
Model:	Integral to RTD Assembly		

TRANSMITTER

Voltage:	N/A				
Power Wiring:	N/A	Signal Type:	N/A		
Comm. Protocol:	N/A	Location:	N/A		
Smart:	No	Indicate:	N/A	Isolate:	N/A
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1:	N/A	IP2:	N/A
Temp Comp:	Yes	RTD Constant:	TBD		
Factory Calibration:	N/A				
T/C Burnout:	N/A				
Operating temp	N/A	Humidity:	N/A		
Calibrated Range:	N/A				
Body Material:	N/A				
SS Tag:	N/A				
Accuracy:	N/A				

ELEMENT

Tag Name:	LLW-TE-1741		
Type:	RTD	Probe Length:	3 in
Single/Duplex:	Single	Fixed/Adjustable:	N/A
Range Limits:	-58 to 482F	Ice Pt Resistance:	
Sensor Length:	6 in	Temp Element	100 ohm Pt, α=0.00385
Probe Diameter:	1/4 in		
Sensor Material:	316SS		
No. of Lead Wire Terminations:	3	Lead Length:	144 in
Spring Loaded:	Yes	Grounded Junction:	N/A
Process Connection:	1/2 in NPT		
Manufacturer:	WIKA		
Model:	Integral to RTD Assembly		

CONNECTION HEAD

Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1:	6	IP2:	7
Material:	Cast Aluminum Epoxy				
Style:	General Purpose Termination Head				
Sensor connection:	RTD				
Conduit Connection:	1/2 in NPT				
Termination Strip:	Three pole crastin				
Manufacturer:	WIKA				
Model:	Integral to RTD Assembly				

2

Furnish with mounting accessories required for wall mount configuration
Thermowell model TR10
C - DIN RTD assembly with threaded protection tube [TR201]
I - Imperial measurement units
S - Self-gripping spring
Z-Z - Without Explosion-proof approval - Without flame path fitting
2-S - Connection head 4000S (Stainless steel) - Cable entry 1/2" NPT
Z-1 - Without Head instrument connection - Crastin terminal block
Z-S - Without neck extension - Neck material 316 SS (1.4401)
B-A - Compression Fitting w/SS ferrule - Material: Stainless Steel 316
K-040 1/2" NPT - Neck length (4")
D-B-K Element Pt100, Class B - Single 3 wire - (-50 - 250C) (-58 - 482F)
C-1 - General purpose tip construction - 1/4" Sensor diameter
P-.00175 Stainless Steel sheath - 1 3/4" insertion length (A-dimension)
1-T Quality certificates (NRTL) - Stainless Steel tag wired to assembly

AECOM

Temperature Instruments

Transmitters, Thermowells, RTDs, TCs

NO.	BY	DATE	REVISION

DATA SHEET NO.		REV.
TE-1742		A
SHEET	OF	DATE
1	1	1-17-13
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project:	RLWTF						
TAG NO:	LLW-TE-1742	Hookup Drawings:	N/A	Loop Wiring Diagrams:	M-6359		
		Spec No:	40 9100	Line / Vessel Number:	EVAP-1701		
Asset No:		P&ID:	D-6029	Line ID: N/A	Size: N/A	Schedule:	N/A
Service Description:	Evaporator 2			Manufacturer:	WIKA		
				Model:	TR10-F-I-SZZ2SZ-1-ZSBAK-040-DBK-C1-P-00175-1T		
Safety class:	NS			Quality Assurance Level	ML-4		

PROCESS CONDITIONS

Pressure:						Units	Fluid:	LLW
Oper:	45	Design:	100	H2OTst:	150	psig	Area Classification:	N/A
Temperature:							Ambient Temperature Requirements:	32 - 125
Min:	N/A	Normal:	75	Max:	125	deg F	Service: Evaporator Condensate	Critical: N/A
Flow:								
Min:	N/A	Normal:	N/A	Max:	N/A	gpm		

THERMOWELL

Tag Name:	LLW-TW-1742		
Type:	Integral to RTD Assembly	NACE:	N/A
Process Connection:	150# 1" Flange		
Element Connection:	1/2 in NPT		
Vibration Calculation:	N/A		
Max Pressure Rating:	≥ 2 x Max Pressure		
Material:	316L SS		
Well ID:	0.26 in	Well OD:	0.5 in
Insertion Length:	1.75 in	Tip Diameter:	0.25 in
Stem Length:	3.5 in	Tip Thickness:	0.5 in
Root Diameter:	N/A	Head Length:	1.75 in
LAG Length:	N/A	Immersion Length:	1.75 in
Manufacturer:	WIKA		
Model:	Integral to RTD Assembly		

TRANSMITTER

Voltage:	N/A				
Power Wiring:	N/A	Signal Type:	N/A		
Comm. Protocol:	N/A	Location:	N/A		
Smart:	No	Indicate:	N/A	Isolate:	N/A
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1	N/A	IP2:	N/A
Temp Comp:	Yes	RTD Constant:	TBD		
Factory Calibration:	N/A				
T/C Burnout:	N/A				
Operating temp	N/A	Humidity:	N/A		
Calibrated Range:	N/A				
Body Material:	N/A				
SS Tag:	N/A				
Accuracy:	N/A				

ELEMENT

Tag Name:	LLW-TE-1742		
Type:	RTD	Probe Length:	3 in
Single/Duplex:	Single	Fixed/Adjustable:	N/A
Range Limits:	-58 to 482F	Ice Pt Resistance:	
Sensor Length:	6 in	Temp Element	100 ohm Pt, α=0.00385
Probe Diameter:	1/4 in		
Sensor Material:	316SS		
No. of Lead Wire Terminations:	3	Lead Length:	144 in
Spring Loaded:	Yes	Grounded Junction:	N/A
Process Connection:	1/2 in NPT		
Manufacturer:	WIKA		
Model:	Integral to RTD Assembly		

CONNECTION HEAD

Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1	6	IP2:	7
Material:	Cast Aluminum Epoxy				
Style:	General Purpose Termination Head				
Sensor connection:	RTD				
Conduit Connection:	1/2 in NPT				
Termination Strip:	Three pole crastin				
Manufacturer:	WIKA				
Model:	Integral to RTD Assembly				

2

Furnish with mounting accessories required for wall mount configuration
Thermowell model TR10
C - DIN RTD assembly with threaded protection tube [TR201]
I - Imperial measurement units
S - Self-gripping spring
Z-Z - Without Explosion-proof approval - Without flame path fitting
2-S - Connection head 4000S (Stainless steel) - Cable entry 1/2" NPT
Z-1 - Without Head instrument connection - Crastin terminal block
Z-S - Without neck extension - Neck material 316 SS (1.4401)
B-A - Compression Fitting w/SS ferrule - Material: Stainless Steel 316
K-040 1/2" NPT - Neck length (4")
D-B-K Element Pt100, Class B - Single 3 wire - (-50 - 250C) (-58 - 482F)
C-1 - General purpose tip construction - 1/4" Sensor diameter
P-.00175 Stainless Steel sheath - 1 3/4" insertion length (A-dimension)
1-T Quality certificates (NRTL) - Stainless Steel tag wired to assembly

AECOM

Temperature Instruments

Transmitters, Thermowells, RTDs, TCs

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
TE-1743			A
SHEET	OF	DATE	
1	1	1-17-13	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project:	RLWTF							
TAG NO:	LLW-TE-1743	Hookup Drawings:	N/A	Loop Wiring Diagrams:	M-6361			
		Spec No:	40 9100	Line / Vessel Number:	EVAP-1701			
Asset No:		P&ID:	D-6029	Line ID:	N/A	Size: N/A	Schedule:	N/A
Service Description:	Evaporator 3			Manufacturer:	WIKA			
				Model:	TR10-F-I-SZZ2SZ-1-ZSBAK-040-DBK-C1-P-00175-1T			
Safety class:	NS	Quality Assurance Level	MIL-4					

PROCESS CONDITIONS

Pressure:						Units	Fluid:	LLW
Oper:	45	Design:	100	H2OTst:	150	psig	Area Classification:	N/A
Temperature:							Ambient Temperature Requirements:	32 - 125
Min:	N/A	Normal:	75	Max:	125	deg F	Service: Water and water vapor	Critical: N/A
Flow:								
Min:	N/A	Normal:	N/A	Max:	N/A	gpm		

THERMOWELL

Tag Name:	LLW-TW-1743		
Type:	Integral to RTD Assembly	NACE	N/A
Process Connection:	150# 1" Flange		
Element Connection:	1/2 in NPT		
Vibration Calculation:	N/A		
Max Pressure Rating:	≥ 2 x Max Pressure		
Material:	316L SS		
Well ID:	0.26 in	Well OD:	0.5 in
Insertion Length:	1.75 in	Tip Diameter:	0.25 in
Stem Length:	3.5 in	Tip Thickness:	0.5 in
Root Diameter:	N/A	Head Length:	1.75 in
LAG Length:	N/A	Immersion Length:	1.75 in
Manufacturer:	WIKA		
Model:	Integral to RTD Assembly		

TRANSMITTER

Voltage:	N/A				
Power Wiring:	N/A		Signal Type:	N/A	
Comm. Protocol:	N/A		Location:	N/A	
Smart:	No	Indicate: N/A	Isolate:	N/A	
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1	N/A	IP2:	N/A
Temp Comp:	Yes	RTD Constant:	TBD		
Factory Calibration:	N/A				
T/C Burnout:	N/A				
Operating temp	N/A	Humidity:	N/A		
Calibrated Range:	N/A				
Body Material:	N/A				
SS Tag:	N/A				
Accuracy:	N/A				

ELEMENT

Tag Name:	LLW-TE-1743		
Type:	RTD	Probe Length:	3 in
Single/Duplex:	Single	Fixed/Adjustable:	N/A
Range Limits:	-58 to 482F	Ice Pt Resistance:	
Sensor Length:	6 in	Temp Element:	100 ohm Pt, α=0.00385
Probe Diameter:	1/4 in		
Sensor Material:	316SS		
No. of Lead Wire Terminations:	3	Lead Length:	144 in
Spring Loaded:	Yes	Grounded Junction:	N/A
Process Connection:	1/2 in NPT		
Manufacturer:	WIKA		
Model:	Integral to RTD Assembly		

CONNECTION HEAD

Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1	6	IP2:	7
Material:	Cast Aluminum Epoxy				
Style:	General Purpose Termination Head				
Sensor connection:	RTD				
Conduit Connection:	1/2 in NPT				
Termination Strip:	Three pole crastin				
Manufacturer:	WIKA				
Model:	Integral to RTD Assembly				

2

Furnish with mounting accessories required for wall mount configuration
Thermowell model TR10
C - DIN RTD assembly with threaded protection tube [TR201]
I - Imperial measurement units
S - Self-gripping spring
Z-Z - Without Explosion-proof approval - Without flame path fitting
2-S - Connection head 4000S (Stainless steel) - Cable entry 1/2" NPT
Z-1 - Without Head instrument connection - Crastin terminal block
Z-S - Without neck extension - Neck material 316 SS (1.4401)
B-A - Compression Fitting w/SS ferrule - Material: Stainless Steel 316
K-040 1/2" NPT - Neck length (4")
D-B-K Element Pt100, Class B - Single 3 wire - (-50 - 250C) (-58 - 482F)
C-1 - General purpose tip construction - 1/4" Sensor diameter
P-00175 Stainless Steel sheath - 1 3/4" insertion length (A-dimension)
1-T Quality certificates (NRTL) - Stainless Steel tag wired to assembly

AECOM

Temperature Instruments

Transmitters, Thermowells, RTDs, TCs

NO	BY	DATE	REVISION

DATA SHEET NO			REV
TE-1744			A
SHEET	OF	DATE	
1	1	1-17-13	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O. REQ.			

Project:	RLWTF						
TAG NO:	LLW-TE-1744	Hookup Drawings:	N/A	Loop Wiring Diagrams:	M-6362		
		Spec No:	40 9100	Line / Vessel Number:	EVAP-1701		
Asset No:		P&ID:	D-6029	Line ID: N/A	Size: N/A	Schedule:	N/A
Service Description:	Evaporator 4			Manufacturer:	WIKA		
				Model:	TR10-F-I-SZZ2SZ-1-ZSBAK-040-DBK-C1-P-00175-1T		
Safety class:	NS	Quality Assurance Level	ML-4				

PROCESS CONDITIONS

Pressure:						Units
Oper:	45	Design:	100	H2OTst:	150	psig
Temperature:						
Min:	N/A	Normal:	75	Max:	125	deg F
Flow:						
Min:	N/A	Normal:	N/A	Max:	N/A	gpm

Fluid:	LLW		
Area Classification:	N/A		
Ambient Temperature Requirements:	32 - 125		
Service:	Water and water vapor	Critical:	N/A

THERMOWELL

Tag Name:	LLW-TW-1744		
Type:	Integral to RTD Assembly	NACE:	N/A
Process Connection:	150# 1" Flange		
Element Connection:	1/2 in NPT		
Vibration Calculation:	N/A		
Max Pressure Rating:	≥ 2 x Max Pressure		
Material:	316L SS		
Well ID:	0.26 in	Well OD:	0.5 in
Insertion Length:	1.75 in	Tip Diameter:	0.25 in
Stem Length:	3.5 in	Tip Thickness:	0.5 in
Root Diameter:	N/A	Head Length:	1.75 in
LAG Length:	N/A	Immersion Length:	1.75 in
Manufacturer:	WIKA		
Model:	Integral to RTD Assembly		

TRANSMITTER

Voltage:	N/A				
Power Wiring:	N/A	Signal Type:	N/A		
Comm. Protocol:	N/A	Location:	N/A		
Smart:	No	Indicate:	N/A	Isolate:	N/A
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1:	N/A	IP2:	N/A
Temp Comp:	Yes	RTD Constant:	TBD		
Factory Calibration:	N/A				
T/C Burnout:	N/A				
Operating temp	N/A	Humidity:	N/A		
Calibrated Range:	N/A				
Body Material:	N/A				
SS Tag:	N/A				
Accuracy:	N/A				

ELEMENT

Tag Name:	LLW-TE-1744		
Type:	RTD	Probe Length:	3 in
Single/Duplex:	Single	Fixed/Adjustable:	N/A
Range Limits:	-58 to 482F	Ice Pt Resistance:	
Sensor Length:	6 in	Temp Element:	100 ohm Pt, α=0.00385
Probe Diameter:	1/4 in		
Sensor Material:	316SS		
No. of Lead Wire Terminations:	3	Lead Length:	144 in
Spring Loaded:	Yes	Grounded Junction:	N/A
Process Connection:	1/2 in NPT		
Manufacturer:	WIKA		
Model:	Integral to RTD Assembly		

CONNECTION HEAD

Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1:	6	IP2:	7
Material:	Cast Aluminum Epoxy				
Style:	General Purpose Termination Head				
Sensor connection:	RTD				
Conduit Connection:	1/2 in NPT				
Termination Strip:	Three pole crastin				
Manufacturer:	WIKA				
Model:	Integral to RTD Assembly				

2

Furnish with mounting accessories required for wall mount configuration
Thermowell model TR10
C - DIN RTD assembly with threaded protection tube [TR201]
I - Imperial measurement units
S - Self-gripping spring
Z-Z - Without Explosion-proof approval - Without flame path fitting
2-S - Connection head 4000S (Stainless steel) - Cable entry 1/2" NPT
Z-1 - Without Head instrument connection - Crastin terminal block
Z-S - Without neck extension - Neck material 316 SS (1.4401)
B-A - Compression Fitting w/SS ferrule - Material: Stainless Steel 316
K-040 1/2" NPT - Neck length (4")
D-B-K Element Pt100, Class B - Single 3 wire - (-50 - 250C) (-58 - 482F)
C-1 - General purpose tip construction - 1/4" Sensor diameter
P-.00175 Stainless Steel sheath - 1 3/4" insertion length (A-dimension)
1-T Quality certificates (NRTL) - Stainless Steel tag wired to assembly

AECOM

Temperature Instruments

Transmitters, Thermowells, RTDs, TCs

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
TE-1745			A
SHEET	OF	DATE	
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BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project:	RLWTF								
TAG NO:	LLW-TE-1745	Hookup Drawings:	N/A	Loop Wiring Diagrams:	M-6363				
		Spec No:	40 9100	Line / Vessel Number:	EVAP-1701				
Asset No:		P&ID:	D-6029	Line ID:	N/A	Size:	N/A	Schedule:	N/A
Service Description:	Condenser 2			Manufacturer:	WIKA				
				Model:	TR10-F-I-SZZ2SZ-1-ZSBAK-040-DBK-C1-P-00175-1T				
Safety class:	NS			Quality Assurance Level	ML-4				

PROCESS CONDITIONS

Pressure:						Units	Fluid:	LLW		
Oper:	45	Design:	100	H2OTst:	150	psig	Area Classification:	N/A		
Temperature:							Ambient Temperature Requirements:	32 - 125		
Min:	N/A	Normal:	75	Max:	125	deg F	Service:	Water and water vapor	Critical:	N/A
Flow:										
Min:	N/A	Normal:	N/A	Max:	N/A	gpm				

THERMOWELL

Tag Name:	LLW-TW-1745		
Type:	Integral to RTD Assembly	NACE:	N/A
Process Connection:	150# 1" Flange		
Element Connection:	1/2 in NPT		
Vibration Calculation:	N/A		
Max Pressure Rating:	≥ 2 x Max Pressure		
Material:	316L SS		
Well ID:	0.26 in	Well OD:	0.5 in
Insertion Length:	1.75 in	Tip Diameter:	0.25 in
Stem Length:	3.5 in	Tip Thickness:	0.5 in
Root Diameter:	N/A	Head Length:	1.75 in
LAG Length:	N/A	Immersion Length:	1.75 in
Manufacturer:	WIKA		
Model:	Integral to RTD Assembly		

TRANSMITTER

Voltage:	N/A				
Power Wiring:	N/A	Signal Type:	N/A		
Comm. Protocol:	N/A	Location:	N/A		
Smart:	No	Indicate:	N/A	Isolate:	N/A
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1:	N/A	IP2:	N/A
Temp Comp:	Yes	RTD Constant:	TBD		
Factory Calibration:	N/A				
T/C Burnout:	N/A				
Operating temp	N/A	Humidity:	N/A		
Calibrated Range:	N/A				
Body Material:	N/A				
SS Tag:	N/A				
Accuracy:	N/A				

ELEMENT

Tag Name:	LLW-TE-1745		
Type:	RTD	Probe Length:	3 in
Single/Duplex:	Single	Fixed/Adjustable:	N/A
Range Limits:	-58 to 482F	Ice Pt Resistance:	
Sensor Length:	6 in	Temp Element	100 ohm Pt, α=0.00385
Probe Diameter:	1/4 in		
Sensor Material:	316SS		
No. of Lead Wire Terminations:	3	Lead Length:	144 in
Spring Loaded:	Yes	Grounded Junction:	N/A
Process Connection:	1/2 in NPT		
Manufacturer:	WIKA		
Model:	Integral to RTD Assembly		

CONNECTION HEAD

Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1:	6	IP2:	7
Material:	Cast Aluminum Epoxy				
Style:	General Purpose Termination Head				
Sensor connection:	RTD				
Conduit Connection:	1/2 in NPT				
Termination Strip:	Three pole crastin				
Manufacturer:	WIKA				
Model:	Integral to RTD Assembly				

2

Furnish with mounting accessories required for wall mount configuration
Thermowell model TR10
C - DIN RTD assembly with threaded protection tube [TR201]
I - Imperial measurement units
S - Self-gripping spring
Z-Z - Without Explosion-proof approval - Without flame path fitting
2-S - Connection head 4000S (Stainless steel) - Cable entry 1/2" NPT
Z-1 - Without Head instrument connection - Crastin terminal block
Z-S - Without neck extension - Neck material 316 SS (1.4401)
B-A - Compression Fitting w/SS ferrule - Material: Stainless Steel 316
K-040 1/2" NPT - Neck length (4")
D-B-K Element Pt100, Class B - Single 3 wire - (-50 - 250C) (-58 - 482F)
C-1 - General purpose tip construction - 1/4" Sensor diameter
P-.00175 Stainless Steel sheath - 1 3/4" insertion length (A-dimension)
1-T Quality certificates (NRTL) - Stainless Steel tag wired to assembly

AECOM

Temperature Instruments

Transmitters, Thermowells, RTDs, TCs

NO.	BY	DATE	REVISION

DATA SHEET NO.		REV.
TIT-5371		A
SHEET	OF	DATE
1	1	1-17-13
BY	CHK'D	PROC.	APPR
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P.O.			
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Project:	RLWTF						
TAG NO:	FAC-TIT-5371	Hookup Drawings:	N/A	Loop Wiring Diagrams:	M-6380		
		Spec No:	40 9100	Line / Vessel Number:	N/A		
Asset No:		P&ID:	M-6400	Line ID:	N/A	Size: N/A	Schedule: N/A
Service Description:	Effluent Sample Building Room Temperature			Manufacturer:	WIKA		
				Model:	TIF52		
Safety class:	NS			Quality Assurance Level	ML-4		

PROCESS CONDITIONS

Pressure:						Units	Fluid:	Room Air
Oper:	ATM	Design:	N/A	H2OTst:	N/A	N/A	Area Classification:	N/A
Temperature:							Ambient Temperature Requirements:	32 - 125
Min:	32	Normal:	75	Max:	125	deg F	Service: Room Air	Critical: N/A
Flow:								
Min:	N/A	Normal:	N/A	Max:	N/A	gpm		

ELEMENT

Tag Name:	FAC-TIT-5371		
Type:	RTD	Probe Length:	3 in
Single/Duplex	Single	Fixed/Adjustable:	N/A
Range Limits:	-328 to 392 F	Ice Pt Resistance:	
Sensor Length:	6 in	Temp Element	100 ohm Pt,
Probe Diameter:	1/4 in		
Sensor Material:	316SS		
No. of Lead Wire Terminations:	3	Lead Length:	6 in
Spring Loaded:	N/A	Grounded Junction:	N/A
Process Connection:	1/2 in NPT		
Manufacturer:	WIKA		
Model:	Integral to RTD Assembly		

TRANSMITTER

Voltage:	N/A				
Power Wiring:	Loop	Signal Type:	4 - 20 mA		
Comm. Protocol:	HART	Location:	Local		
Smart:	Yes	Indicate:	Yes	Isolate:	N/A
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP:	6	IP2:	6
Temp Comp:	Yes	RTD Constant:	TBD		
Factory Calibration:	Yes				
T/C Burnout:	N/A				
Ambient temp	N/A	Humidity:	N/A		
Calibrated Range:	N/A				
Body Material:	N/A				
SS Tag:	FAC-TIT-5371				
Accuracy:	N/A				

NOTES

Furnish with mounting accessories required for wall mount configuration
Transmitter Model TIF52
Sensor: Pt100

3-Jan-13

END OF SECTION

SECTION 40 9113.23

GAS ANALYSIS PROCESS MEASUREMENT DEVICES

PART 1 GENERAL

1.1 SCOPE

A. It is the intent of this section to provide the specification for the procurement, installation, connection, programming, and calibration of the oxygen monitor. Some equipment controls are specified in other portions of the subcontract documents. It is the responsibility of the bidder to read and conform to all sections of this specification, review all subcontract drawings of all divisions, and coordinate with all equipment suppliers of material specified under other sections of this specification.

B. The installation supervision, start up, and checkout necessary for the oxygen monitor and the combustion gas analyzer shall be provided under this section.

C. Provide the necessary materials and manpower to participate in the testing, adjusting, and balance and the commissioning process as required by those sections of this specification.

1.2 SECTION INCLUDES

A. Gas Analysis Process Measurement Devices:

1. Oxygen monitor.

2. Combustible gas analyzer.

1.3 RELATED SECTIONS

A. Section 01 2500, "Substitution Procedures."

B. Section 01 4000, "Quality Requirements."

C. Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

D. Section 01 6000, "Product Requirements."

E. Section 01 8116, "Facility Environmental Requirements."

F. Section 13 4800, "Sound, Vibration, and Seismic Control."

1.4 ABBREVIATIONS AND ACRONYMS, DEFINITIONS, AND REFERENCES

A. Refer to Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

1.5 SUBMITTALS

A. Provide the following in accordance with the requirements of Exhibit I:

1. Before Fabrication:

a. Documentation of International Organization for Standardization (ISO 9001) certification (if applicable).

b. Provide a copy of the Quality Assurance Plan identifying procurement, design, fabrication, test and inspection, material

traceability, and nonconformity controls for approval by LANL prior to Subcontract award.

c. Catalog data sheets on instrumentation, which show performance characteristics, dimensions, material of fabrication, and other characteristics necessary to ensure conformity with the design requirements.

d. Provide functional test procedure.

e. Manufacturer's assembly drawings, wiring diagrams, and electrical schematics.

f. Support plan outlining product support for products in Part 2. Identify which products are available for 5 years or more. Identify if the parts are "off-the-shelf"

2. Before Shipment:

a. Certificates of conformance (COC) for Oxygen Monitor, attesting that items are in accordance with the requirements of ANSI/ISA-92.04.01, Part I-2007, American National Standard for Performance Requirements for Instruments Used to Detect Oxygen-Deficient/Oxygen-Enriched Atmospheres. For the purposes of determining the requirements:

1) The oxygen monitor is considered a stand-alone monitor with local, visual and audible alarms;

2) The oxygen monitor shall have a digital display; and

3) The oxygen monitor shall include an external battery back-up.

b. Detailed installation instructions for instrumentation devices.

c. Listing of configuration parameters.

d. Functional test report for instrumentation devices per Paragraph 1.9A.

e. Manufacturer's operating procedures, including safety and troubleshooting procedures.

f. Manufacturer's maintenance procedures, including service schedules, recommended spare parts, and warranties.

g. Storage and handling procedure: long term storage, humidity trimming, temperature conditioning, shelf life limits.

h. Listing of associated tagnames with firmware version number.

3. With Shipment:

a. Calibration certification traceable to the NIST for all instrumentation.

b. Each shipment container shall include a packing list of all items contained in that shipment container. Also, a copy of each packing list shall be sent to the LANL Subcontractor Technical Representative..

c. Evidence of nationally recognized testing laboratory (NRTL) or Underwriters Laboratories, Inc. (UL) listing or labeling for all instrumentation.

d. Miscellaneous hardware such as specialty cables, keys, configuration or calibration tools, handheld programming devices, converters, device drivers etc. necessary to utilize any of the supplied process control auxiliary devices and applicable resident software for its intended function.

1.6 QUALITY ASSURANCE

A. Seller's Quality Assurance Requirements:

1. Work identified in this section shall be done under a QAP in accordance with Section 01 4000, "Quality Requirements."

B. Receipt Inspection:

1. Generally, all equipment and accessories installed under this subcontract shall be inspected by the subcontractor in the presence of the LANL Startup and Commissioning Representative and approved before acceptance. The subcontractor shall be responsible for all repairs as required.

2. Upon receipt, the instruments will be visually inspected by a qualified Subcontractor QC Inspector for any damage or abnormalities that could affect their performance in accordance with the QAP.

3. Documentation will be reviewed by a qualified Subcontractor QC Inspector to determine that the required documentation as specified in Section 1.6 is present and traceable to the instruments.

C. Calibration and Material Certifications:

1. Instruments to be calibrated by manufacturer. Calibration shall be traceable to National Institute of Standards and Technology (NIST) standards.

2. Calibration documentation is to be included with the instruments at time of delivery.

3. Material certification for all process-wetted materials to be included with the instrument at time of delivery.

D. Storage and Handling:

1. In addition to the requirements in Section 01 6000, "Product Requirements," comply with the following requirements:

a. Vendor shall be responsible for any damage resulting from improper packing until acceptance. Subcontractor shall inspect all materials upon receipt.

b. Each shipment container shall include a packing list of all items contained in that shipment container. Also, a copy of each packing list shall be sent to the LANL Subcontractor Technical Representative.

c. Vendor shall be responsible for providing any special devices needed for the delivery of any equipment and/or material.

d. Vendor shall define any heating, air conditioning, humidity control, or other storage criteria for equipment that is to be installed for regular use or is intended to be used as spare.

e. Vendor shall define long-term storage limits and maintenance procedures that are required to ensure these limits.

f. Vendor shall define shelf-life limits of all supplied equipment.

g. All openings shall be capped, plugged, or otherwise sealed against the intrusion or water, dirt, and debris. Water shall be removed from cavities to protect against damage caused by freezing and desiccant inserted, if appropriate.

E. Personnel Qualification:

1. Personnel installing instrumentation devices shall be familiar with type of instrument, and required installation practices. Refer to vendor's Quality Assurance Plan for additional requirements for installation personnel.

F. Nonconformance:

1. Nonconformance of an instrument shall be documented and corrected before shipment. If found on receipt, nonconformance shall be documented and corrected before installation at the expense of the subcontractor in accordance with Section 01 4000, "Quality Requirements."

G. Electrical Suitability:

1. All process control auxiliary devices shall be Underwriters Laboratories, Inc. (UL) or nationally recognized testing laboratory (NRTL) listed or labeled.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Design the process components to operate at a design altitude of 7,500 ft above sea level and in the general environmental conditions specified in Section 01 8116, "Facility Environmental Requirements." Seismic requirements are located in Section 13 4800, "Sound, Vibration, and Seismic Control."

1.8 RECORDS

A. Furnish complete spare parts lists, operating instructions, and maintenance literature.

B. Provide record drawings as required by the general subcontract requirements.

C. Supply instrumentation device software and configuration management type tools as applicable:

1. Verified listing of parameter values for each device required to comply with individual device datasheets.

2. Licensed copies of all specialty software needed for controlled configuration.

3. Miscellaneous hardware such as cables, dongles, keys, configuration or calibration tools, handheld programming or monitoring devices, or converters necessary to use any of the supplied devices or parameter entry.

D. Supply calibrations records for each tagged instrument.

1.9 TESTING

A. Functional Test:

1. Verify that each instrument is calibrated using the manufacturer's recommended calibration equipment and specified calibration procedures.

2. For the Oxygen Monitor, perform functional testing per ANSI/ISA-92.04.01, Part I-2007. Submit test results according to Paragraph 0 of this section.

3. Submission of calibration certificate is sufficient for validating functionality and configuration of the combustible gas analyzer.

1.10 TRAINING

A. Provide 2 hours of training to cover all general aspects of instrumentation installation, wiring, calibration techniques, programming, configuration management of devices, and parameter entry.

B. Provide 40 hours of onsite training during the warranty period. The Subcontractor shall provide this training at the request of LANL.

1.11 SERVICE AND WARRANTY

A. For all instrumentation devices provide one-year warranty including travel costs.

B. If the manufacturer has a standard warranty that exceeds one year then the longer warranty shall be provided.

PART 2 PRODUCTS

2.1 PRODUCT OPTIONS AND SUBSTITUTIONS

A. Refer to Section 01 2500, "Substitution Procedures."

2.2 GAS ANALYSIS PROCESS MEASUREMENT DEVICES

A. Oxygen Monitors – (See Attachment 1)

1. Power Requirements: 110/230VAC, 50-60Hz or 18-32VDC. Battery backup is required as a critical characteristic.

2. Accuracy: ± 0.5% O_2.

3. Range: 0 to 25% Oxygen.

4. Output: 4 to 20mA, Alarm Relay.

5. Local Indications Visual Alarm display, Audible Alarm. Alarms must latch and require operator intervention to clear.

6. Manufacturer: RKI Industries.

7. Controller Model: Beacon110.

8. Sensor Model: 72-2110 RK-03

9. Battery Backup Model: 49-8104RK

B. Combustible Gas Analyzers – (See Attachment 2)

1. Sensor Type: Beadle Combustible.
2. Sensor Life: 3 to 5 years typical.
3. Accuracy: (The greater of) ± 5% reading or 2% full scale.
4. Response Time: 90% in 45 sec.
5. Measuring Ranges: 0-100% LEL.
6. Manufacturer: RKI Industries.
7. Controller Model: Beacon110.
8. Sensor Model: 61-1006RK

PART 3 EXECUTION

3.1 GENERAL

A. Provide the control devices as specified in PART 2 of this section; and all field hardware, conduit, wiring, etc., for a complete installation.

B. Install all aspects of the system in compliance with all applicable codes, regulations, and all related Subcontract documents.

C. Install all materials in accordance with the published manufacturer's recommendations.

D. Where miscellaneous materials are required to complete an installation (isolation valves for sensors, etc.), supply the materials as defined in the relevant section of this specification and install them under this section of this specification, unless otherwise noted.

E. Coordinate with other trades where installation of a particular component requires other trades to be involved. Installation coordination includes location the correct placement of sensors and monitors. Care shall be exercised to identify locations that meet the requirements of the manufacture including upstream and downstream distances, pressures, temperatures, etc.

F. All signal wiring requiring shielding shall have the shield terminated at the controller end only. Trim and insulate the shield wire at the device end.

G. Label all wiring with permanent labels indicating the point device identifier. Install a phenolic label mounted at the device indicating the device type and point identifier name.

H. Label all field devices with 1" x 3" phenolic labels. Labels shall include the point name and device name. Labels shall be glued, attached with screws, or stainless wire in the case of valves.

3.2 GAS ANALYSIS PROCESS MEASUREMENT DEVICES

A. Ensure all process connections for measurement devices are helium leak tight.

B. Instruments with an electrical input or output shall be UL or NRTL listed or labeled.

C. Install instruments in accordance with manufacturer's installation instructions and facility requirements providing all of the required gaskets, thermal compounds, flanges, mounting brackets, insulation, piping, fittings, and manual valves for

shutoff, equalization, purging, and calibration. Replace or repair any damaged insulation after devices are installed to match existing work and repair any damaged galvanized surfaces with zinc paint.

D. Instruments with an NPT connection shall be installed per manufacturer requirements. Minimum basic requirements include: verifying that threads are clean, torque "snug-tight" using a thread locking compound. Do not over tighten the instrument or use the instrument housing for tightening purposes.

E. Penetrate all enclosures from the bottom and seal using a silicone rubber sealant to preclude entry of water.

3.3 FIELD TESTING AND ADJUSTING EQUIPMENT

A. Testing: The sub-contractor shall provide personnel, equipment, instrumentation, and supplies necessary to perform site testing. LANL will witness the testing, and written permission shall be obtained from LANL before proceeding with testing.

B. Data: Original copies of data produced, including the results of each test procedure, shall be turned over to LANL at the conclusion of each phase of testing prior to LANL approval of the test.

C. Test Procedures: The test procedures shall cover actual equipment and functions specified for the project.

AECOM

Gas Analyzer Instrument

Oxygen Depletion

NO.	BY	DATE	REVISION

DATA SHEET NO.		REV.
AIT-5300		A
SHEET	OF	DATE
1	1	1-17-13
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project:	RLWTF							
TAG NO:	FAC-AIT-5300	Hookup Drawings:	N/A	Loop Wiring Diagrams:	N/A			
		Spec No:	40 9113 23	Line / Vessel Number:	Room			
Asset No:		P&ID:	P-6201	Line ID:	N/A	Size:	N/A	Schedule: N\
Service Description:	Wet Lab Area Oxygen Monitor			Manufacturer:	RKI Instruments			
				Model:	72-2110 RK-03			
Safety Class	GS			Quality Assurance Level	ML-4			

PROCESS CONDITIONS

Pressure:						Units	Fluid:	Room Air
Oper:	1	Design:	1	H2OTst:	N/A	atm	Area Classification:	N/A
Temperature:							Ambient Temperature Requirements:	N/A
Min:	N/A	Normal:	75	Max:	N/A	deg F	Service: Wet Lab	Critical: N/A
Flow:							pH:	Units
Min:	N/A	Normal:	N/A	Max:	N/A	gpm	Min: N/A Normal: N/A	Max: N N/A

ELEMENT

Tag Name:	FAC-AIT-5300	SS Tag:	Yes
Type:	Oxygen Depletion		
Process Connection:	Controller Mounted Probe 3/4" NPT		
Electrical Connection:	Standard connector		
Calibration Gas:	Oxygen		
Sampling Method:	Diffusion	Detection Range:	0-25% Oxygen
Body Material:	N/A	Electrode Material:	N/A
Insulation Material	N/A	O-ring Material:	N/A
Response Time	90% / 30 Sec	Temp Element:	N/A
Element Diameter	1.75"		
Element Length:	N/A		
Accuracy:	± 0.5% O_2		
Manufacturer:	RKI Instruments		
Model:	65-2494RK		

CONTROLLER

Voltage:	115 VAC				
Power Wiring:	N/A	Signal Type:	4 - 20 mA		
Communication Protocc	N/A	Location:	Integral		
Smart:	No	Indicate:	Yes	Alarm:	Yes
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP	6	IP2:	5
Ambient Temperature Compensation:	No				
Factory Calibration:	Yes				
Fail Mode:	Upscale				
Conduit Connectior	qty 2 3/4" NPT Conduit hubs				
Operating Temp:	-4 to 122 deg F	Humidity:	0 to 95% RH		
Body Material:	Fiberglass				
SS Tag:	Yes				
Accuracy:	≤0.01 pH ± 0.02mA	Calibrated Range:	-2 to 16 pH		

	N/A		
	N/A		
	N/A		
	N/A		N/A
	N/A		
	N/A		
	N/A		
	N/A		

BACKUP BATTERY

Gas Group:	N/A	Enclosure Protection IP	6	IP2:	5
Material:	ABS Plastic	Size:	11.3" H x 7.5" W x 5.8" D		
Style:	Lead Acid 24 VDC				
Power Rating:	12 AH (amp hour)				
Operating Temp:	32 F to 104 F				
Termination Strip:	Yes				
Manufacturer:	RKI Instruments				
Model:	49-8104RK				

NOTES

72-2110RK Model Controller NEMA 4X enclosure w/ audible alarm
-03 Case mounted Strobe
49-8104RK Battery Backup > 8 hours

AECOM

Gas Analyzer Instrument

LEL Combustible Gas

DATA SHEET NO.	REV.
AT-5810	A

SHEET	OF	DATE
1	1	1-17-13

NO.	BY	DATE	REVISION

BY	CHK'D	PROC.	APPR.
NCC	AME		

P.O.	
REQ.	

Project:	RLWTF

TAG NO:	FAC-AT-5810	Hookup Drawings:	N/A	Loop Wiring Diagrams:	N/A	
		Spec No:	40 9113 23	Line / Vessel Number:	Room	<-
Asset No:		P&ID:	P-6200	Line ID: N/A	Size: N/A	Schedule: N\ <-
Service Description:	LLW Utility Building			Manufacturer:	RKI Instruments	<-
				Model:	72-2110 RK-03	<-
Safety Class	GS	Quality Assurance Level		ML-4		<-

PROCESS CONDITIONS

Pressure:						Units	Fluid:	Room Air	<-
Oper:	1	Design:	1	H2OTst:	N/A	atm	Area Classification:	N/A	<-
Temperature:							Ambient Temperature Requirements:	N/A	<-
Min:	N/A	Normal:	75	Max:	N/A	deg F	Service: Wet Lab	Critical: N/A	<-
Flow:							pH:	Units	<-
Min:	N/A	Normal:	N/A	Max:	N/A	gpm	Min: N/A	Normal: N/A	Max: N N/A <-

ELEMENT

Tag Name:	FAC-AT-5810	SS Tag:	Yes
Type:	LEL Combustible		
Process Connection:	Junction Box mounted Probe 3/4" NPT		
Electrical Connection:	Standard connector		
Calibration Gas:	Methane		
Sampling Method:	Diffusion	Detection Range:	0-100% Range
Body Material:	N/A	Electrode Material:	N/A
Insulation Material	N/A	O-ring Material:	N/A
Response Time	90% / 45 Sec	Temp Element:	N/A
Element Diameter	1.5"		
Element Length:	N/A		
Accuracy:	(The greater of) ± 5% reading or 2% full scale		
Manufacturer:	RKI Instruments		
Model:	61-1006RK		

CONTROLLER

Voltage:	115 VAC			
Power Wiring:	N/A	Signal Type:	4 - 20 mA	
Communication Protocc	N/A	Location:	Integral	
Smart: No	Indicate: Yes	Alarm:	Yes	
Electrical Protection:	N/A	Temperature Category:	N/A	
Gas Group: N/A	Enclosure Protection IP	6	IP2:	5
Ambient Temperature Compensation:	No			
Factory Calibration:	Yes			
Fail Mode:	Upscale			
Conduit Connectio	qty 2 3/4" NPT Conduit hubs			
Operating Temp:	-4 to 122 deg F	Humidity:	0 to 95% RH	
Body Material:	Fiberglass			
SS Tag:	Yes			
Accuracy:	?0.01 pH ± 0.02mA	Calibrated Range:	-2 to 16 pH	

	N/A		
	N/A		
	N/A		
	N/A		N/A
	N/A		
	N/A		
	N/A		
	N/A		

NOTES

72-2110RK Model Controller NEMA 4X enclosure w/ audible alarm
-03 Case mounted Strobe

61-1006RK Combustible Gas Detector w/ Junction Box for remote mounting

61

20-Dec-12

END OF SECTION

SECTION 40 9200

PRIMARY CONTROL DEVICES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. This section includes the specification for development of the primary control devices.

B. It is the intent of this section to procure, install, connect, program, and calibrate the selected control devices as necessary as shown in the system drawings. Some equipment controls are specified in other portions of the subcontract documents. It is the responsibility of the bidder to read and conform to all sections of this specification, review all subcontract drawings of all divisions, and coordinate with all equipment suppliers of material specified under other sections of this specification.

C. The engineering, installation supervision, calibration, start up, and checkout necessary for the primary control devices shall be provided under this section.

D. Provide the necessary materials and manpower to participate in the testing, adjusting, and balance and the commissioning process as required by those sections of this specification.

E. Primary Control Valves:

1. Electrically-Operated Primary Control Valves,
2. Pneumatically-Operated Primary Control Valves,
3. Pressure Relief Primary Control Valves,
4. Solenoid Primary Control Valves, and
5. Specialty Primary Control Valves.

F. This specification concerns the following low-level waste process measurement devices detailed on the Data Sheets included as Attachment 1.

1.2 RELATED SECTIONS

A. Section 01 2500, "Substitution Procedures."

B. Section 01 4000, "Quality Requirements."

C. Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

D. Section 01 6000, "Product Requirements."

E. Section 01 8116, "Facility Environmental Requirements."

F. Section 13 4800, "Sound, Vibration, and Seismic Control."

1.3 ABBREVIATIONS AND ACRONYMS, DEFINITIONS, AND REFERENCES

A. Refer to Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

B. Drawings:

1. Drawing C55864, Sheet D-6010, "Influent Filter System Roughing Filters P&ID."
2. Drawing C55864, Sheet D-6011, "Reaction/Precipitation System Mixing Chamber P&ID."
3. Drawing C55864, Sheet D-6012, "Reaction/Precipitation System TK-1101 P&ID."

4. Drawing C55864, Sheet D-6013, "Microfiltration System TK-1102 P&ID."
5. Drawing C55864, Sheet D-6014, "Microfiltration System Microfilter P&ID."
6. Drawing C55864, Sheet D-6015, "Microfiltration System Clean-In-Place Skid P&ID."
7. Drawing C55864, Sheet D-6016, "Reverse Osmosis System TK-1301 P&ID."
8. Drawing C55864, Sheet D-6017, "Reverse Osmosis System P-1302 P&ID."
9. Drawing C55864, Sheet D-6018, "Reverse Osmosis System Reverse Osmosis Unit P&ID."
10. Drawing C55864, Sheet D-6019, "Reverse Osmosis System TAC-4302 P&ID."
11. Drawing C55864, Sheet D-6020, "Reverse Osmosis System TK-1304 P&ID."
12. Drawing C55864, Sheet D-6021, "Polishing System Pump and FLT-1401 P&ID."
13. Drawing C55864, Sheet D-6022, "Polishing System FLT-1403 and FLT-1405 P&ID."
14. Drawing C55864, Sheet D-6023, "Solids Collection & Concentration System TK-1707 and Pump P&ID."
15. Drawing C55864, Sheet D-6024, "Solids Collection & Concentration System Rotary Filter P&ID."
16. Drawing C55864, Sheet D-6025, "Solids Collection & Concentration System TK-1702 and Pump P&ID."
17. Drawing C55864, Sheet D-6026, "Solids Collection & Concentration System TK-1704 and Pump P&ID."
18. Drawing C55864, Sheet D-6027, "Solids Collection & Concentration System TK-1703 and Pump P&ID."
19. Drawing C55864, Sheet D-6028, "De-Watering System TK-1705 and Pump P&ID."
20. Drawing C55864, Sheet D-6029, "De-Watering System EVAP-1701, EVAP-1702 P&ID."
21. Drawing C55864, Sheet D-6030, "De-Watering System TK-1706 and Pump P&ID."
22. Drawing C55864, Sheet P-6004, "Sewer System P&ID."
23. Drawing C55864, Sheet P-6006, "CAM and FAS P&ID."
24. Drawing C55865, Sheet P-6200, "Natural Gas P&ID."
25. Drawing C55865, Sheet P-6201, "Potable & Non-Potable Water P&ID."
26. Drawing C55865, Sheet P-6202, "Compressed Air P&ID."
27. Drawing C55867, Sheet D-6410, "Effluent Storage System TK-1501 P&ID."
28. Drawing C55867, Sheet D-6411, "Effluent Storage System TK-1502 and Pump P&ID."
29. Drawing C55867, Sheet D-6412, "Effluent Storage System Sample – pH Adjustment P&ID."

1.4 SUBMITTALS

A. Provide the following in accordance with the requirements of Exhibit I and timeline specified.

1. Before Fabrication:

a. Documentation of International Organization for Standardization (ISO 9001) certification (if applicable).

b. Provide a copy of the Quality Assurance Plan identifying procurement, design, fabrication, test and inspection, material traceability, and nonconformity controls for approval by Los Alamos National Laboratory (LANL) prior to Subcontract award.

c. Catalog data sheets on control devices, which show performance characteristics, dimensions, material of fabrication, and other characteristics necessary to ensure conformity with the design requirements.

d. Provide leak test procedure.

e. Provide weld inspection procedure.

f. Provide functional test procedure.

g. American Society of Mechanical Engineers (ASME)-certified Weld Inspector records.

h. Manufacturer's assembly drawings, wiring diagrams, and electrical schematics.

i. Support plan outlining product support for products in PART 2 of this section. Identify which products are available for 5 years or more. Identify if the parts are "off-the-shelf".

2. Before Shipment:

a. Certificates of Conformance (COC) for all control devices, attesting that items are in accordance with specified requirements.

b. Detailed installation instructions for instrumentation and control devices.

c. Listing of configuration parameters.

d. Loop diagrams for all instrumentation and hardwired interlocks (one instrument and related input/output per loop drawing).

e. Functional test report for control devices per Paragraph 1.8C.

f. Manufacturer's operating procedures, including safety and troubleshooting procedures, for control devices.

g. Manufacturer's maintenance procedures, including service schedules, recommended spare parts, and warranties for control devices.

h. Storage and handling procedure: long term storage, humidity trimming, temperature conditioning, shelf life limits.

3. With Shipment:

a. Base material and weld filler material Certified Material Test Report (CMTR).

b. Leak test report per Paragraph 1.8B.

c. Weld inspection report per Paragraph 1.8A.

d. Calibration certification traceable to National Institute of Standards and Technology (NIST) for positioners for electrically operated valves.

e. Evidence of nationally recognized testing laboratory (NRTL) or Underwriters Laboratories, Inc. (UL) listing or labeling for all control devices.

f. Each shipment container shall include a packing list of all items contained in that shipment container. Also, a copy of each packing list shall be sent to the LANL Subcontractor Technical Representative (STR).

1.5 QUALITY ASSURANCE

A. Seller's Quality Assurance Requirements:

1. Work Identified in this section shall be done under a Quality Assurance Program in accordance with Section 01 4000, "Quality Requirements."

B. Receipt Inspection:

1. Generally, all equipment and accessories installed under this subcontract shall be inspected by the Subcontractor in the presence of the LANL Startup and Commissioning Representative and approved before acceptance. The Subcontractor shall be responsible for all repairs as required.

2. Upon receipt, the instruments and control devices will be visually inspected by a qualified Subcontractor Quality Control Inspector for any damage or abnormalities that could affect their performance in accordance with the Quality Assurance Program.

3. Documentation will be reviewed by a qualified Subcontractor Quality Control Inspector to determine that the required documentation as specified in Paragraph 1.4 is present and traceable to the control devices.

C. Calibration and Material Certifications:

1. Electrically-operated valve positioners to be calibrated by manufacturer. Calibration shall be traceable to National Institute of Standards and Technology (NIST) standards.

2. Calibration documentation is to be included with the instruments at time of delivery.

3. Material certification for all process-wetted materials to be included with the control device at time of delivery.

D. Storage and Handling:

1. In addition to the requirements in Section 01 6000, "Product Requirements," comply with the following requirements:

a. Vendor shall be responsible for any damage resulting from improper packing until acceptance. Subcontractor shall inspect all materials upon receipt.

b. Each shipment container shall include a packing list of all items contained in that shipment container. Also, a copy of each

packing list shall be sent to the LANL Subcontractor Technical Representative (STR).

c. Vendor shall be responsible for providing any special devices needed for the delivery of any equipment and/or material.

d. Vendor shall define any heating, air conditioning, humidity control, or other storage criteria for equipment that is to be installed for regular use or is intended to be used as spare.

e. Vendor shall define long-term storage limits and maintenance procedures that are required to ensure these limits.

f. Vendor shall define shelf-life limits of all supplied equipment.

g. All openings shall be capped, plugged, or otherwise sealed against the intrusion or water, dirt, and debris. Water shall be removed from cavities to protect against damage caused by freezing and desiccant inserted, if appropriate.

E. Personnel Qualification:

1. Personnel installing control devices shall be familiar with type of control device, and required installation practices. Refer to vendor's Quality Assurance Plan for additional requirements for installation personnel.

2. Nondestructive examination of welds (where welding is used) shall be conducted by a Weld Inspector qualified in accordance with AWS QC-1 and LANL ESM (Chapter 13). All test reports shall be signed by personnel who performed or witnessed the tests and hold either Level II or Level III certification. The personnel certifications shall be submitted for approval prior to fabrication.

F. Nonconformance:

1. Nonconformance of a control device shall be documented and corrected before shipment. If found on receipt, nonconformance shall be documented and corrected before installation at the expense of the contractor in accordance with Section 01 4000, "Quality Requirements."

G. Electrical Suitability:

1. All Primary Control Devices shall be UL- or NRTL-listed or labeled.

1.6 ENVIRONMENTAL REQUIREMENTS

A. Design the process components to operate at a design altitude of 7,500 ft above sea level and in the general environmental conditions specified in Section 01 8116, "Facility Environmental Requirements." Seismic requirements are located in Section 13 4800, "Sound, Vibration, and Seismic Control."

B. For compatibility issues, additional component specific process conditions are listed on the data sheets and can include process streams with H_2SO_4, NaOH, $Fe_2(SO_4)_3$, and $MgSO_4$.

1.7 RECORDS

A. Furnish complete spare parts lists, operating instructions, and maintenance literature.

B. Provide record drawings as required by general subcontract requirements.

C. Supply control device software and configuration management type tools as applicable:

1. Verified listing of parameter values for each device required to comply with individual device datasheets.

2. Licensed copies of all specialty software needed for controlled configuration.

3. Miscellaneous hardware such as cables, dongles, keys, configuration or calibration tools, handheld programming or monitoring devices, or converters necessary to use any of the supplied devices or parameter entry.

D. Supply calibrations records for each tagged instrument.

1.8 TESTING

A. Nondestructive Examination:

1. Examine welds on structures, systems, and/or components (SSCs) in accordance with ASME B31.3 (Chapter VIII, Part 10, "Inspection, Examination, and Testing Requirements"). The attached instrument datasheets indicate the fluid service. Submit results of the weld test per Paragraph 1.4A.3.c.

B. Leak Test:

1. Perform leak test on all devices in accordance with ASME B31.3 (Chapter VIII, Part 10). The attached instrument datasheets indicate the fluid service. Submit results of the weld test per Paragraph 1.4A.3.b.

C. Functional Test:

1. Stroke all valves.

a. Ensure air-operated ball valve actuators stroke times meet requirements documented in the datasheets included with this section;

b. Ensure on/off valve proximity switches indicate correct open or close status;

c. Ensure motor-operated ball valve throttles to correct position using generator to simulate 25, 50, 75, and 100 percent open status; and

d. Submit results of the Function Test per Paragraph 1.4A.2.e.

1.9 TRAINING

A. Provide 20 hours of training to cover all general aspects of instrumentation installation, wiring, calibration techniques, programming, configuration management of devices, and parameter entry.

B. Provide 200 hours startup support to LANL startup and commissioning personnel. Support functions to include troubleshooting, point verification, performance trending, and sequence of operation verification.

C. Provide 40 hours of onsite training during the warranty period. The Subcontractor shall provide this training at the request of LANL.

1.10 SERVICE AND WARRANTY

A. For all control devices provide one-year warranty including travel costs.

B. If the manufacturer has a standard warranty that exceeds one year then the longer warranty shall be provided.

PART 2 PRODUCTS

2.1 PRODUCT OPTIONS AND SUBSTITUTIONS

A. Refer to Section 01 2500, "Substitution Procedures."

2.2 PRIMARY CONTROL VALVES

A. Electrically-Operated Primary Control Valves for Process Fluid:

1. Wetted Material – Stainless steel;
2. Power Requirement – 24V dc;
3. Process Connection – 316SS butt weld;
4. Recommended Valve Manufacturer – Flow-Tek 7000 Series Ball Valve; and
5. Recommended Actuator Manufacturer – Bray Automator Series 73.

B. Electrically-Operated Primary Modulating Control Valves for Process Fluid:

1. Wetted Material – Stainless steel;
2. Power Requirement – 24V dc;
3. Process Connection – ASME Class 150-lb raised-face flange;
4. Recommended Valve Manufacturer – Fisher GX Series; and
5. Recommended Actuator Manufacturer – Emerson M2CP1000.

C. Pneumatically-Operated Primary Modulating Control Valves for Process Fluid:

1. Wetted Material – Stainless steel;
2. Power Requirement – CA 60 to 120 psi;
3. Process Connection – ASME Class 150-lb raised-face flange; and
4. Recommended Manufacturer – Fisher GX Series.

D. Pneumatically-Operated Primary Control Valves for Process Fluid:

1. Wetted Material – Stainless steel;
2. Power Requirement – 60 to 120 psi;
3. Process Connection – 316SS butt weld; and
4. Recommended Valve Manufacturer – Flow-Tek 7000 Series Ball Valve.

E. Pressure Relief Primary Control Valves for Non-Corrosive Gases:

1. Body Material – Ductile Iron;
2. Process Connection – FNPT x FNPT; and
3. Recommended Valve Manufacturer – Crosby Series 800.

The following table provides additional component details:

Component EIN	P&ID Drawing/ Sheet No.	Service To	Line Size	Set Pressure
LLW-PRV-1105	C55864/D-6010	Roughing Filter FLT-1101	2.0 in.	125 psig
LLW-PRV-1401	C55864/D-6021	Perchlorate Ion Exchange Filter FLT-1401	2.0 in.	125 psig
LLW-PRV-1403	C55864/D-6021	Perchlorate Ion Exchange Filter FLT-1402	2.0 in.	125 psig
LLW-PRV-1405	C55864/D-6022	Polishing Ion Exchange FLT-1403	2.0 in.	125 psig
LLW-PRV-1407	C55864/D-6022	Polishing Ion Exchange FLT-1404	2.0 in.	125 psig

Component EIN	P&ID Drawing/ Sheet No.	Service To	Line Size	Set Pressure
LLW-PRV-1409	C55864/D-6022	Absorber FLT-1405	2.0 in.	125 psig
LLW-PRV-1411	C55864/D-6022	Absorber FLT-1406	2.0 in.	125 psig

F. Pressure Relief Primary Control Valves for Instrument Air:

1. Body Material – 316 Stainless Steel ASTM A 479;
2. Process Connection – FNPT x FNPT;
3. Recommended Valve Manufacturer – Generant; and
4. Recommended Model Number – IRVD-4V-V-80-X with 0.312" Orifice.

The following table provides additional component details:

Component EIN	P&ID Drawing/ Sheet No.	Service To	Line Size	Set Pressure
CA-PSV-5412	C55864/D-6014	FCV-1219	1/2 in.	80 psig
CA-PSV-5413	C55864/D-6017	FCV-1311	1/2 in.	80 psig
CA-PSV-5414	C55864/D-6017	FCV-1314	1/2 in.	80 psig
CA-PSV-5415	C55864/D-6021	FCV-1403	1/2 in.	80 psig
CA-PSV-5418	C55864/D-6030	FCV-1701	1/2 in.	80 psig
CA-PSV-5419	C55864/D-6023	FCV-1707	1/2 in.	80 psig
CA-PSV-5420	C55864/D-6027	FCV-1719	1/2 in.	80 psig

G. Vacuum Relief Primary Control Valves for Non-Corrosive Gases:

1. Body Material – Stainless Steel;
2. Process Connection – ASME Class 150-lb raised-face flange; and
3. Recommended Valve Manufacturer – Anderson Greenwood Type 9200.

The following table provides additional component details:

Component EIN	P&ID Drawing/ Sheet No.	Service To	Line Size	Set Vacuum
LLW-PSV-1400	C55864/D-6021	Perchlorate Ion Exchange Filter FLT-1401	2.0 in.	50" H_2O
LLW-PSV-1402	C55864/D-6021	Perchlorate Ion Exchange Filter FLT-1402	2.0 in.	50" H_2O
LLW-PSV-1404	C55864/D-6022	Polishing Ion Exchange FLT-1403	2.0 in.	50" H_2O
LLW-PSV-1406	C55864/D-6022	Polishing Ion Exchange FLT-1404	2.0 in.	50" H_2O
LLW-PSV-1408	C55864/D-6022	Absorber FLT-1405	2.0 in.	50" H_2O
LLW-PSV-1410	C55864/D-6022	Absorber FLT-1406	2.0 in.	50" H_2O

H. Pressure Reducing Regulators for Compressed Air Service:

1. Body Material – Stainless steel;
2. Process Connection – NPT; and
3. Valve Manufacturer – Fisher 95H Series; 70 to 150 psig outlet pressure range.

The following table provides additional component details (air pressure to all regulators is 105 to 120 psig):

Component EIN	P&ID Drawing/ Sheet No.	Service To	Line Size	Set Pressure
CA-PCV-5401	C55864/D-6018	Reverse Osmosis Array Skid, ROU-1301	1/8 in.	100 psig
CA-PCV-5406	C55864/D-6010	Roughing Filter FLT-1101	1/2 in.	80 psig
CA-PCV-5407	C55864/D-6013	Microfilter Skid	1/2 in.	100 psig
CA-PCV-5412	C55864/D-6014	Flow Control Valve FCV-1206 Pneumatic Actuator	1/2 in.	75 psig
CA-PCV-5413	C55864/D-6017	Flow Control Valve FCV-1311 Pneumatic Actuator	1/2 in.	75 psig
CA-PCV-5414	C55864/D-6017	Flow Control Valve FCV-1315 Pneumatic Actuator	1/2 in.	75 psig
CA-PCV-5415	C55864/D-6021	Flow Control Valve FCV-1403 Pneumatic Actuator	1/2 in.	75 psig
CA-PCV-5417	C55864/D-6030	Flow Control Valve FCV-1700 Pneumatic Actuator	1/2 in.	75 psig
CA-PCV-5418	C55864/D-6030	Flow Control Valve FCV-1701 Pneumatic Actuator	1/2 in.	75 psig
CA-PCV-5419	C55864/D-6023	Flow Control Valve FCV-1707 Pneumatic Actuator	1/2 in.	75 psig
CA-PCV-5420	C55864/D-6027	Flow Control Valve FCV-1719 Pneumatic Actuator	1/2 in.	75 psig
CA-PCV-5421	C55864/D-6012	Level Control Valve LCV-1124 Pneumatic Actuator	1/2 in.	75 psig

I. Solenoid Primary Control Valves:

1. Process Connection – ASME Class 150-lb raised-face flange and
2. Valve Manufacturer – ASCO, Series 8223.

PART 3 EXECUTION

3.1 GENERAL

A. Provide control devices as specified in PART 2 of this section, and all field hardware, conduit, wiring, etc., for a complete installation.

B. Install all aspects of the system in compliance with all applicable codes, regulations, and all related Subcontract documents.

C. Install all materials in accordance with the published manufacturer's recommendations without exception.

D. Where miscellaneous materials are required to complete an installation (control solenoids, etc.), supply the materials as defined in the relevant section of this specification. Install them under this section of this specification, unless otherwise noted.

E. Coordinate with other trades where installation of a particular component requires other trades to be involved. Installation coordination includes the correct placement of control valves, solenoids, relays, control power circuits, etc. Care shall be exercised to identify locations that meet the requirements of the manufacture.

F. All signal wiring requiring shielding shall have the shield terminated at the controller end only. Trim and insulate the shield wire at the device end.

G. Label all wiring with permanent labels indicating the point device identifier. Install a phenolic label mounted at the device indicating the device type and point identifier name.

H. Label all field devices with 1-in. by 3-in. phenolic labels. Labels shall include the point name and device name. Labels shall be glued, attached with screws, or stainless wire in the case of valves.

3.2 PRIMARY CONTROL DEVICES

A. Valves shall be flushed clean of dirt, burrs, and welding residues.

B. Valves with an electrical input or output shall be UL- or NRTL-listed or labeled.

C. Primary Control Valves

1. Electrically-Operated Primary Control Valves

a. Clean and inspect metal parts. If the seating surfaces have been damaged then replace the ball and stem.

b. Actuators shall be mounted vertically either top-dead-center (above the pipe) or 90 degrees from top-dead-center.

c. Actuators shall be installed to ensure they do not interfere with the operation or access to other equipment.

d. Actuators shall be configured in a consistent manner with attention to actuator rotation direction so that a 0 percent "close" or 100 percent open command has consistent result to close or open the valve.

2. Pneumatically-Operated Primary Control Valves

a. Clean and inspect metal parts. If the seating surfaces have been damaged then replace the ball and stem.

b. Actuators shall be mounted vertically either top-dead-center (above the pipe) or 90 degrees from top-dead-center.

c. Actuators shall be installed to ensure they do not interfere with the operation or access to other equipment.

d. Proximity sensor assembly shall include commercial off-the-shelf (COTS) cord set with one end having mating plug connection for interfacing sensor housing. The other end shall have flying leads.

e. Provide A UL-labeled junction box and connecting means to terminate the cord set. All wiring and terminations shall be *National Electrical Code* (NEC) (NFPA 70)-compliant.

3. Pressure Relief Primary Control Valves

a. Clean and inspect metal parts. If the seating surfaces have been damaged then replace the ball and stem.

4. Solenoid Primary Control Valves

a. Provide Verein Deutscher Ingenieure/Verband Deutscher Elektrotechniker (VDI/VDE) standard compliant mounting.

5. Specialty Primary Control Valves

a. Clean and inspect metal parts. If the seating surfaces have been damaged then replace the ball and stem.

b. Actuators shall be mounted vertically either top-dead-center (above the pipe) or 90 degrees from top-dead-center.

c. Actuators shall be installed to ensure they do not interfere with the operation or access to other equipment.

d. Provide a UL-labeled junction box and connecting means to terminate the cord set. All wiring and terminations shall be NEC (NFPA 70)-compliant.

3.3 FIELD TESTING AND ADJUSTING EQUIPMENT

A. Testing: The Subcontractor shall provide personnel, equipment, instrumentation, and supplies necessary to perform site testing. LANL will witness the testing, and written permission shall be obtained from LANL before proceeding with testing.

B. Data: Original copies of data produced, including the results of each test procedure, shall be turned over to LANL at the conclusion of each phase of testing prior to LANL approval of the test.

C. Test Procedures: The test procedures shall cover actual equipment and functions specified for the Project.

PART 4 ATTACHMENT 1 DATA SHEETS

Component EIN	Component Name	Drawing / Sheet No.	Data Sheet
LLW-AOBV-1103	FLT-1101 Inlet Supply Valve	C55864 / D-6010	AOBV-1103
LLW-AOBV-1107	FLT-1101 Discharge Valve	C55864 / D-6010	AOBV-1107
LLW-AOBV-1115	TK-1101 Inlet from Lab & Utility Sinks	C55864 / D-6012	AOBV-1115
LLW-AOBV-1122	TK-1102 Drain Valve	C55864 / D-6012	AOBV-1122
LLW-AOBV-1124	FLT-1201 Recirculation Valve	C55864 / D-6014	AOBV-1124
LLW-AOBV-1126	TK-1101 Discharge Valve	C55864 / D-6012	AOBV-1126
LLW-AOBV-1157	TK-1706 Evap Condensate Return Valve	C55864 / D-6030	AOBV-1157
LLW-AOBV-1304	TK-1301 LLW Condensate Recycle Inlet Valve	C55864 / D-6016	AOBV-1304
LLW-AOBV-1320	ROU-1301 Feed Valve	C55864 / D-6018	AOBV-1320
LLW-AOBV-1323	TK-1705 RO Recycle Valve	C55864 / D-6018	AOBV-1323
LLW-AOBV-1324	TK-1101 RO Recycle Valve	C55864 / D-6018	AOBV-1324
LLW-AOBV-1329	ROU-1301 Permeate Feed Valve to TAC-4302	C55864 / D-6018	AOBV-1329
LLW-AOBV-1331	ROU-1301 Permeate Feed Valve to TK-1304	C55864 / D-6018	AOBV-1331
LLW-AOBV-1340	Condensate Bypass Valve to Tank TK-1304	C55864 / D-6020	AOBV-1340
LLW-AOBV-1342	TK-1304 Outlet Feed Valve	C55864 / D-6021	AOBV-1342
LLW-AOBV-1355	ROU-1301 Conc Feed Valve to TAC-4302	C55864 / D-6018	AOBV-1355
LLW-MOBV-1510	TK-1501 Feed Valve	C55867 / D-6410	MOBV-1510
LLW-MOBV-1512	TK-1501 Recycle Feed Valve	C55867 / D-6410	MOBV-1512
LLW-MOBV-1513	TK-1501 Discharge Valve	C55867 / D-6410	MOBV-1513
LLW-MOBV-1529	TK-1501, TK-1502 Discharge Valve to ZLD, Outfall	C55867 / D-6411	MOBV-1529
LLW-MOBV-1531	TK-1502 Discharge Valve	C55867 / D-6411	MOBV-1531
LLW-MOBV-1549	TK-1502 Recycle Feed Valve	C55867 / D-6411	MOBV-1549
LLW-MOBV-1550	TK-1502 Feed Valve	C55867 / D-6411	MOBV-1550
LLW-AOBV-1706	TK-1702 Supply Valve	C55864 / D-6024	AOBV-1706
LLW-AOBV-1708	TK-1707 Discharge Valve	C55864 / D-6023	AOBV-1708
LLW-AOBV-1717	TK-1702 to TK-1703 Feed Valve	C55864 / D-6025	AOBV-1717
LLW-AOBV-1728	EVAP-1702 Feed Valve	C55864 / D-6029	AOBV-1728
LLW-AOBV-1737	LLW Return to TK-1705	C55864 / D-6028	AOBV-1737
NPWC-AOBV-5622	TK-1101 NPWC Supply Valve	C55864 / D-6012	AOBV-5622
NPWC-AOBV-5623	TK-1102 NPWC Supply Valve	C55864 / D-6013	AOBV-5623
NPWC-AOBV-5624	TAC-4302 NPWC Supply Valve	C55864 / D-6019	AOBV-5624
NPWC-AOBV-5625	TK-1702 Potable Water Feed Valve	C55864 / D-6025	AOBV-5625
NPWC-AOBV-5626	TK-1705 Potable Water Feed Valve	C55864 / D-6028	AOBV-5626
NPWC-AOBV-5627	TK-1102 NPWC Bypass Valve	C55864 / D-6013	AOBV-5627
LLW-FCV-1206	MF Outlet Flow Control Valve	C55864 / D-6014	FCV-1206
LLW-FCV-1311	RO Recycle to TK-1301	C55864 / D-6017	FCV-1311
LLW-FCV-1315	RO Feed Flow Control Valve	C55864 / D-6017	FCV-1315
LLW-FCV-1403	RO Permeate Recycle Flow Control Valve	C55864 / D-6021	FCV-1403
LLW-FCV-1515	Effluent Recycle Flow Control Valve	C55867 / D-6412	FCV-1515

Component EIN	Component Name	Drawing / Sheet No.	Data Sheet
LLW-FCV-1700	TK-1706 Condensate Recycle Flow Control Valve	C55864 / D-6030	FCV-1700
LLW-FCV-1701	TK-1706 Condensate Recycle Flow Control Valve	C55864 / D-6030	FCV-1701
LLW-FCV-1707	TK-1707 Recycle Flow Control Valve	C55864 / D6023	FCV-1707
LLW-FCV-1719	TK-1703 Recycle Flow Control Valve	C55864 / D-6027	FCV-1719
LLW-LCV-1124	TK-1101 Discharge Level Control Valve	C55864 / D-6012	LCV-1124
CA-SOV-5409	P-1701 Compressed Air Supply Valve	C55864 / D-6012	SOV-5409
CA-SOV-5410	P-1702 Compressed Air Supply Valve	C55864 / D-6025	SOV-5410

AECOM

On/Off Control Valves

DATA SHEET NO.			REV.
AOBV-1103			A
SHEET	OF	DATE	
1	2	1-17-13	

NO.	BY	DATE	REVISION

BY	CHK'D	PROC.	APPR.
AME	NCC		

P.O.	
REQ.	

Project: RLWTF

TAG NO: LLW-AOBV-1103

Spec No:	40 9200	Line / Vessel Number:	LLW-101				
Asset No:		P&ID:	D-6010	Line ID:	1.610"	Size: 1.5"	Schedule: 40
Service Description:	LLW Influent Roughing Filter FLT-1101 Inlet	Manufacturer:	*Flow-Tek				
		Model:	7-3-07-3-U-U-SR				
Safety Class	NS	Quality Assurance Level:	ML-4				

PROCESS CONDITIONS

Process Data Case:	Normal									Units:
Sizing Case:	Normal									-
Required Cv:	225 to 325									-
Travel:	NA									-
Sound Pressure Level:	NA									-
	Inlet:	Outlet:	Inlet:	Outlet:	Inlet:	Outlet:	Inlet:	Outlet:		
Liquid Flow:	25.5	25.5								gpm
Vapor Flow:	NA	NA								cfm
Temperature:	75	75								°F
Pressure:	45	45								psig
Density:	1.02									g/ml
Viscosity:	1.05									cP
Critical Pressure (Pseudo):	NA									psia
pH:	8.2									-
Compressibility (Z):	NA									-
Specific Heat Ratio (C_P/C_V):	NA									-

Fluid:	LLW (contaminated water)	Max Temperature:	125 °F	Inlet:	Outlet
Area Classification:		Max Upset Pressure (normal flow):			
Ambient Temperature Requirements:	55 to 95 °F	Max Upset Pressure (reverse flow):			

VALVE BODY / BONNET

Valve Type:	3 Piece Full Port Ball Valve		
Body Size:	1.5"	ANSI Class:	150
Max Rated Pressure:	1000 psi	Max Rated Temperature:	200 °F
Body/Bonnet Material:	316SS (ASTM A351 CF8M)		
Liner Material / ID:	N/A		
Inlet Connection Face:	Butt Weld		
Outlet Connection Face:	Butt Weld		
Flange Face Finish:	N/A		
Bonnet Style:	N/A		
Lube Iso Valve:	No	Lube:	N/A
Packing Style:	Seat Rings		
Packing Material:	UHMWPE		
Body/Bonnet Gasket Material:	N/A		
Manufacturer:	*Flow-Tek		
Model:	7000-316SS		

SWITCH

RELAY 1	Tag No:	ZSO-1103			
	Power Rating:	24V dc	Type:	N/O	
	Alarm Setting	N/A			
RELAY 2	Tag No:	ZSC-1103			
	Power Rating:	24V dc	Type:	N/O	
	Alarm Setting	N/A			
Sensor Type:	Proximity	Max. Load Current:	200 mA		
Conduit Connection:	1/2" NPT				
Manufacturer:	*Flow-Tek (Bray)				
Model No.	2N1 (Series 52)				
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1:	5	IP2:	6

TRIM

TrimType:	Single Seat				
Size:	1.5"	Travel	N/A		
Rated Cv:	275	FI:	N/A	Xt:	N/A
Characteristic:	N/A				
Balanced/Unbalanced:	Balanced				
Plug Material:	316SS (ASTM A351 CF8M)				
Seat Material:	UHMWPE				
Stem Material:	316SS (ASTM A479)				
Ext Trim Material:	316SS (ASTM A351 CF3M)				
Seat Leakage Class:	FCI 70-2 Class IV	Flow Direction:	Bi-directional		
Manufacturer:	*Flow-Tek	Model:	7000-316SS		

ACTUATOR

Actuator Type:	Pneumatic				
Valve Air Failure Position:	FC	Valve Function:	On / Off		
Size:	N/A	Effective Area:	N/A		
Actuator Orientation:	Top Mount	Spring action	Close		
Hand Wheel Type:	None	Position	Indicator Pointer		
Air Failure Valve:	None	Set at	N/A		
Available Air Supply Pressure:					
Min:	105 psig	Max:	120 psig		
Allowable Pressure Requirements:					
Min:	80 psig	Max:	140 psig		
Bench Range:	N/A				
Required Stroke Time to Open:	1/2 s @ 80 psig				
Required Stroke Time to Close:	1/2 s @ 80 psig				
Manufacturer:	*Flow-Tek				
Model:	Series 93: Size 119-4				

TAG NO.	LLW-AOBV-1103	ON/OFF Control Valves	DATA SHEET NO.	SHEET	OF
			AOBV-1103	2	2

SOLENOID

Tag No:	HS-1103	Fluid:	Air		
Type:	3-Way	Coil:	Class F		
Coil Housing:	NEMA 4X	Watts:	6.9		
Voltage:	24V dc				
Power Wiring:	N/A	Signal Type:	N/A		
Communication Protocol:	N/A	Location:	Direct Mounted		
Smart:	N/A	Indicate:	No	Isolate:	No
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1	5	IP2:	6
Main Valve Action when Coil is Deenergized:	Close				
Conduit Connection:	1/2" NPT				
Body Material:	Anodized Aluminum				
Manufacturer:	*Bray	Model:	Series 63		

NOTES

Valves to be tested in accordance with ASTM D5162, ANSI B16.34 or B16.42 and MSS SP-61 (Pressure Testing of Valves). All dimensions are to be in accordance with ANSI B16.42 (ductile iron) or ANSI B16.5 (steel) and MSS SP-72 (Ball Valves with Flanged or Butt-Welding Ends for General Service). Valves are to be certified Fire-Safe in accordance with API-607.

*Recommended Manufacturer

Valve Model 7-3-07-3-U-U-SR:
- 7 - Body Material: 316 Stainless Steel (CF8M)
- 3 - End Connection: Butt Weld
- 07 - Valve Size: 1.5"
- 3 - Ball and Stem: 316 Stainless Steel
- U - Seat: UHMWPE
- U - Seals: UHMWPE
- SR - Operator: Spring Return Pneumatic Actuator

Actuator Model Series 93, Size 119-4:
- 93 - Actuator Type: Pneumatic Spring Return Actuator
- 119 - Actuator Size Designation (12.40" l x 4.91" w x 7.28" h)
- 4 - No. of Springs per Piston

Actuator to Valve Mounting Kit: ISO Mounting Kit EZ-010S

AECOM

On/Off Control Valves

DATA SHEET NO.	REV.
AOBV-1107	A

SHEET	OF	DATE
1	2	1-17-13

NO.	BY	DATE	REVISION

BY	CHK'D	PROC.	APPR.
AME	NCC		

P.O.

REQ.

Project:	RLWTF
TAG NO:	LLW-AOBV-1107
Asset No:	
Service Description:	LLW Influent Roughing Filter FLT-1101 Discharge
Safety Class	NS

Spec No:	40 9200	Line / Vessel Number:	LLW-075
P&ID:	D-6010	Line ID: 1.380" Size: 1.25"	Schedule: 40
		Manufacturer:	*Flow-Tek
		Model:	7-3-06-3-U-U-SR
		Quality Assurance Level:	ML-4

PROCESS CONDITIONS

Process Data Case:	Normal								Units:
Sizing Case:	Normal								-
Required Cv:	160 to 240								-
Travel:	NA								-
Sound Pressure Level:	NA								-
	Inlet:	Outlet:	Inlet:	Outlet:	Inlet:	Outlet:	Inlet:	Outlet:	
Liquid Flow:	25.5	25.5							gpm
Vapor Flow:	NA	NA							cfm
Temperature:	75	75							°F
Pressure:	45	45							psig
Density:	1.02								g/ml
Viscosity:	1.05								cP
Critical Pressure (Pseudo):	NA								psia
pH:	8.2								-
Compressibility (Z):	NA								-
Specific Heat Ratio ($^{C_P}/_{C_V}$):	NA								-

Fluid:	LLW (contaminated water)	Max Temperature:	125 °F	Inlet:	Outlet
Area Classification:		Max Upset Pressure (normal flow):			
Ambient Temperature Requirements:	55 to 95 °F	Max Upset Pressure (reverse flow):			

VALVE BODY / BONNET

Valve Type:	3 Piece Full Port Ball Valve		
Body Size:	1.25"	ANSI Class:	150
Max Rated Pressure:	1000 psi	Max Rated Temperature:	200 °F
Body/Bonnet Material:	316SS (ASTM A351 CF8M)		
Liner Material / ID:	N/A		
Inlet Connection Face:	Butt Weld		
Outlet Connection Face:	Butt Weld		
Flange Face Finish:	N/A		
Bonnet Style:	N/A		
Lube Iso Valve:	No	Lube:	N/A
Packing Style:	Seat Rings		
Packing Material:	UHMWPE		
Body/Bonnet Gasket Material:	N/A		
Manufacturer:	*Flow-Tek		
Model:	7000-316SS		

SWITCH

RELAY 1	Tag No:	ZSO-1107			
	Power Rating:	24V dc	Type:	N/O	
	Alarm Setting	N/A			
RELAY 2	Tag No:	ZSC-1107			
	Power Rating:	24V dc	Type:	N/O	
	Alarm Setting	N/A			
Sensor Type:	Proximity	Max. Load Current:	200 mA		
Conduit Connection:	1/2" NPT				
Manufacturer:	*Flow-Tek (Bray)				
Model No.	2N1 (Series 52)				
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1	5	IP2:	6

TRIM

TrimType:	Single Seat				
Size:	1.25"	Travel	N/A		
Rated Cv:	200	Fl:	N/A	Xt:	N/A
Characteristic:	N/A				
Balanced/Unbalanced:	Balanced				
Plug Material:	316SS (ASTM A351 CF8M)				
Seat Material:	UHMWPE				
Stem Material:	316SS (ASTM A479)				
Ext Trim Material:	316SS (ASTM A351 CF3M)				
Seat Leakage Class:	FCI 70-2 Class IV	Flow Direction:	Bi-directional		
Manufacturer:	*Flow-Tek	Model:	7000-316SS		

ACTUATOR

Actuator Type:	Pneumatic		
Valve Air Failure Position:	FC	Valve Function:	On / Off
Size:	N/A	Effective Area:	N/A
Actuator Orientation:	Top Mount	Spring action	Close
Hand Wheel Type:	None	Position	Indicator Pointer
Air Failure Valve:	None	Set at	N/A
Available Air Supply Pressure:			
Min:	105 psig	Max:	120 psig
Allowable Pressure Requirements:			
Min:	80 psig	Max:	140 psig
Bench Range:	N/A		
Required Stroke Time to Open:	1/4 s @ 80 psig		
Required Stroke Time to Close:	1/4 s @ 80 psig		
Manufacturer:	*Flow-Tek		
Model:	Series 93: Size 93-4		

TAG NO.	LLW-AOBV-1107	ON/OFF Control Valves	DATA SHEET NO.	SHEET	OF
			AOBV-1107	2	2

SOLENOID

Tag No:	HS-1107	Fluid:	Air		
Type:	3-Way	Coil:	Class F		
Coil Housing:	NEMA 4X	Watts:	6.9		
Voltage:	24V dc				
Power Wiring:	N/A	Signal Type:	N/A		
Communication Protocol:	N/A	Location:	Direct Mounted		
Smart:	N/A	Indicate:	No	Isolate:	No
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1	5	IP2:	6
Main Valve Action when Coil is Deenergized:	Close				
Conduit Connection:	1/2" NPT				
Body Material:	Anodized Aluminum				
Manufacturer:	*Bray	Model:	Series 63		

NOTES

Valves to be tested in accordance with ASTM D5162, ANSI B16.34 or B16.42 and MSS SP-61 (Pressure Testing of Valves). All dimensions are to be in accordance with ANSI B16.42 (ductile iron) or ANSI B16.5 (steel) and MSS SP-72 (Ball Valves with Flanged or Butt-Welding Ends for General Service). Valves are to be certified Fire-Safe in accordance with API-607.

*Recommended Manufacturer

Valve Model 7-3-06-3-U-U-SR:
- 7 - Body Material: 316 Stainless Steel (CF8M)
- 3 - End Connection: Butt Weld
- 06 - Valve Size: 1.25"
- 3 - Ball and Stem: 316 Stainless Steel
- U - Seat: UHMWPE
- U - Seals: UHMWPE
- SR - Operator: Spring Return Pneumatic Actuator

Actuator Model Series 93, Size 93-4:
- 93 - Actuator Type: Pneumatic Spring Return Actuator
- 93 - Actuator Size Designation (8.59" l x 4.17" w x 5.78" h)
- 4 - No. of Springs per Piston

Actuator to Valve Mounting Kit: ISO Mounting Kit EZ-005S

AECOM

On/Off Control Valves

DATA SHEET NO.			REV.
AOBV-1115			A
SHEET	OF	DATE	
1	2	1-17-13	

NO.	BY	DATE	REVISION

BY	CHK'D	PROC.	APPR.
AME	NCC		

P.O.	
REQ.	

Project:	RLWTF
TAG NO:	LLW-AOBV-1115
Asset No:	
Service Description:	LLW from Corridor Sump to Tank TK-1101 Inlet
Safety Class	NS

Spec No:	40 9200	Line / Vessel Number:	LLW-096
P&ID:	D-6012	Line ID: 1.610" Size: 1.5"	Schedule: 40
Manufacturer:	*Flow-Tek		
Model:	7-3-07-3-U-U-SR		
Quality Assurance Level:	ML-4		

PROCESS CONDITIONS

Process Data Case:	Normal									Units:
Sizing Case:	Normal									-
Required Cv:	225 to 325									-
Travel:	NA									-
Sound Pressure Level:	NA									-
	Inlet:	Outlet:	Inlet:	Outlet:	Inlet:	Outlet:	Inlet:	Outlet:		
Liquid Flow:	N/A	N/A								gpm
Vapor Flow:	N/A	N/A								cfm
Temperature:	75	75								°F
Pressure:	45	45								psig
Density:	1.02									g/ml
Viscosity:	1.05									cP
Critical Pressure (Pseudo):	NA									psia
pH:	8.2									-
Compressibility (Z):	NA									-
Specific Heat Ratio (C_P/C_V):	NA									-

Fluid:	LLW (contaminated water)	Max Temperature:	125 °F	Inlet:	Outlet
Area Classification:		Max Upset Pressure (normal flow):			
Ambient Temperature Requirements:	55 to 95 °F	Max Upset Pressure (reverse flow):			

VALVE BODY / BONNET

Valve Type:	3 Piece Full Port Ball Valve		
Body Size:	1.5"	ANSI Class:	150
Max Rated Pressure:	1000 psi	Max Rated Temperature:	200 °F
Body/Bonnet Material:	316SS (ASTM A351 CF8M)		
Liner Material / ID:	N/A		
Inlet Connection Face:	Butt Weld		
Outlet Connection Face:	Butt Weld		
Flange Face Finish:	N/A		
Bonnet Style:	N/A		
Lube Iso Valve:	No	Lube:	N/A
Packing Style:	Seat Rings		
Packing Material:	UHMWPE		
Body/Bonnet Gasket Material:	N/A		
Manufacturer:	*Flow-Tek		
Model:	7000-316SS		

SWITCH

RELAY 1	Tag No:	ZSO-1115			
	Power Rating:	24V dc	Type:	N/O	
	Alarm Setting	N/A			
RELAY 2	Tag No:	ZSC-1115			
	Power Rating:	24V dc	Type:	N/O	
	Alarm Setting	N/A			
Sensor Type:	Proximity	Max. Load Current:	200 mA		
Conduit Connection:	1/2" NPT				
Manufacturer:	*Flow-Tek (Bray)				
Model No.	2N1 (Series 52)				
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1	5	IP2:	6

TRIM

TrimType:	Single Seat				
Size:	1.5"	Travel	N/A		
Rated Cv:	275	Fl:	N/A	Xt:	N/A
Characteristic:	N/A				
Balanced/Unbalanced:	Balanced				
Plug Material:	316SS (ASTM A351 CF8M)				
Seat Material:	UHMWPE				
Stem Material:	316SS (ASTM A479)				
Ext Trim Material:	316SS (ASTM A351 CF3M)				
Seat Leakage Class:	FCI 70-2 Class IV	Flow Direction:	Bi-directional		
Manufacturer:	*Flow-Tek	Model:	7000-316SS		

ACTUATOR

Actuator Type:	Pneumatic		
Valve Air Failure Position:	FC	Valve Function:	On / Off
Size:	N/A	Effective Area:	N/A
Actuator Orientation:	Top Mount	Spring action	Close
Hand Wheel Type:	None	Position	Indicator Pointer
Air Failure Valve:	None	Set at	N/A
Available Air Supply Pressure:			
Min:	105 psig	Max:	120 psig
Allowable Pressure Requirements:			
Min:	80 psig	Max:	140 psig
Bench Range:	N/A		
Required Stroke Time to Open:	1/2 s @ 80 psig		
Required Stroke Time to Close:	1/2 s @ 80 psig		
Manufacturer:	*Flow-Tek		
Model:	Series 93: Size 119-4		

TAG NO.	LLW-AOBV-1115	ON/OFF Control Valves	DATA SHEET NO.	SHEET	OF
			AOBV-1115	2	2

SOLENOID

Tag No:	HS-1115	Fluid:	Air		
Type:	3-Way	Coil:	Class F		
Coil Housing:	NEMA 4X	Watts:	6.9		
Voltage:	24V dc				
Power Wiring:	N/A	Signal Type:	N/A		
Communication Protocol:	N/A	Location:	Direct Mounted		
Smart:	N/A	Indicate:	No	Isolate:	No
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1:	5	IP2:	6
Main Valve Action when Coil is Deenergized:	Close				
Conduit Connection:	1/2" NPT				
Body Material:	Anodized Aluminum				
Manufacturer:	*Bray	Model:	Series 63		

NOTES

Valves to be tested in accordance with ASTM D5162, ANSI B16.34 or B16.42 and MSS SP-61 (Pressure Testing of Valves). All dimensions are to be in accordance with ANSI B16.42 (ductile iron) or ANSI B16.5 (steel) and MSS SP-72 (Ball Valves with Flanged or Butt-Welding Ends for General Service). Valves are to be certified Fire-Safe in accordance with API-607.

*Recommended Manufacturer

Valve Model 7-3-07-3-U-U-SR:
- 7 - Body Material: 316 Stainless Steel (CF8M)
- 3 - End Connection: Butt Weld
- 07 - Valve Size: 1.5"
- 3 - Ball and Stem: 316 Stainless Steel
- U - Seat: UHMWPE
- U - Seals: UHMWPE
- SR - Operator: Spring Return Pneumatic Actuator

Actuator Model Series 93, Size 119-4:
- 93 - Actuator Type: Pneumatic Spring Return Actuator
- 119 - Actuator Size Designation (12.40" l x 4.91" w x 7.28" h)
- 4 - No. of Springs per Piston

Actuator to Valve Mounting Kit: ISO Mounting Kit EZ-010S

AECOM

On/Off Control Valves

DATA SHEET NO.			REV.
AOBV-1122			A
SHEET	OF	DATE	
1	2	1-17-13	
BY	CHK'D	PROC.	APPR.
AME	NCC		
P.O.			
REQ.			

NO.	BY	DATE	REVISION

Project:	RLWTF
TAG NO:	LLW-AOBV-1122
Asset No:	
Service Description:	LLW from Tank TK-1101 Drain
Safety Class	NS

Spec No:	40 9200	Line / Vessel Number:	LLW-314
P&ID:	D-6012	Line ID: 1.610" Size: 1.5"	Schedule: 40
Manufacturer:	*Flow-Tek		
Model:	7-3-07-3-U-U-SR		
Quality Assurance Level:	ML-4		

PROCESS CONDITIONS

Process Data Case:	Normal									Units:
Sizing Case:	Normal									-
Required Cv:	225 to 325									-
Travel:	NA									-
Sound Pressure Level:	NA									-
	Inlet:	Outlet:	Inlet:	Outlet:	Inlet:	Outlet:	Inlet:	Outlet:		
Liquid Flow:	36.6	36.6								gpm
Vapor Flow:	NA	NA								cfm
Temperature:	75	75								°F
Pressure:	45	45								psig
Density:	1.02									g/ml
Viscosity:	1.05									cP
Critical Pressure (Pseudo):	NA									psia
pH:	10.8									-
Compressibility (Z):	NA									-
Specific Heat Ratio ($^{C_P}/_{C_V}$):	NA									-

Fluid:	LLW (contaminated water)	Max Temperature:	125 °F	Inlet:	Outlet
Area Classification:		Max Upset Pressure (normal flow):			
Ambient Temperature Requirements:	55 to 95 °F	Max Upset Pressure (reverse flow):			

VALVE BODY / BONNET

Valve Type:	3 Piece Full Port Ball Valve		
Body Size:	1.5"	ANSI Class:	150
Max Rated Pressure:	1000 psi	Max Rated Temperature:	200 °F
Body/Bonnet Material:	316SS (ASTM A351 CF8M)		
Liner Material / ID:	N/A		
Inlet Connection Face:	Butt Weld		
Outlet Connection Face:	Butt Weld		
Flange Face Finish:	N/A		
Bonnet Style:	N/A		
Lube Iso Valve:	No	Lube:	N/A
Packing Style:	Seat Rings		
Packing Material:	UHMWPE		
Body/Bonnet Gasket Material:	N/A		
Manufacturer:	*Flow-Tek		
Model:	7000-316SS		

SWITCH

RELAY 1	Tag No:	ZSO-1122			
	Power Rating:	24V dc	Type:	N/O	
	Alarm Setting	N/A			
RELAY 2	Tag No:	ZSC-1122			
	Power Rating:	24V dc	Type:	N/O	
	Alarm Setting	N/A			
Sensor Type:	Proximity	Max. Load Current:	200 mA		
Conduit Connection:	1/2" NPT				
Manufacturer:	*Flow-Tek (Bray)				
Model No.	2N1 (Series 52)				
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1:	5	IP2:	6

TRIM

TrimType:	Single Seat				
Size:	1.5"	Travel	N/A		
Rated Cv:	275	FI:	N/A	Xt:	N/A
Characteristic:	N/A				
Balanced/Unbalanced:	Balanced				
Plug Material:	316SS (ASTM A351 CF8M)				
Seat Material:	UHMWPE				
Stem Material:	316SS (ASTM A479)				
Ext Trim Material:	316SS (ASTM A351 CF3M)				
Seat Leakage Class:	FCI 70-2 Class IV	Flow Direction:	Bi-directional		
Manufacturer:	*Flow-Tek	Model:	7000-316SS		

ACTUATOR

Actuator Type:	Pneumatic				
Valve Air Failure Position:	FC	Valve Function:	On / Off		
Size:	N/A	Effective Area:	N/A		
Actuator Orientation:	Top Mount	Spring action	Close		
Hand Wheel Type:	None	Position	Indicator Pointer		
Air Failure Valve:	None	Set at	N/A		
Available Air Supply Pressure:					
Min:	105 psig	Max:	120 psig		
Allowable Pressure Requirements:					
Min:	80 psig	Max:	140 psig		
Bench Range:	N/A				
Required Stroke Time to Open:	1/2 s @ 80 psig				
Required Stroke Time to Close:	1/2 s @ 80 psig				
Manufacturer:	*Flow-Tek				
Model:	Series 93: Size 119-4				

TAG NO.	LLW-AOBV-1122	ON/OFF Control Valves	DATA SHEET NO.	SHEET	OF
			AOBV-1122	2	2

SOLENOID

Tag No:	HS-1122	Fluid:	Air		
Type:	3-Way	Coil:	Class F		
Coil Housing:	NEMA 4X	Watts:	6.9		
Voltage:	24V dc				
Power Wiring:	N/A	Signal Type:	N/A		
Communication Protocol:	N/A	Location:	Direct Mounted		
Smart:	N/A	Indicate:	No	Isolate:	No
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1	5	IP2:	6
Main Valve Action when Coil is Deenergized:	Close				
Conduit Connection:	1/2" NPT				
Body Material:	Anodized Aluminum				
Manufacturer:	*Bray	Model:	Series 63		

NOTES

Valves to be tested in accordance with ASTM D5162, ANSI B16.34 or B16.42 and MSS SP-61 (Pressure Testing of Valves). All dimensions are to be in accordance with ANSI B16.42 (ductile iron) or ANSI B16.5 (steel) and MSS SP-72 (Ball Valves with Flanged or Butt-Welding Ends for General Service). Valves are to be certified Fire-Safe in accordance with API-607.

*Recommended Manufacturer

Valve Model 7-3-07-3-U-U-SR:
- 7 - Body Material: 316 Stainless Steel (CF8M)
- 3 - End Connection: Butt Weld
- 07 - Valve Size: 1.5"
- 3 - Ball and Stem: 316 Stainless Steel
- U - Seat: UHMWPE
- U - Seals: UHMWPE
- SR - Operator: Spring Return Pneumatic Actuator

Actuator Model Series 93, Size 119-4:
- 93 - Actuator Type: Pneumatic Spring Return Actuator
- 119 - Actuator Size Designation (12.40" l x 4.91" w x 7.28" h)
- 4 - No. of Springs per Piston

Actuator to Valve Mounting Kit: ISO Mounting Kit EZ-010S

AECOM

On/Off Control Valves

DATA SHEET NO.			REV.
AOBV-1124			A
SHEET	OF	DATE	
1	2	1-17-13	
BY	CHK'D	PROC.	APPR.
AME	NCC		
P.O.			
REQ.			

NO.	BY	DATE	REVISION

Project:	RLWTF						
TAG NO:	LLW-AOBV-1124	Spec No:	40 9200	Line / Vessel Number:	LLW-330		
Asset No:		P&ID:	D-6014	Line ID: 0.622"	Size: 0.5"	Schedule:	40
Service Description:	Microfilter FLT-1201 Sludge Recirculation			Manufacturer:	*Flow-Tek		
				Model:	7-3-03-3-U-U-SR		
Safety Class	NS			Quality Assurance Level:	ML-4		

PROCESS CONDITIONS

Process Data Case:	Normal									Units:
Sizing Case:	Normal									-
Required Cv:	25 to 40									-
Travel:	NA									-
Sound Pressure Level:	NA									-
	Inlet:	Outlet:	Inlet:	Outlet:	Inlet:	Outlet:	Inlet:	Outlet:		
Liquid Flow:	7	7								gpm
Vapor Flow:	NA	NA								cfm
Temperature:	75	75								°F
Pressure:	45	45								psig
Density:	1.02									g/ml
Viscosity:	1.05									cP
Critical Pressure (Pseudo):	NA									psia
pH:	10.8									-
Compressibility (Z):	NA									-
Specific Heat Ratio (C_P/C_V):	NA									-

Fluid:	LLW (contaminated water)	Max Temperature:	125 °F	Inlet:	Outlet
Area Classification:		Max Upset Pressure (normal flow):			
Ambient Temperature Requirements:	55 to 95 °F	Max Upset Pressure (reverse flow):			

VALVE BODY / BONNET

Valve Type:	3 Piece Full Port Ball Valve		
Body Size:	0.5"	ANSI Class:	150
Max Rated Pressure:	1000 psi	Max Rated Temperature:	200 °F
Body/Bonnet Material:	316SS (ASTM A351 CF8M)		
Liner Material / ID:	N/A		
Inlet Connection Face:	Butt Weld		
Outlet Connection Face:	Butt Weld		
Flange Face Finish:	N/A		
Bonnet Style:	N/A		
Lube Iso Valve:	No	Lube:	N/A
Packing Style:	Seat Rings		
Packing Material:	UHMWPE		
Body/Bonnet Gasket Material:	N/A		
Manufacturer:	*Flow-Tek		
Model:	7000-316SS		

SWITCH

RELAY 1	Tag No:	ZSO-1124			
	Power Rating:	24V dc	Type:	N/O	
	Alarm Setting	N/A			
RELAY 2	Tag No:	ZSC-1124			
	Power Rating:	24V dc	Type:	N/O	
	Alarm Setting	N/A			
Sensor Type:	Proximity	Max. Load Current:	200 mA		
Conduit Connection:	1/2" NPT				
Manufacturer:	*Flow-Tek (Bray)				
Model No.	2N1 (Series 52)				
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1	5	IP2:	6

TRIM

TrimType:	Single Seat				
Size:	0.5"	Travel	N/A		
Rated Cv:	32	Fl:	N/A	Xt:	N/A
Characteristic:	N/A				
Balanced/Unbalanced:	Balanced				
Plug Material:	316SS (ASTM A351 CF8M)				
Seat Material:	UHMWPE				
Stem Material:	316SS (ASTM A479)				
Ext Trim Material:	316SS (ASTM A351 CF3M)				
Seat Leakage Class:	FCI 70-2 Class IV	Flow Direction:	Bi-directional		
Manufacturer:	*Flow-Tek	Model:	7000-316SS		

ACTUATOR

Actuator Type:	Pneumatic				
Valve Air Failure Position:	FC	Valve Function:	On / Off		
Size:	N/A	Effective Area:	N/A		
Actuator Orientation:	Top Mount	Spring action	Close		
Hand Wheel Type:	None	Position	Indicator Pointer		
Air Failure Valve:	None	Set at	N/A		
Available Air Supply Pressure:					
Min:	105 psig	Max:	120 psig		
Allowable Pressure Requirements:					
Min:	80 psig	Max:	140 psig		
Bench Range:	N/A				
Required Stroke Time to Open:	1/4 s @ 80 psig				
Required Stroke Time to Close:	1/4 s @ 80 psig				
Manufacturer:	*Flow-Tek				
Model:	Series 93: Size 63-4				

TAG NO.	LLW-AOBV-1124	ON/OFF Control Valves	DATA SHEET NO.	SHEET	OF
			AOBV-1124	2	2

SOLENOID

Tag No:	HS-1124	Fluid:	Air		
Type:	3-Way	Coil:	Class F		
Coil Housing:	NEMA 4X	Watts:	6.9		
Voltage:	24V dc				
Power Wiring:	N/A	Signal Type:	N/A		
Communication Protocol:	N/A	Location:	Direct Mounted		
Smart:	N/A	Indicate:	No	Isolate:	No
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1:	5	IP2:	6
Main Valve Action when Coil is Deenergized:	Close				
Conduit Connection:	1/2" NPT				
Body Material:	Anodized Aluminum				
Manufacturer:	*Bray	Model:	Series 63		

NOTES

Valves to be tested in accordance with ASTM D5162, ANSI B16.34 or B16.42 and MSS SP-61 (Pressure Testing of Valves). All dimensions are to be in accordance with ANSI B16.42 (ductile iron) or ANSI B16.5 (steel) and MSS SP-72 (Ball Valves with Flanged or Butt-Welding Ends for General Service). Valves are to be certified Fire-Safe in accordance with API-607.

*Recommended Manufacturer

Valve Model 7-3-03-3-U-U-SR:
- 7 - Body Material: 316 Stainless Steel (CF8M)
- 3 - End Connection: Butt Weld
- 03 - Valve Size: 0.5"
- 3 - Ball and Stem: 316 Stainless Steel
- U - Seat: UHMWPE
- U - Seals: UHMWPE
- SR - Operator: Spring Return Pneumatic Actuator

Actuator Model Series 93, Size 63-4:
- 93 - Actuator Type: Pneumatic Spring Return Actuator
- 63 - Actuator Size Designation (5.58" l x 3.11" w x 4.53" h)
- 4 - No. of Springs per Piston

Actuator to Valve Mounting Kit: ISO Mounting Kit EZ-002S

AECOM

On/Off Control Valves

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
AOBV-1126			A
SHEET	OF	DATE	
1	2	1-17-13	
BY	CHK'D	PROC.	APPR.
AME	NCC		
P.O.			
REQ.			

Project:	RLWTF						
TAG NO:	LLW-AOBV-1126	Spec No:	40 9200	Line / Vessel Number:	LLW-167		
Asset No:		P&ID:	D-6012	Line ID: 1.610"	Size: 1.5"	Schedule:	40
Service Description:	LLW to Tank TK-1102 Inlet			Manufacturer:	*Flow-Tek		
				Model:	7-3-07-3-U-U-SR		
Safety Class	NS			Quality Assurance Level:	ML-4		

PROCESS CONDITIONS

Process Data Case:	Normal								Units:
Sizing Case:	Normal								-
Required Cv:	225 to 325								-
Travel:	NA								-
Sound Pressure Level:	NA								-
	Inlet:	Outlet:	Inlet:	Outlet:	Inlet:	Outlet:	Inlet:	Outlet:	
Liquid Flow:	36.6	36.6							gpm
Vapor Flow:	NA	NA							cfm
Temperature:	75	75							°F
Pressure:	45	45							psig
Density:	1.02								g/ml
Viscosity:	1.05								cP
Critical Pressure (Pseudo):	NA								psia
pH:	10.8								-
Compressibility (Z):	NA								-
Specific Heat Ratio (C_P/C_V):	NA								-

Fluid:	LLW (contaminated water)	Max Temperature:	125 °F	Inlet:	Outlet
Area Classification:		Max Upset Pressure (normal flow):			
Ambient Temperature Requirements:	55 to 95 °F	Max Upset Pressure (reverse flow):			

VALVE BODY / BONNET

Valve Type:	3 Piece Full Port Ball Valve		
Body Size:	1.5"	ANSI Class:	150
Max Rated Pressure:	1000 psi	Max Rated Temperature:	200 °F
Body/Bonnet Material:	316SS (ASTM A351 CF8M)		
Liner Material / ID:	N/A		
Inlet Connection Face:	Butt Weld		
Outlet Connection Face:	Butt Weld		
Flange Face Finish:	N/A		
Bonnet Style:	N/A		
Lube Iso Valve:	No	Lube:	N/A
Packing Style:	Seat Rings		
Packing Material:	UHMWPE		
Body/Bonnet Gasket Material:	N/A		
Manufacturer:	*Flow-Tek		
Model:	7000-316SS		

SWITCH

RELAY 1	Tag No:	ZSO-1126			
	Power Rating:	24V dc	Type:	N/O	
	Alarm Setting	N/A			
RELAY 2	Tag No:	ZSC-1126			
	Power Rating:	24V dc	Type:	N/O	
	Alarm Setting	N/A			
Sensor Type:	Proximity	Max. Load Current:	200 mA		
Conduit Connection:	1/2" NPT				
Manufacturer:	*Flow-Tek (Bray)				
Model No.	2N1 (Series 52)				
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1	5	IP2:	6

TRIM

TrimType:	Single Seat				
Size:	1.5"	Travel	N/A		
Rated Cv:	275	Ft:	N/A	Xt:	N/A
Characteristic:	N/A				
Balanced/Unbalanced:	Balanced				
Plug Material:	316SS (ASTM A351 CF8M)				
Seat Material:	UHMWPE				
Stem Material:	316SS (ASTM A479)				
Ext Trim Material:	316SS (ASTM A351 CF3M)				
Seat Leakage Class:	FCI 70-2 Class IV	Flow Direction:	Bi-directional		
Manufacturer:	*Flow-Tek	Model:	7000-316SS		

ACTUATOR

Actuator Type:	Pneumatic				
Valve Air Failure Position:	FC	Valve Function:	On / Off		
Size:	N/A	Effective Area:	N/A		
Actuator Orientation:	Top Mount	Spring action	Close		
Hand Wheel Type:	None	Position	Indicator Pointer		
Air Failure Valve:	None	Set at	N/A		
Available Air Supply Pressure:					
Min:	105 psig	Max:	120 psig		
Allowable Pressure Requirements:					
Min:	80 psig	Max:	140 psig		
Bench Range:	N/A				
Required Stroke Time to Open:	1/2 s @ 80 psig				
Required Stroke Time to Close:	1/2 s @ 80 psig				
Manufacturer:	*Flow-Tek				
Model:	Series 93: Size 119-4				

TAG NO.	LLW-AOBV-1126	ON/OFF Control Valves	DATA SHEET NO.	SHEET	OF
			AOBV-1126	2	2

SOLENOID

Tag No:	HS-1126	Fluid:	Air		
Type:	3-Way	Coil:	Class F		
Coil Housing:	NEMA 4X	Watts:	6.9		
Voltage:	24V dc				
Power Wiring:	N/A	Signal Type:	N/A		
Communication Protocol:	N/A	Location:	Direct Mounted		
Smart:	N/A	Indicate:	No	Isolate:	No
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1:	5	IP2:	6
Main Valve Action when Coil is Deenergized:	Close				
Conduit Connection:	1/2" NPT				
Body Material:	Anodized Aluminum				
Manufacturer:	*Bray	Model:	Series 63		

NOTES

Valves to be tested in accordance with ASTM D5162, ANSI B16.34 or B16.42 and MSS SP-61 (Pressure Testing of Valves). All dimensions are to be in accordance with ANSI B16.42 (ductile iron) or ANSI B16.5 (steel) and MSS SP-72 (Ball Valves with Flanged or Butt-Welding Ends for General Service). Valves are to be certified Fire-Safe in accordance with API-607.

*Recommended Manufacturer

Valve Model 7-3-07-3-U-U-SR:
- 7 - Body Material: 316 Stainless Steel (CF8M)
- 3 - End Connection: Butt Weld
- 07 - Valve Size: 1.5"
- 3 - Ball and Stem: 316 Stainless Steel
- U - Seat: UHMWPE
- U - Seals: UHMWPE
- SR - Operator: Spring Return Pneumatic Actuator

Actuator Model Series 93, Size 119-4:
- 93 - Actuator Type: Pneumatic Spring Return Actuator
- 119 - Actuator Size Designation (12.40" l x 4.91" w x 7.28" h)
- 4 - No. of Springs per Piston

Actuator to Valve Mounting Kit: ISO Mounting Kit EZ-010S

AECOM

On/Off Control Valves

DATA SHEET NO.			REV.
AOBV-1157			A
SHEET	OF	DATE	
1	2	1-17-13	

NO.	BY	DATE	REVISION

BY	CHK'D	PROC.	APPR.
AME	NCC		

P.O.

REQ.

Project: RLWTF

TAG NO: LLW-AOBV-1157

Spec No:	40 9200	Line / Vessel Number:	LLW-099				
Asset No:		P&ID:	D-6030	Line ID:	0.622"	Size: 0.5"	Schedule: 40
Service Description:	TK-1706 Evaporator Condensate Return Valve	Manufacturer:	*Flow-Tek				
		Model:	7-3-03-3-U-U-SR				
Safety Class	NS	Quality Assurance Level:	ML-4				

PROCESS CONDITIONS

Process Data Case:	Normal									Units:
Sizing Case:	Normal									-
Required Cv:	25 to 40									-
Travel:	NA									-
Sound Pressure Level:	NA									-
	Inlet:	Outlet:	Inlet:	Outlet:	Inlet:	Outlet:	Inlet:	Outlet:		
Liquid Flow:	NA	NA								gpm
Vapor Flow:	NA	NA								cfm
Temperature:	75	75								°F
Pressure:	45	45								psig
Density:	1.02									g/ml
Viscosity:	1.05									cP
Critical Pressure (Pseudo):	NA									psia
pH:	8.2									-
Compressibility (Z):	NA									-
Specific Heat Ratio (C_P/C_V):	NA									-

Fluid:	LLW (contaminated water)	Max Temperature:	125 °F	Inlet:	Outlet
Area Classification:		Max Upset Pressure (normal flow):			
Ambient Temperature Requirements:	55 to 95 °F	Max Upset Pressure (reverse flow):			

VALVE BODY / BONNET

Valve Type:	3 Piece Full Port Ball Valve		
Body Size:	0.5"	ANSI Class:	150
Max Rated Pressure:	1000 psi	Max Rated Temperature:	200 °F
Body/Bonnet Material:	316SS (ASTM A351 CF8M)		
Liner Material / ID:	N/A		
Inlet Connection Face:	Butt Weld		
Outlet Connection Face:	Butt Weld		
Flange Face Finish:	N/A		
Bonnet Style:	N/A		
Lube Iso Valve:	No	Lube:	N/A
Packing Style:	Seat Rings		
Packing Material:	UHMWPE		
Body/Bonnet Gasket Material:	N/A		
Manufacturer:	*Flow-Tek		
Model:	7000-316SS		

SWITCH

RELAY 1	Tag No:	ZSO-1157			
	Power Rating:	24V dc	Type:	N/O	
	Alarm Setting	N/A			
RELAY 2	Tag No:	ZSC-1157			
	Power Rating:	24V dc	Type:	N/O	
	Alarm Setting	N/A			
Sensor Type:	Proximity	Max. Load Current:	200 mA		
Conduit Connection:	1/2" NPT				
Manufacturer:	*Flow-Tek (Bray)				
Model No.	2N1 (Series 52)				
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1	5	IP2:	6

TRIM

TrimType:	Single Seat				
Size:	0.5"	Travel	N/A		
Rated Cv:	32	Fl:	N/A	Xt:	N/A
Characteristic:	N/A				
Balanced/Unbalanced:	Balanced				
Plug Material:	316SS (ASTM A351 CF8M)				
Seat Material:	UHMWPE				
Stem Material:	316SS (ASTM A479)				
Ext Trim Material:	316SS (ASTM A351 CF3M)				
Seat Leakage Class:	FCI 70-2 Class IV	Flow Direction:	Bi-directional		
Manufacturer:	*Flow-Tek	Model:	7000-316SS		

ACTUATOR

Actuator Type:	Pneumatic				
Valve Air Failure Position:	FC	Valve Function:	On / Off		
Size:	N/A	Effective Area:	N/A		
Actuator Orientation:	Top Mount	Spring action	Close		
Hand Wheel Type:	None	Position	Indicator Pointer		
Air Failure Valve:	None	Set at	N/A		
Available Air Supply Pressure:					
Min:	105 psig	Max:	120 psig		
Allowable Pressure Requirements:					
Min:	80 psig	Max:	140 psig		
Bench Range:	N/A				
Required Stroke Time to Open:	1/4 s @ 80 psig				
Required Stroke Time to Close:	1/4 s @ 80 psig				
Manufacturer:	*Flow-Tek				
Model:	Series 93: Size 63-4				

TAG NO.	LLW-AOBV-1157	ON/OFF Control Valves	DATA SHEET NO.	SHEET	OF
			AOBV-1157	2	2

SOLENOID

Tag No:	HS-1157	Fluid:	Air		
Type:	3-Way	Coil:	Class F		
Coil Housing:	NEMA 4X	Watts:	6.9		
Voltage:	24V dc				
Power Wiring:	N/A	Signal Type:	N/A		
Communication Protocol:	N/A	Location:	Direct Mounted		
Smart:	N/A	Indicate:	No	Isolate:	No
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1	5	IP2:	6
Main Valve Action when Coil is Deenergized:	Close				
Conduit Connection:	1/2" NPT				
Body Material:	Anodized Aluminum				
Manufacturer:	*Bray	Model:	Series 63		

NOTES

Valves to be tested in accordance with ASTM D5162, ANSI B16.34 or B16.42 and MSS SP-61 (Pressure Testing of Valves). All dimensions are to be in accordance with ANSI B16.42 (ductile iron) or ANSI B16.5 (steel) and MSS SP-72 (Ball Valves with Flanged or Butt-Welding Ends for General Service). Valves are to be certified Fire-Safe in accordance with API-607.

*Recommended Manufacturer

Valve Model 7-3-03-3-U-U-SR:
- 7 - Body Material: 316 Stainless Steel (CF8M)
- 3 - End Connection: Butt Weld
- 03 - Valve Size: 0.5"
- 3 - Ball and Stem: 316 Stainless Steel
- U - Seat: UHMWPE
- U - Seals: UHMWPE
- SR - Operator: Spring Return Pneumatic Actuator

Actuator Model Series 93, Size 63-4:
- 93 - Actuator Type: Pneumatic Spring Return Actuator
- 63 - Actuator Size Designation (5.58" l x 3.11" w x 4.53" h)
- 4 - No. of Springs per Piston

Actuator to Valve Mounting Kit: ISO Mounting Kit EZ-002S

AECOM

On/Off Control Valves

DATA SHEET NO.			REV.
AOBV-1304			A
SHEET	OF		DATE
1	2		1-17-13
BY	CHK'D	PROC.	APPR.
AME	NCC		
P.O.			
REQ.			

NO.	BY	DATE	REVISION

Project:	RLWTF						
TAG NO:	LLW-AOBV-1304	Spec No:	40 9200	Line / Vessel Number:	LLW-397		
Asset No:		P&ID:	D-6016	Line ID: 0.622"	Size: 0.5"	Schedule:	40
Service Description:	LLW Condensate Recycle to Tank TK-1301 Inlet			Manufacturer:	*Flow-Tek		
				Model:	7-3-03-3-U-U-SR		
Safety Class	NS			Quality Assurance Level:	ML-4		

PROCESS CONDITIONS

Process Data Case:	Normal								Units:
Sizing Case:	Normal								-
Required Cv:	25 to 40								-
Travel:	NA								-
Sound Pressure Level:	NA								-
	Inlet:	Outlet:	Inlet:	Outlet:	Inlet:	Outlet:	Inlet:	Outlet:	
Liquid Flow:	NA	NA							gpm
Vapor Flow:	NA	NA							cfm
Temperature:	75	75							°F
Pressure:	45	45							psig
Density:	1.02								g/ml
Viscosity:	1.05								cP
Critical Pressure (Pseudo):	NA								psia
pH:	7.7								-
Compressibility (Z):	NA								-
Specific Heat Ratio (C_P/C_V):	NA								-

Fluid:	LLW (contaminated water)	Max Temperature:	125 °F	Inlet:	Outlet
Area Classification:		Max Upset Pressure (normal flow):			
Ambient Temperature Requirements:	55 to 95 °F	Max Upset Pressure (reverse flow):			

VALVE BODY / BONNET

Valve Type:	3 Piece Full Port Ball Valve		
Body Size:	0.5"	ANSI Class:	150
Max Rated Pressure:	1000 psi	Max Rated Temperature:	200 °F
Body/Bonnet Material:	316SS (ASTM A351 CF8M)		
Liner Material / ID:	N/A		
Inlet Connection Face:	Butt Weld		
Outlet Connection Face:	Butt Weld		
Flange Face Finish:	N/A		
Bonnet Style:	N/A		
Lube Iso Valve:	No	Lube:	N/A
Packing Style:	Seat Rings		
Packing Material:	UHMWPE		
Body/Bonnet Gasket Material:	N/A		
Manufacturer:	*Flow-Tek		
Model:	7000-316SS		

SWITCH

RELAY 1	Tag No:	ZSO-1304			
	Power Rating:	24V dc	Type:	N/O	
	Alarm Setting	N/A			
RELAY 2	Tag No:	ZSC-1304			
	Power Rating:	24V dc	Type:	N/O	
	Alarm Setting	N/A			
Sensor Type:	Proximity	Max. Load Current:	200 mA		
Conduit Connection:	1/2" NPT				
Manufacturer:	*Flow-Tek (Bray)				
Model No.	2N1 (Series 52)				
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1	5	IP2:	6

TRIM

TrimType:	Single Seat				
Size:	0.5"	Travel	N/A		
Rated Cv:	32	Fl:	N/A	Xt:	N/A
Characteristic:	N/A				
Balanced/Unbalanced:	Balanced				
Plug Material:	316SS (ASTM A351 CF8M)				
Seat Material:	UHMWPE				
Stem Material:	316SS (ASTM A479)				
Ext Trim Material:	316SS (ASTM A351 CF3M)				
Seat Leakage Class:	FCI 70-2 Class IV	Flow Direction:	Bi-directional		
Manufacturer:	*Flow-Tek	Model:	7000-316SS		

ACTUATOR

Actuator Type:	Pneumatic				
Valve Air Failure Position:	FC	Valve Function:	On / Off		
Size:	N/A	Effective Area:	N/A		
Actuator Orientation:	Top Mount	Spring action	Close		
Hand Wheel Type:	None	Position	Indicator Pointer		
Air Failure Valve:	None	Set at	N/A		
Available Air Supply Pressure:					
Min:	105 psig	Max:	120 psig		
Allowable Pressure Requirements:					
Min:	80 psig	Max:	140 psig		
Bench Range:	N/A				
Required Stroke Time to Open:	1/4 s @ 80 psig				
Required Stroke Time to Close:	1/4 s @ 80 psig				
Manufacturer:	*Flow-Tek				
Model:	Series 93: Size 63-4				

TAG NO.	LLW-AOBV-1304	ON/OFF Control Valves	DATA SHEET NO.	SHEET	OF
			AOBV-1304	2	2

SOLENOID

Tag No:	HS-1304	Fluid:	Air		
Type:	3-Way	Coil:	Class F		
Coil Housing:	NEMA 4X	Watts:	6.9		
Voltage:	24V dc				
Power Wiring:	N/A	Signal Type:	N/A		
Communication Protocol:	N/A	Location:	Direct Mounted		
Smart:	N/A	Indicate:	No	Isolate:	No
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1	5	IP2:	6
Main Valve Action when Coil is Deenergized:	Close				
Conduit Connection:	1/2" NPT				
Body Material:	Anodized Aluminum				
Manufacturer:	*Bray	Model:	Series 63		

NOTES

Valves to be tested in accordance with ASTM D5162, ANSI B16.34 or B16.42 and MSS SP-61 (Pressure Testing of Valves). All dimensions are to be in accordance with ANSI B16.42 (ductile iron) or ANSI B16.5 (steel) and MSS SP-72 (Ball Valves with Flanged or Butt-Welding Ends for General Service). Valves are to be certified Fire-Safe in accordance with API-607.

*Recommended Manufacturer

Valve Model 7-3-03-3-U-U-SR:
- 7 - Body Material: 316 Stainless Steel (CF8M)
- 3 - End Connection: Butt Weld
- 03 - Valve Size: 0.5"
- 3 - Ball and Stem: 316 Stainless Steel
- U - Seat: UHMWPE
- U - Seals: UHMWPE
- SR - Operator: Spring Return Pneumatic Actuator

Actuator Model Series 93, Size 63-4:
- 93 - Actuator Type: Pneumatic Spring Return Actuator
- 63 - Actuator Size Designation (5.58" l x 3.11" w x 4.53" h)
- 4 - No. of Springs per Piston

Actuator to Valve Mounting Kit: ISO Mounting Kit EZ-002S

AECOM

On/Off Control Valves

DATA SHEET NO.			REV.
AOBV-1320			A
SHEET	OF	DATE	
1	2	1-17-13	
BY	CHK'D	PROC.	APPR.
AME	NCC		
P.O.			
REQ.			

NO.	BY	DATE	REVISION

Project:	RLWTF
TAG NO:	LLW-AOBV-1320
Asset No:	
Service Description:	LLW Reverse Osmosis Unit Feed ROU-1301 Inlet
Safety Class	NS

Spec No:	40 9200	Line / Vessel Number:	LLW-228
P&ID:	D-6018	Line ID: 1.610" Size: 1.5"	Schedule: 40
Manufacturer:	*Flow-Tek		
Model:	7-3-07-3-U-U-SR		
Quality Assurance Level:	ML-4		

PROCESS CONDITIONS

Process Data Case:	Normal								Units:
Sizing Case:	Normal								-
Required Cv:	225 to 325								-
Travel:	NA								-
Sound Pressure Level:	NA								-
	Inlet:	Outlet:	Inlet:	Outlet:	Inlet:	Outlet:	Inlet:	Outlet:	
Liquid Flow:	33.1	33.1							gpm
Vapor Flow:	NA	NA							cfm
Temperature:	75	75							°F
Pressure:	45	45							psig
Density:	1.02								g/ml
Viscosity:	1.05								cP
Critical Pressure (Pseudo):	NA								psia
pH:	7.5								-
Compressibility (Z):	NA								-
Specific Heat Ratio (C_P/C_V):	NA								-

Fluid:	LLW (contaminated water)	Max Temperature:	125 °F	Inlet:	Outlet
Area Classification:		Max Upset Pressure (normal flow):			
Ambient Temperature Requirements:	55 to 95 °F	Max Upset Pressure (reverse flow):			

VALVE BODY / BONNET

Valve Type:	3 Piece Full Port Ball Valve		
Body Size:	1.5"	ANSI Class:	150
Max Rated Pressure:	1000 psi	Max Rated Temperature:	200 °F
Body/Bonnet Material:	316SS (ASTM A351 CF8M)		
Liner Material / ID:	N/A		
Inlet Connection Face:	Butt Weld		
Outlet Connection Face:	Butt Weld		
Flange Face Finish:	N/A		
Bonnet Style:	N/A		
Lube Iso Valve:	No	Lube:	N/A
Packing Style:	Seat Rings		
Packing Material:	UHMWPE		
Body/Bonnet Gasket Material:	N/A		
Manufacturer:	*Flow-Tek		
Model:	7000-316SS		

TRIM

TrimType:	Single Seat				
Size:	1.5"	Travel	N/A		
Rated Cv:	275	Ft:	N/A	Xt:	N/A
Characteristic:	N/A				
Balanced/Unbalanced:	Balanced				
Plug Material:	316SS (ASTM A351 CF8M)				
Seat Material:	UHMWPE				
Stem Material:	316SS (ASTM A479)				
Ext Trim Material:	316SS (ASTM A351 CF3M)				
Seat Leakage Class:	FCI 70-2 Class IV	Flow Direction:	Bi-directional		
Manufacturer:	*Flow-Tek	Model:	7000-316SS		

SWITCH

RELAY 1	Tag No:	ZSO-1320			
	Power Rating:	24V dc	Type:	N/O	
	Alarm Setting	N/A			
RELAY 2	Tag No:	ZSC-1320			
	Power Rating:	24V dc	Type:	N/O	
	Alarm Setting	N/A			
Sensor Type:	Proximity	Max. Load Current:	200 mA		
Conduit Connection:	1/2" NPT				
Manufacturer:	*Flow-Tek (Bray)				
Model No.	2N1 (Series 52)				
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1	5	IP2:	6

ACTUATOR

Actuator Type:	Pneumatic		
Valve Air Failure Position:	FC	Valve Function:	On / Off
Size:	N/A	Effective Area:	N/A
Actuator Orientation:	Top Mount	Spring action	Close
Hand Wheel Type:	None	Position	Indicator Pointer
Air Failure Valve:	None	Set at	N/A
Available Air Supply Pressure:			
Min:	105 psig	Max:	120 psig
Allowable Pressure Requirements:			
Min:	80 psig	Max:	140 psig
Bench Range:	N/A		
Required Stroke Time to Open:	1/2 s @ 80 psig		
Required Stroke Time to Close:	1/2 s @ 80 psig		
Manufacturer:	*Flow-Tek		
Model:	Series 93: Size 119-4		

TAG NO.	LLW-AOBV-1320	ON/OFF Control Valves	DATA SHEET NO.	SHEET	OF
			AOBV-1320	2	2

SOLENOID

Tag No:	HS-1320	Fluid:	Air		
Type:	3-Way	Coil:	Class F		
Coil Housing:	NEMA 4X	Watts:	6.9		
Voltage:	24V dc				
Power Wiring:	N/A	Signal Type:	N/A		
Communication Protocol:	N/A	Location:	Direct Mounted		
Smart:	N/A	Indicate:	No	Isolate:	No
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1	5	IP2:	6
Main Valve Action when Coil is Deenergized:	Close				
Conduit Connection:	1/2" NPT				
Body Material:	Anodized Aluminum				
Manufacturer:	*Bray	Model:	Series 63		

NOTES

Valves to be tested in accordance with ASTM D5162, ANSI B16.34 or B16.42 and MSS SP-61 (Pressure Testing of Valves). All dimensions are to be in accordance with ANSI B16.42 (ductile iron) or ANSI B16.5 (steel) and MSS SP-72 (Ball Valves with Flanged or Butt-Welding Ends for General Service). Valves are to be certified Fire-Safe in accordance with API-607.

*Recommended Manufacturer

Valve Model 7-3-07-3-U-U-SR:
- 7 - Body Material: 316 Stainless Steel (CF8M)
- 3 - End Connection: Butt Weld
- 07 - Valve Size: 1.5"
- 3 - Ball and Stem: 316 Stainless Steel
- U - Seat: UHMWPE
- U - Seals: UHMWPE
- SR - Operator: Spring Return Pneumatic Actuator

Actuator Model Series 93, Size 119-4:
- 93 - Actuator Type: Pneumatic Spring Return Actuator
- 119 - Actuator Size Designation (12.40" l x 4.91" w x 7.28" h)
- 4 - No. of Springs per Piston

Actuator to Valve Mounting Kit: ISO Mounting Kit EZ-010S

AECOM

On/Off Control Valves

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
AOBV-1323			A
SHEET	OF	DATE	
1	2	1-17-13	
BY	CHK'D	PROC.	APPR.
AME	NCC		
P.O.			
REQ.			

Project: RLWTF

TAG NO: LLW-AOBV-1323

Spec No:	40 9200	Line / Vessel Number:	LLW-238				
Asset No:		P&ID:	D-6018	Line ID:	0.622"	Size: 0.5"	Schedule: 40
Service Description:	LLW RO Recycle to Tank TK-1705	Manufacturer:	*Flow-Tek				
		Model:	7-3-03-3-U-U-SR				
Safety Class	NS	Quality Assurance Level:	ML-4				

PROCESS CONDITIONS

Process Data Case:	Normal									Units:
Sizing Case:	Normal									-
Required Cv:	25 to 40									-
Travel:	NA									-
Sound Pressure Level:	NA									-
	Inlet:	Outlet:	Inlet:	Outlet:	Inlet:	Outlet:	Inlet:	Outlet:		
Liquid Flow:	2.3	2.3								gpm
Vapor Flow:	NA	NA								cfm
Temperature:	75	75								°F
Pressure:	45	45								psig
Density:	1.02									g/ml
Viscosity:	1.05									cP
Critical Pressure (Pseudo):	NA									psia
pH:	7.7									-
Compressibility (Z):	NA									-
Specific Heat Ratio (C_P/C_V):	NA									-

Fluid:	LLW (contaminated water)	Max Temperature:	125 °F	Inlet:	Outlet
Area Classification:		Max Upset Pressure (normal flow):			
Ambient Temperature Requirements:	55 to 95 °F	Max Upset Pressure (reverse flow):			

VALVE BODY / BONNET

Valve Type:	3 Piece Full Port Ball Valve		
Body Size:	0.5"	ANSI Class:	150
Max Rated Pressure:	1000 psi	Max Rated Temperature:	200 °F
Body/Bonnet Material:	316SS (ASTM A351 CF8M)		
Liner Material / ID:	N/A		
Inlet Connection Face:	Butt Weld		
Outlet Connection Face:	Butt Weld		
Flange Face Finish:	N/A		
Bonnet Style:	N/A		
Lube Iso Valve:	No	Lube:	N/A
Packing Style:	Seat Rings		
Packing Material:	UHMWPE		
Body/Bonnet Gasket Material:	N/A		
Manufacturer:	*Flow-Tek		
Model:	7000-316SS		

SWITCH

RELAY 1	Tag No:	ZSO-1323			
	Power Rating:	24V dc	Type:	N/O	
	Alarm Setting	N/A			
RELAY 2	Tag No:	ZSC-1323			
	Power Rating:	24V dc	Type:	N/O	
	Alarm Setting	N/A			
Sensor Type:	Proximity	Max. Load Current:	200 mA		
Conduit Connection:	1/2" NPT				
Manufacturer:	*Flow-Tek (Bray)				
Model No.	2N1 (Series 52)				
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1	5	IP2:	6

TRIM

TrimType:	Single Seat				
Size:	0.5"	Travel	N/A		
Rated Cv:	32	Fl:	N/A	Xt:	N/A
Characteristic:	N/A				
Balanced/Unbalanced:	Balanced				
Plug Material:	316SS (ASTM A351 CF8M)				
Seat Material:	UHMWPE				
Stem Material:	316SS (ASTM A479)				
Ext Trim Material:	316SS (ASTM A351 CF3M)				
Seat Leakage Class:	FCI 70-2 Class IV	Flow Direction:	Bi-directional		
Manufacturer:	*Flow-Tek	Model:	7000-316SS		

ACTUATOR

Actuator Type:	Pneumatic				
Valve Air Failure Position:	FC	Valve Function:	On / Off		
Size:	N/A	Effective Area:	N/A		
Actuator Orientation:	Top Mount	Spring action	Close		
Hand Wheel Type:	None	Position	Indicator Pointer		
Air Failure Valve:	None	Set at	N/A		
Available Air Supply Pressure:					
Min:	105 psig	Max:	120 psig		
Allowable Pressure Requirements:					
Min:	80 psig	Max:	140 psig		
Bench Range:	N/A				
Required Stroke Time to Open:	1/4 s @ 80 psig				
Required Stroke Time to Close:	1/4 s @ 80 psig				
Manufacturer:	*Flow-Tek				
Model:	Series 93: Size 63-4				

TAG NO.	LLW-AOBV-1323	ON/OFF Control Valves	DATA SHEET NO.	SHEET	OF
			AOBV-1323	2	2

SOLENOID

Tag No:	HS-1323	Fluid:	Air		
Type:	3-Way	Coil:	Class F		
Coil Housing:	NEMA 4X	Watts:	6.9		
Voltage:	24V dc				
Power Wiring:	N/A	Signal Type:	N/A		
Communication Protocol:	N/A	Location:	Direct Mounted		
Smart:	N/A	Indicate:	No	Isolate:	No
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1:	5	IP2:	6
Main Valve Action when Coil is Deenergized:	Close				
Conduit Connection:	1/2" NPT				
Body Material:	Anodized Aluminum				
Manufacturer:	*Bray	Model:	Series 63		

NOTES

Valves to be tested in accordance with ASTM D5162, ANSI B16.34 or B16.42 and MSS SP-61 (Pressure Testing of Valves). All dimensions are to be in accordance with ANSI B16.42 (ductile iron) or ANSI B16.5 (steel) and MSS SP-72 (Ball Valves with Flanged or Butt-Welding Ends for General Service). Valves are to be certified Fire-Safe in accordance with API-607.

*Recommended Manufacturer

Valve Model 7-3-03-3-U-U-SR:
- 7 - Body Material: 316 Stainless Steel (CF8M)
- 3 - End Connection: Butt Weld
- 03 - Valve Size: 0.5"
- 3 - Ball and Stem: 316 Stainless Steel
- U - Seat: UHMWPE
- U - Seals: UHMWPE
- SR - Operator: Spring Return Pneumatic Actuator

Actuator Model Series 93, Size 63-4:
- 93 - Actuator Type: Pneumatic Spring Return Actuator
- 63 - Actuator Size Designation (5.58" l x 3.11" w x 4.53" h)
- 4 - No. of Springs per Piston

Actuator to Valve Mounting Kit: ISO Mounting Kit EZ-002S

AECOM

On/Off Control Valves

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
AOBV-1324			A
SHEET	OF	DATE	
1	2	1-17-13	
BY	CHK'D	PROC.	APPR.
AME	NCC		
P.O.			
REQ.			

Project:	RLWTF
TAG NO:	LLW-AOBV-1324
Asset No:	
Service Description:	LLW RO Recycle to Tank TK-1705
Safety Class	NS

Spec No:	40 9200	Line / Vessel Number:	LLW-094
P&ID:	D-6018	Line ID: 0.824" Size: 0.75"	Schedule: 40
		Manufacturer:	*Flow-Tek
		Model:	7-3-04-3-U-U-SR
		Quality Assurance Level:	ML-4

PROCESS CONDITIONS

Process Data Case:	Normal								Units:
Sizing Case:	Normal								-
Required Cv:	45 to 65								-
Travel:	NA								-
Sound Pressure Level:	NA								-
	Inlet:	Outlet:	Inlet:	Outlet:	Inlet:	Outlet:	Inlet:	Outlet:	
Liquid Flow:	NA	NA							gpm
Vapor Flow:	NA	NA							cfm
Temperature:	75	75							°F
Pressure:	45	45							psig
Density:	1.02								g/ml
Viscosity:	1.05								cP
Critical Pressure (Pseudo):	NA								psia
pH:	7.7								-
Compressibility (Z):	NA								-
Specific Heat Ratio (C_P/C_V):	NA								-

Fluid:	LLW (contaminated water)	Max Temperature:	125 °F	Inlet:	Outlet
Area Classification:		Max Upset Pressure (normal flow):			
Ambient Temperature Requirements:	55 to 95 °F	Max Upset Pressure (reverse flow):			

VALVE BODY / BONNET

Valve Type:	3 Piece Full Port Ball Valve		
Body Size:	0.75"	ANSI Class:	150
Max Rated Pressure:	1000 psi	Max Rated Temperature:	200 °F
Body/Bonnet Material:	316SS (ASTM A351 CF8M)		
Liner Material / ID:	N/A		
Inlet Connection Face:	Butt Weld		
Outlet Connection Face:	Butt Weld		
Flange Face Finish:	N/A		
Bonnet Style:	N/A		
Lube Iso Valve:	No	Lube:	N/A
Packing Style:	Seat Rings		
Packing Material:	UHMWPE		
Body/Bonnet Gasket Material:	N/A		
Manufacturer:	*Flow-Tek		
Model:	7000-316SS		

SWITCH

RELAY 1	Tag No:	ZSO-1324			
	Power Rating:	24V dc	Type:	N/O	
	Alarm Setting	N/A			
RELAY 2	Tag No:	ZSC-1324			
	Power Rating:	24V dc	Type:	N/O	
	Alarm Setting	N/A			
Sensor Type:	Proximity	Max. Load Current:	200 mA		
Conduit Connection:	1/2" NPT				
Manufacturer:	*Flow-Tek (Bray)				
Model No.	2N1 (Series 52)				
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1	5	IP2:	6

TRIM

TrimType:	Single Seat				
Size:	0.75"	Travel	N/A		
Rated Cv:	54	Ft:	N/A	Xt:	N/A
Characteristic:	N/A				
Balanced/Unbalanced:	Balanced				
Plug Material:	316SS (ASTM A351 CF8M)				
Seat Material:	UHMWPE				
Stem Material:	316SS (ASTM A479)				
Ext Trim Material:	316SS (ASTM A351 CF3M)				
Seat Leakage Class:	FCI 70-2 Class IV	Flow Direction:	Bi-directional		
Manufacturer:	*Flow-Tek	Model:	7000-316SS		

ACTUATOR

Actuator Type:	Pneumatic			
Valve Air Failure Position:	FC	Valve Function:	On / Off	
Size:	N/A	Effective Area:	N/A	
Actuator Orientation:	Top Mount	Spring action	Close	
Hand Wheel Type:	None	Position	Indicator Pointer	
Air Failure Valve:	None	Set at	N/A	
Available Air Supply Pressure:				
Min:	105 psig	Max:	120 psig	
Allowable Pressure Requirements:				
Min:	80 psig	Max:	140 psig	
Bench Range:	N/A			
Required Stroke Time to Open:	1/4 s @ 80 psig			
Required Stroke Time to Close:	1/4 s @ 80 psig			
Manufacturer:	*Flow-Tek			
Model:	Series 93: Size 83-4			

TAG NO.	LLW-AOBV-1324	ON/OFF Control Valves	DATA SHEET NO.	SHEET	OF
			AOBV-1324	2	2

SOLENOID

Tag No:	HS-1324	Fluid:	Air		
Type:	3-Way	Coil:	Class F		
Coil Housing:	NEMA 4X	Watts:	6.9		
Voltage:	24V dc				
Power Wiring:	N/A	Signal Type:	N/A		
Communication Protocol:	N/A	Location:	Direct Mounted		
Smart:	N/A	Indicate:	No	Isolate:	No
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1	5	IP2:	6
Main Valve Action when Coil is Deenergized:	Close				
Conduit Connection:	1/2" NPT				
Body Material:	Anodized Aluminum				
Manufacturer:	*Bray	Model:	Series 63		

NOTES

Valves to be tested in accordance with ASTM D5162, ANSI B16.34 or B16.42 and MSS SP-61 (Pressure Testing of Valves). All dimensions are to be in accordance with ANSI B16.42 (ductile iron) or ANSI B16.5 (steel) and MSS SP-72 (Ball Valves with Flanged or Butt-Welding Ends for General Service). Valves are to be certified Fire-Safe in accordance with API-607.

*Recommended Manufacturer

Valve Model 7-3-04-3-U-U-SR:
- 7 - Body Material: 316 Stainless Steel (CF8M)
- 3 - End Connection: Butt Weld
- 04 - Valve Size: 0.75"
- 3 - Ball and Stem: 316 Stainless Steel
- U - Seat: UHMWPE
- U - Seals: UHMWPE
- SR - Operator: Spring Return Pneumatic Actuator

Actuator Model Series 93, Size 83-4:
- 93 - Actuator Type: Pneumatic Spring Return Actuator
- 83 - Actuator Size Designation (7.40" l x 3.83" w x 5.43" h)
- 4 - No. of Springs per Piston

Actuator to Valve Mounting Kit: ISO Mounting Kit EZ-002S

AECOM

On/Off Control Valves

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
AOBV-1329			A
SHEET	OF	DATE	
1	2	1-17-13	
BY	CHK'D	PROC.	APPR.
AME	NCC		
P.O.			
REQ.			

Project:	RLWTF						
TAG NO:	LLW-AOBV-1329	Spec No:	40 9200	Line / Vessel Number:	LLW-434		
Asset No:		P&ID:	D-6018	Line ID: 1.610"	Size: 1.5"	Schedule:	40
Service Description:	ROU-1301 Permeate Feed to Tank TAC-4302			Manufacturer:	*Flow-Tek		
				Model:	7-3-07-3-U-U-SR		
Safety Class	NS			Quality Assurance Level:	ML-4		

PROCESS CONDITIONS

Process Data Case:	Normal									Units:
Sizing Case:	Normal									-
Required Cv:	225 to 325									-
Travel:	NA									-
Sound Pressure Level:	NA									-
	Inlet:	Outlet:	Inlet:	Outlet:	Inlet:	Outlet:	Inlet:	Outlet:		
Liquid Flow:	NA	NA								gpm
Vapor Flow:	NA	NA								cfm
Temperature:	75	75								°F
Pressure:	45	45								psig
Density:	1.02									g/ml
Viscosity:	1.05									cP
Critical Pressure (Pseudo):	NA									psia
pH:	7.7									-
Compressibility (Z):	NA									-
Specific Heat Ratio (C_P/C_V):	NA									-

Fluid:	LLW (contaminated water)	Max Temperature:	125 °F	Inlet:	Outlet
Area Classification:		Max Upset Pressure (normal flow):			
Ambient Temperature Requirements:	55 to 95 °F	Max Upset Pressure (reverse flow):			

VALVE BODY / BONNET

Valve Type:	3 Piece Full Port Ball Valve		
Body Size:	1.5"	ANSI Class:	150
Max Rated Pressure:	1000 psi	Max Rated Temperature:	200 °F
Body/Bonnet Material:	316SS (ASTM A351 CF8M)		
Liner Material / ID:	N/A		
Inlet Connection Face:	Butt Weld		
Outlet Connection Face:	Butt Weld		
Flange Face Finish:	N/A		
Bonnet Style:	N/A		
Lube Iso Valve:	No	Lube:	N/A
Packing Style:	Seat Rings		
Packing Material:	UHMWPE		
Body/Bonnet Gasket Material:	N/A		
Manufacturer:	*Flow-Tek		
Model:	7000-316SS		

SWITCH

RELAY 1	Tag No:	ZSO-1329			
	Power Rating:	24V dc	Type:	N/O	
	Alarm Setting	N/A			
RELAY 2	Tag No:	ZSC-1329			
	Power Rating:	24V dc	Type:	N/O	
	Alarm Setting	N/A			
Sensor Type:	Proximity	Max. Load Current:	200 mA		
Conduit Connection:	1/2" NPT				
Manufacturer:	*Flow-Tek (Bray)				
Model No.	2N1 (Series 52)				
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1	5	IP2:	6

TRIM

TrimType:	Single Seat				
Size:	1.5"	Travel	N/A		
Rated Cv:	275	Fl:	N/A	Xt:	N/A
Characteristic:	N/A				
Balanced/Unbalanced:	Balanced				
Plug Material:	316SS (ASTM A351 CF8M)				
Seat Material:	UHMWPE				
Stem Material:	316SS (ASTM A479)				
Ext Trim Material:	316SS (ASTM A351 CF3M)				
Seat Leakage Class:	FCI 70-2 Class IV	Flow Direction:	Bi-directional		
Manufacturer:	*Flow-Tek	Model:	7000-316SS		

ACTUATOR

Actuator Type:	Pneumatic				
Valve Air Failure Position:	FC	Valve Function:	On / Off		
Size:	N/A	Effective Area:	N/A		
Actuator Orientation:	Top Mount	Spring action	Close		
Hand Wheel Type:	None	Position	Indicator Pointer		
Air Failure Valve:	None	Set at	N/A		
Available Air Supply Pressure:					
Min:	105 psig	Max:	120 psig		
Allowable Pressure Requirements:					
Min:	80 psig	Max:	140 psig		
Bench Range:	N/A				
Required Stroke Time to Open:	1/2 s @ 80 psig				
Required Stroke Time to Close:	1/2 s @ 80 psig				
Manufacturer:	*Flow-Tek				
Model:	Series 93: Size 119-4				

TAG NO.	LLW-AOBV-1329	ON/OFF Control Valves	DATA SHEET NO.	SHEET	OF
			AOBV-1329	2	2

SOLENOID

Tag No:	HS-1329			Fluid:	Air		
Type:	3-Way			Coil:	Class F		
Coil Housing:	NEMA 4X			Watts:	6.9		
Voltage:	24V dc						
Power Wiring:	N/A			Signal Type:	N/A		
Communication Protocol:	N/A			Location:	Direct Mounted		
Smart:	N/A	Indicate:	No	Isolate:	No		
Electrical Protection:	N/A			Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1	5	IP2:	6		
Main Valve Action when Coil is Deenergized:	Close						
Conduit Connection:	1/2" NPT						
Body Material:	Anodized Aluminum						
Manufacturer:	*Bray			Model:	Series 63		

NOTES

Valves to be tested in accordance with ASTM D5162, ANSI B16.34 or B16.42 and MSS SP-61 (Pressure Testing of Valves). All dimensions are to be in accordance with ANSI B16.42 (ductile iron) or ANSI B16.5 (steel) and MSS SP-72 (Ball Valves with Flanged or Butt-Welding Ends for General Service). Valves are to be certified Fire-Safe in accordance with API-607.

*Recommended Manufacturer

Valve Model 7-3-07-3-U-U-SR:
- 7 - Body Material: 316 Stainless Steel (CF8M)
- 3 - End Connection: Butt Weld
- 07 - Valve Size: 1.5"
- 3 - Ball and Stem: 316 Stainless Steel
- U - Seat: UHMWPE
- U - Seals: UHMWPE
- SR - Operator: Spring Return Pneumatic Actuator

Actuator Model Series 93, Size 119-4:
- 93 - Actuator Type: Pneumatic Spring Return Actuator
- 119 - Actuator Size Designation (12.40" l x 4.91" w x 7.28" h)
- 4 - No. of Springs per Piston

Actuator to Valve Mounting Kit: ISO Mounting Kit EZ-010S

AECOM

On/Off Control Valves

DATA SHEET NO.			REV.
AOBV-1331			A
SHEET	OF	DATE	
1	2	1-17-13	
BY	CHK'D	PROC.	APPR.
AME	NCC		
P.O.			
REQ.			

NO.	BY	DATE	REVISION

Project:	RLWTF
TAG NO:	LLW-AOBV-1331
Asset No:	
Service Description:	ROU-1301 Permeate Feed to Tank TK-1304
Safety Class	NS
Spec No:	40 9200
P&ID:	D-6018
Line / Vessel Number:	LLW-245
Line ID:	1.610"
Size:	1.5"
Schedule:	40
Manufacturer:	*Flow-Tek
Model:	7-3-07-3-U-U-SR
Quality Assurance Level:	ML-4

PROCESS CONDITIONS

Process Data Case:	Normal								Units:
Sizing Case:	Normal								-
Required Cv:	225 to 325								-
Travel:	NA								-
Sound Pressure Level:	NA								-
	Inlet:	Outlet:	Inlet:	Outlet:	Inlet:	Outlet:	Inlet:	Outlet:	
Liquid Flow:	25.2	25.2							gpm
Vapor Flow:	NA	NA							cfm
Temperature:	75	75							°F
Pressure:	45	45							psig
Density:	1.02								g/ml
Viscosity:	1.05								cP
Critical Pressure (Pseudo):	NA								psia
pH:	6.5								-
Compressibility (Z):	NA								-
Specific Heat Ratio ($^{C_P}/_{C_V}$):	NA								-

Fluid:	LLW (contaminated water)	Max Temperature:	125 °F	Inlet:	Outlet:
Area Classification:		Max Upset Pressure (normal flow):			
Ambient Temperature Requirements:	55 to 95 °F	Max Upset Pressure (reverse flow):			

VALVE BODY / BONNET

Valve Type:	3 Piece Full Port Ball Valve		
Body Size:	1.5"	ANSI Class:	150
Max Rated Pressure:	1000 psi	Max Rated Temperature:	200 °F
Body/Bonnet Material:	316SS (ASTM A351 CF8M)		
Liner Material / ID:	N/A		
Inlet Connection Face:	Butt Weld		
Outlet Connection Face:	Butt Weld		
Flange Face Finish:	N/A		
Bonnet Style:	N/A		
Lube Iso Valve:	No	Lube:	N/A
Packing Style:	Seat Rings		
Packing Material:	UHMWPE		
Body/Bonnet Gasket Material:	N/A		
Manufacturer:	*Flow-Tek		
Model:	7000-316SS		

SWITCH

RELAY 1	Tag No:	ZSO-1331			
	Power Rating:	24V dc	Type:	N/O	
	Alarm Setting	N/A			
RELAY 2	Tag No:	ZSC-1331			
	Power Rating:	24V dc	Type:	N/O	
	Alarm Setting	N/A			
Sensor Type:	Proximity	Max. Load Current:	200 mA		
Conduit Connection:	1/2" NPT				
Manufacturer:	*Flow-Tek (Bray)				
Model No.	2N1 (Series 52)				
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1	5	IP2:	6

TRIM

TrimType:	Single Seat				
Size:	1.5"	Travel	N/A		
Rated Cv:	275	Fl:	N/A	Xt:	N/A
Characteristic:	N/A				
Balanced/Unbalanced:	Balanced				
Plug Material:	316SS (ASTM A351 CF8M)				
Seat Material:	UHMWPE				
Stem Material:	316SS (ASTM A479)				
Ext Trim Material:	316SS (ASTM A351 CF3M)				
Seat Leakage Class:	FCI 70-2 Class IV	Flow Direction:	Bi-directional		
Manufacturer:	*Flow-Tek	Model:	7000-316SS		

ACTUATOR

Actuator Type:	Pneumatic				
Valve Air Failure Position:	FC	Valve Function:	On / Off		
Size:	N/A	Effective Area:	N/A		
Actuator Orientation:	Top Mount	Spring action	Close		
Hand Wheel Type:	None	Position	Indicator Pointer		
Air Failure Valve:	None	Set at	N/A		
Available Air Supply Pressure:					
Min:	105 psig	Max:	120 psig		
Allowable Pressure Requirements:					
Min:	80 psig	Max:	140 psig		
Bench Range:	N/A				
Required Stroke Time to Open:	1/2 s @ 80 psig				
Required Stroke Time to Close:	1/2 s @ 80 psig				
Manufacturer:	*Flow-Tek				
Model:	Series 93: Size 119-4				

TAG NO.	LLW-AOBV-1331	ON/OFF Control Valves	DATA SHEET NO.	SHEET	OF
			AOBV-1331	2	2

SOLENOID

Tag No:	HS-1331	Fluid:	Air		
Type:	3-Way	Coil:	Class F		
Coil Housing:	NEMA 4X	Watts:	6.9		
Voltage:	24V dc				
Power Wiring:	N/A	Signal Type:	N/A		
Communication Protocol:	N/A	Location:	Direct Mounted		
Smart:	N/A	Indicate:	No	Isolate:	No
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1	5	IP2:	6
Main Valve Action when Coil is Deenergized:	Close				
Conduit Connection:	1/2" NPT				
Body Material:	Anodized Aluminum				
Manufacturer:	*Bray	Model:	Series 63		

NOTES

Valves to be tested in accordance with ASTM D5162, ANSI B16.34 or B16.42 and MSS SP-61 (Pressure Testing of Valves). All dimensions are to be in accordance with ANSI B16.42 (ductile iron) or ANSI B16.5 (steel) and MSS SP-72 (Ball Valves with Flanged or Butt-Welding Ends for General Service). Valves are to be certified Fire-Safe in accordance with API-607.

*Recommended Manufacturer

Valve Model 7-3-07-3-U-U-SR:
- 7 - Body Material: 316 Stainless Steel (CF8M)
- 3 - End Connection: Butt Weld
- 07 - Valve Size: 1.5"
- 3 - Ball and Stem: 316 Stainless Steel
- U - Seat: UHMWPE
- U - Seals: UHMWPE
- SR - Operator: Spring Return Pneumatic Actuator

Actuator Model Series 93, Size 119-4:
- 93 - Actuator Type: Pneumatic Spring Return Actuator
- 119 - Actuator Size Designation (12.40" l x 4.91" w x 7.28" h)
- 4 - No. of Springs per Piston

Actuator to Valve Mounting Kit: ISO Mounting Kit EZ-010S

AECOM

On/Off Control Valves

DATA SHEET NO.	REV.
AOBV-1340	A

SHEET	OF	DATE
1	2	1-17-13

NO.	BY	DATE	REVISION

BY	CHK'D	PROC.	APPR.
AME	NCC		

P.O.	
REQ.	

Project:	RLWTF						
TAG NO:	LLW-AOBV-1340	Spec No	40 9200	Line / Vessel Number:	LLW-269		
Asset No:		P&ID:	D-6020	Line ID: 0.622"	Size: 0.5"	Schedule:	40
Service Description:	Condensate Bypass to Tank TK-1304			Manufacturer:	*Flow-Tek		
				Model:	7-3-03-3-U-U-SR		
Safety Class	NS			Quality Assurance Level:	ML-4		

PROCESS CONDITIONS

Process Data Case:	Normal								Units:
Sizing Case:	Normal								-
Required Cv:	25 to 40								-
Travel:	NA								-
Sound Pressure Level:	NA								-
	Inlet:	Outlet:	Inlet:	Outlet:	Inlet:	Outlet:	Inlet:	Outlet:	
Liquid Flow:	NA	NA							gpm
Vapor Flow:	NA	NA							cfm
Temperature:	75	75							°F
Pressure:	45	45							psig
Density:	1.02								g/ml
Viscosity:	1.05								cP
Critical Pressure (Pseudo):	NA								psia
pH:	8.2								-
Compressibility (Z):	NA								-
Specific Heat Ratio (C_P/C_V):	NA								-

Fluid:	LLW (contaminated water)	Max Temperature:	125 °F	Inlet:	Outlet
Area Classification:		Max Upset Pressure (normal flow):			
Ambient Temperature Requirements:	55 to 95 °F	Max Upset Pressure (reverse flow):			

VALVE BODY / BONNET

Valve Type:	3 Piece Full Port Ball Valve		
Body Size:	0.5"	ANSI Class:	150
Max Rated Pressure:	1000 psi	Max Rated Temperature	200 °F
Body/Bonnet Material:	316SS (ASTM A351 CF8M)		
Liner Material / ID:	N/A		
Inlet Connection Face:	Butt Weld		
Outlet Connection Face:	Butt Weld		
Flange Face Finish:	N/A		
Bonnet Style:	N/A		
Lube Iso Valve:	No	Lube:	N/A
Packing Style:	Seat Rings		
Packing Material:	UHMWPE		
Body/Bonnet Gasket Material:	N/A		
Manufacturer:	*Flow-Tek		
Model:	7000-316SS		

SWITCH

RELAY 1	Tag No:	ZSO-1340			
	Power Rating:	24V dc	Type:	N/O	
	Alarm Setting	N/A			
RELAY 2	Tag No:	ZSC-1340			
	Power Rating:	24V dc	Type:	N/O	
	Alarm Setting	N/A			
Sensor Type:	Proximity	Max. Load Current:	200 mA		
Conduit Connection:	1/2" NPT				
Manufacturer:	*Flow-Tek (Bray)				
Model No.	2N1 (Series 52)				
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1	5	IP2:	6

TRIM

TrimType:	Single Seat				
Size:	0.5"	Travel	N/A		
Rated Cv:	32	Fl:	N/A	Xt:	N/A
Characteristic:	N/A				
Balanced/Unbalanced:	Balanced				
Plug Material:	316SS (ASTM A351 CF8M)				
Seat Material:	UHMWPE				
Stem Material:	316SS (ASTM A479)				
Ext Trim Material:	316SS (ASTM A351 CF3M)				
Seat Leakage Class:	FCI 70-2 Class IV	Flow Direction:	Bi-directional		
Manufacturer:	*Flow-Tek	Model:	7000-316SS		

ACTUATOR

Actuator Type:	Pneumatic				
Valve Air Failure Position:	FC	Valve Function:	On / Off		
Size:	N/A	Effective Area:	N/A		
Actuator Orientation:	Top Mount	Spring action	Close		
Hand Wheel Type:	None	Position	Indicator Pointer		
Air Failure Valve:	None	Set at	N/A		
Available Air Supply Pressure:					
Min:	105 psig	Max:	120 psig		
Allowable Pressure Requirements:					
Min:	80 psig	Max:	140 psig		
Bench Range:	N/A				
Required Stroke Time to Open:	1/4 s @ 80 psig				
Required Stroke Time to Close:	1/4 s @ 80 psig				
Manufacturer:	*Flow-Tek				
Model:	Series 93: Size 63-4				

TAG NO.	LLW-AOBV-1340	ON/OFF Control Valves	DATA SHEET NO.	SHEET	OF
			AOBV-1340	2	2

SOLENOID

Tag No:	HS-1340	Fluid:	Air				
Type:	3-Way	Coil:	Class F				
Coil Housing:	NEMA 4X	Watts:	6.9				
Voltage:	24V dc						
Power Wiring:	N/A	Signal Type:	N/A				
Communication Protocol:	N/A	Location:	Direct Mounted				
Smart:	N/A	Indicate:	No	Isolate:	No		
Electrical Protection:	N/A	Temperature Category:	N/A				
Gas Group:	N/A	Enclosure Protection IP1	5	IP2:	6		
Main Valve Action when Coil is Deenergized:	Close						
Conduit Connection:	1/2" NPT						
Body Material:	Anodized Aluminum						
Manufacturer:	*Bray	Model:	Series 63				

NOTES

Valves to be tested in accordance with ASTM D5162, ANSI B16.34 or B16.42 and MSS SP-61 (Pressure Testing of Valves). All dimensions are to be in accordance with ANSI B16.42 (ductile iron) or ANSI B16.5 (steel) and MSS SP-72 (Ball Valves with Flanged or Butt-Welding Ends for General Service). Valves are to be certified Fire-Safe in accordance with API-607.

*Recommended Manufacturer

Valve Model 7-3-03-3-U-U-SR:
- 7 - Body Material: 316 Stainless Steel (CF8M)
- 3 - End Connection: Butt Weld
- 03 - Valve Size: 0.5"
- 3 - Ball and Stem: 316 Stainless Steel
- U - Seat: UHMWPE
- U - Seals: UHMWPE
- SR - Operator: Spring Return Pneumatic Actuator

Actuator Model Series 93, Size 63-4:
- 93 - Actuator Type: Pneumatic Spring Return Actuator
- 63 - Actuator Size Designation (5.58" l x 3.11" w x 4.53" h)
- 4 - No. of Springs per Piston

Actuator to Valve Mounting Kit: ISO Mounting Kit EZ-002S

AECOM

On/Off Control Valves

DATA SHEET NO.			REV.
AOBV-1342			A
SHEET	OF	DATE	
1	2	1-17-13	

NO.	BY	DATE	REVISION

BY	CHK'D	PROC.	APPR.
AME	NCC		

P.O.	
REQ.	

Project:	RLWTF
TAG NO:	LLW-AOBV-1342
Asset No:	
Service Description:	RO Permeate Discharge from Tank TK-1304
Safety Class	NS

Spec No	40 9200	Line / Vessel Number:	LLW-267
P&ID:	D-6021	Line ID: 1.610"	Size: 1.5" Schedule: 40
Manufacturer:	*Flow-Tek		
Model:	7-3-07-3-U-U-SR		
Quality Assurance Level:	ML-4		

PROCESS CONDITIONS

Process Data Case:	Normal								Units:
Sizing Case:	Normal								-
Required Cv:	225 to 325								-
Travel:	NA								-
Sound Pressure Level:	NA								-
	Inlet:	Outlet:	Inlet:	Outlet:	Inlet:	Outlet:	Inlet:	Outlet:	
Liquid Flow:	25.2	25.2							gpm
Vapor Flow:	NA	NA							cfm
Temperature:	75	75							°F
Pressure:	45	45							psig
Density:	1.02								g/ml
Viscosity:	1.05								cP
Critical Pressure (Pseudo):	NA								psia
pH:	6.5								-
Compressibility (Z):	NA								-
Specific Heat Ratio (C_P/C_V):	NA								-

Fluid:	LLW (contaminated water)	Max Temperature:	125 °F	Inlet:	Outlet
Area Classification:		Max Upset Pressure (normal flow):			
Ambient Temperature Requirements:	55 to 95 °F	Max Upset Pressure (reverse flow):			

VALVE BODY / BONNET

Valve Type:	3 Piece Full Port Ball Valve		
Body Size:	1.5"	ANSI Class:	150
Max Rated Pressure:	1000 psi	Max Rated Temperature:	200 °F
Body/Bonnet Material:	316SS (ASTM A351 CF8M)		
Liner Material / ID:	N/A		
Inlet Connection Face:	Butt Weld		
Outlet Connection Face:	Butt Weld		
Flange Face Finish:	N/A		
Bonnet Style:	N/A		
Lube Iso Valve:	No	Lube:	N/A
Packing Style:	Seat Rings		
Packing Material:	UHMWPE		
Body/Bonnet Gasket Material:	N/A		
Manufacturer:	*Flow-Tek		
Model:	7000-316SS		

SWITCH

RELAY 1	Tag No:	ZSO-1342			
	Power Rating:	24V dc	Type:	N/O	
	Alarm Setting	N/A			
RELAY 2	Tag No:	ZSC-1342			
	Power Rating:	24V dc	Type:	N/O	
	Alarm Setting	N/A			
Sensor Type:	Proximity	Max. Load Current:	200 mA		
Conduit Connection:	1/2" NPT				
Manufacturer:	*Flow-Tek (Bray)				
Model No.	2N1 (Series 52)				
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1	5	IP2:	6

TRIM

TrimType:	Single Seat				
Size:	1.5"	Travel	N/A		
Rated Cv:	275	Fl:	N/A	Xt:	N/A
Characteristic:	N/A				
Balanced/Unbalanced:	Balanced				
Plug Material:	316SS (ASTM A351 CF8M)				
Seat Material:	UHMWPE				
Stem Material:	316SS (ASTM A479)				
Ext Trim Material:	316SS (ASTM A351 CF3M)				
Seat Leakage Class:	FCI 70-2 Class IV	Flow Direction:	Bi-directional		
Manufacturer:	*Flow-Tek	Model:	7000-316SS		

ACTUATOR

Actuator Type:	Pneumatic		
Valve Air Failure Position:	FC	Valve Function:	On / Off
Size:	N/A	Effective Area:	N/A
Actuator Orientation:	Top Mount	Spring action	Close
Hand Wheel Type:	None	Position	Indicator Pointer
Air Failure Valve:	None	Set at	N/A
Available Air Supply Pressure:			
Min:	105 psig	Max:	120 psig
Allowable Pressure Requirements:			
Min:	80 psig	Max:	140 psig
Bench Range:	N/A		
Required Stroke Time to Open:	1/2 s @ 80 psig		
Required Stroke Time to Close:	1/2 s @ 80 psig		
Manufacturer:	*Flow-Tek		
Model:	Series 93: Size 119-4		

TAG NO.	LLW-AOBV-1342	ON/OFF Control Valves	DATA SHEET NO.	SHEET	OF
			AOBV-1342	2	2

SOLENOID

Tag No:	HS-1342	Fluid:	Air		
Type:	3-Way	Coil:	Class F		
Coil Housing:	NEMA 4X	Watts:	6.9		
Voltage:	24V dc				
Power Wiring:	N/A	Signal Type:	N/A		
Communication Protocol:	N/A	Location:	Direct Mounted		
Smart:	N/A	Indicate:	No	Isolate:	No
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1	5	IP2:	6
Main Valve Action when Coil is Deenergized:	Close				
Conduit Connection:	1/2" NPT				
Body Material:	Anodized Aluminum				
Manufacturer:	*Bray	Model:	Series 63		

NOTES

Valves to be tested in accordance with ASTM D5162, ANSI B16.34 or B16.42 and MSS SP-61 (Pressure Testing of Valves). All dimensions are to be in accordance with ANSI B16.42 (ductile iron) or ANSI B16.5 (steel) and MSS SP-72 (Ball Valves with Flanged or Butt-Welding Ends for General Service). Valves are to be certified Fire-Safe in accordance with API-607.

*Recommended Manufacturer

Valve Model 7-3-07-3-U-U-SR:
- 7 - Body Material: 316 Stainless Steel (CF8M)
- 3 - End Connection: Butt Weld
- 07 - Valve Size: 1.5"
- 3 - Ball and Stem: 316 Stainless Steel
- U - Seat: UHMWPE
- U - Seals: UHMWPE
- SR - Operator: Spring Return Pneumatic Actuator

Actuator Model Series 93, Size 119-4:
- 93 - Actuator Type: Pneumatic Spring Return Actuator
- 119 - Actuator Size Designation (12.40" l x 4.91" w x 7.28" h)
- 4 - No. of Springs per Piston

Actuator to Valve Mounting Kit: ISO Mounting Kit EZ-010S

AECOM

On/Off Control Valves

DATA SHEET NO.	REV.
AOBV-1355	A

SHEET	OF	DATE
1	2	1-17-13

NO.	BY	DATE	REVISION

BY	CHK'D	PROC.	APPR.
AME	NCC		

P.O.	
REQ.	

Project:	RLWTF
TAG NO:	LLW-AOBV-1355
Asset No:	
Service Description:	ROU-1301 Concentrate Feed to Tank TAC-4302
Safety Class	NS

Spec No	40 9200
P&ID:	D-6018
Line / Vessel Number:	LLW-434
Line ID:	1.610"
Size:	1.5"
Schedule:	40
Manufacturer:	*Flow-Tek
Model:	7-3-07-3-U-U-SR
Quality Assurance Level:	ML-4

PROCESS CONDITIONS

Process Data Case:	Normal								Units:
Sizing Case:	Normal								-
Required Cv:	225 to 325								-
Travel:	NA								-
Sound Pressure Level:	NA								-
	Inlet:	Outlet:	Inlet:	Outlet:	Inlet:	Outlet:	Inlet:	Outlet:	
Liquid Flow:	NA	NA							gpm
Vapor Flow:	NA	NA							cfm
Temperature:	75	75							°F
Pressure:	45	45							psig
Density:	1.02								g/ml
Viscosity:	1.05								cP
Critical Pressure (Pseudo):	NA								psia
pH:	7.7								-
Compressibility (Z):	NA								-
Specific Heat Ratio (C_P/C_V):	NA								-

Fluid:	LLW (contaminated water)	Max Temperature:	125 °F	Inlet:	Outlet
Area Classification:		Max Upset Pressure (normal flow):			
Ambient Temperature Requirements:	55 to 95 °F	Max Upset Pressure (reverse flow):			

VALVE BODY / BONNET

Valve Type:	3 Piece Full Port Ball Valve		
Body Size:	1.5"	ANSI Class:	150
Max Rated Pressure:	1000 psi	Max Rated Temperature:	200 °F
Body/Bonnet Material:	316SS (ASTM A351 CF8M)		
Liner Material / ID:	N/A		
Inlet Connection Face:	Butt Weld		
Outlet Connection Face:	Butt Weld		
Flange Face Finish:	N/A		
Bonnet Style:	N/A		
Lube Iso Valve:	No	Lube:	N/A
Packing Style:	Seat Rings		
Packing Material:	UHMWPE		
Body/Bonnet Gasket Material:	N/A		
Manufacturer:	*Flow-Tek		
Model:	7000-316SS		

SWITCH

RELAY 1	Tag No:	ZSO-1355			
	Power Rating:	24V dc	Type:	N/O	
	Alarm Setting	N/A			
RELAY 2	Tag No:	ZSC-1355			
	Power Rating:	24V dc	Type:	N/O	
	Alarm Setting	N/A			
Sensor Type:	Proximity	Max. Load Current:	200 mA		
Conduit Connection:	1/2" NPT				
Manufacturer:	*Flow-Tek (Bray)				
Model No.	2N1 (Series 52)				
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1	5	IP2:	6

TRIM

TrimType:	Single Seat				
Size:	1.5"	Travel	N/A		
Rated Cv:	275	Ft:	N/A	Xt:	N/A
Characteristic:	N/A				
Balanced/Unbalanced:	Balanced				
Plug Material:	316SS (ASTM A351 CF8M)				
Seat Material:	UHMWPE				
Stem Material:	316SS (ASTM A479)				
Ext Trim Material:	316SS (ASTM A351 CF3M)				
Seat Leakage Class:	FCI 70-2 Class IV	Flow Direction:	Bi-directional		
Manufacturer:	*Flow-Tek	Model:	7000-316SS		

ACTUATOR

Actuator Type:	Pneumatic				
Valve Air Failure Position:	FC	Valve Function:	On / Off		
Size:	N/A	Effective Area:	N/A		
Actuator Orientation:	Top Mount	Spring action	Close		
Hand Wheel Type:	None	Position	Indicator Pointer		
Air Failure Valve:	None	Set at	N/A		
Available Air Supply Pressure:					
Min:	105 psig	Max:	120 psig		
Allowable Pressure Requirements:					
Min:	80 psig	Max:	140 psig		
Bench Range:	N/A				
Required Stroke Time to Open:	1/2 s @ 80 psig				
Required Stroke Time to Close:	1/2 s @ 80 psig				
Manufacturer:	*Flow-Tek				
Model:	Series 93: Size 119-4				

TAG NO.	LLW-AOBV-1355	ON/OFF Control Valves	DATA SHEET NO.	SHEET	OF
			AOBV-1355	2	2

SOLENOID

Tag No:	HS-1355	Fluid:	Air		
Type:	3-Way	Coil:	Class F		
Coil Housing:	NEMA 4X	Watts:	6.9		
Voltage:	24V dc				
Power Wiring:	N/A	Signal Type:	N/A		
Communication Protocol:	N/A	Location:	Direct Mounted		
Smart:	N/A	Indicate:	No	Isolate:	No
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1	5	IP2:	6
Main Valve Action when Coil is Deenergized:	Close				
Conduit Connection:	1/2" NPT				
Body Material:	Anodized Aluminum				
Manufacturer:	*Bray	Model:	Series 63		

NOTES

Valves to be tested in accordance with ASTM D5162, ANSI B16.34 or B16.42 and MSS SP-61 (Pressure Testing of Valves). All dimensions are to be in accordance with ANSI B16.42 (ductile iron) or ANSI B16.5 (steel) and MSS SP-72 (Ball Valves with Flanged or Butt-Welding Ends for General Service). Valves are to be certified Fire-Safe in accordance with API-607.

*Recommended Manufacturer

Valve Model 7-3-07-3-U-U-SR:
- 7 - Body Material: 316 Stainless Steel (CF8M)
- 3 - End Connection: Butt Weld
- 07 - Valve Size: 1.5"
- 3 - Ball and Stem: 316 Stainless Steel
- U - Seat: UHMWPE
- U - Seals: UHMWPE
- SR - Operator: Spring Return Pneumatic Actuator

Actuator Model Series 93, Size 119-4:
- 93 - Actuator Type: Pneumatic Spring Return Actuator
- 119 - Actuator Size Designation (12.40" l x 4.91" w x 7.28" h)
- 4 - No. of Springs per Piston

Actuator to Valve Mounting Kit: ISO Mounting Kit EZ-010S

AECOM

On/Off Control Valves

NO	BY	DATE	REVISION

DATA SHEET NO.			REV.
MOBV-1510			A
SHEET	OF	DATE	
1	2	1-17-13	
BY	CHK'D	PROC.	APPR.
AME	NCC		
P.O.			
REQ.			

Project:	RLWTF						
TAG NO:	LLW-MOBV-1510	Spec No:	40 9200	Line / Vessel Number:	LLW-293		
Asset No:		P&ID:	D-6410	Line ID: 1.610"	Size: 1.5"	Schedule:	40
Service Description:	Treated Effluent Feed to Tank TK-1502			Manufacturer:	*Flow-Tek		
				Model:	7-3-07-3-U-U-EL		
Safety Class	NS			Quality Assurance Level:	ML-4		

PROCESS CONDITIONS

Process Data Case:	Normal									Units:
Sizing Case:	Normal									-
Required Cv:	225 to 325									-
Travel:	NA									-
Sound Pressure Level:	NA									-
	Inlet:	Outlet:	Inlet:	Outlet:	Inlet:	Outlet:	Inlet:	Outlet:		
Liquid Flow:	100	100								gpm
Vapor Flow:	NA	NA								cfm
Temperature:	75	75								°F
Pressure:	45	45								psig
Density:	1.02									-
Viscosity:	1.05									cP
Critical Pressure (Pseudo):	NA									psia
pH:	6.50									-
Compressibility (Z):	NA									-
Specific Heat Ratio (C_P/C_V):	NA									-

Fluid:	LLW (contaminated water)	Max Temperature:	125 °F	Inlet:	Outlet:
Area Classification:		Max Upset Pressure (normal flow):			
Ambient Temperature Requirements:	5 to 110 °F	Max Upset Pressure (reverse flow):			

VALVE BODY / BONNET

Valve Type:	3 Piece Full Port Ball Valve		
Body Size:	1.5"	ANSI Class:	150
Max Rated Pressure:	1000 psi	Max Rated Temperature:	200 °F
Body/Bonnet Material:	316SS (ASTM A351 CF8M)		
Liner Material / ID:	N/A		
Inlet Connection Face:	Butt Weld		
Outlet Connection Face:	Butt Weld		
Flange Face Finish:	N/A		
Bonnet Style:	N/A		
Lube Iso Valve:	No	Lube:	N/A
Packing Style:	Seat Rings		
Packing Material:	UHMWPE		
Body/Bonnet Gasket Material:	N/A		
Manufacturer:	*Flow-Tek		
Model:	7000-316SS		

SWITCH

RELAY 1	Tag No:	ZSO-1510			
	Power Rating:	24V dc	Type:	N/O	
	Alarm Setting	N/A			
RELAY 2	Tag No:	ZSC-1510			
	Power Rating:	24V dc	Type:	N/O	
	Alarm Setting	N/A			
Sensor Type:	Limit Switch	Max. Load Current:	10A		
Conduit Connection:	N/A				
Manufacturer:	See Actuator				
Model No.	See Actuator Notes				
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1	N/A	IP2:	N/A

TRIM

TrimType:	Single Seat				
Size:	1.5"	Travel	N/A		
Rated Cv:	275	Fl:	N/A	Xt:	N/A
Characteristic:	N/A				
Balanced/Unbalanced:	Balanced				
Plug Material:	316SS (ASTM A351 CF8M)				
Seat Material:	UHMWPE				
Stem Material:	316SS (ASTM A479)				
Ext Trim Material:	316SS (ASTM A351 CF3M)				
Seat Leakage Class:	FCI 70-2 Class IV	Flow Direction:	Bi-directional		
Manufacturer:	*Flow-Tek	Model:	7000-316SS		

ACTUATOR

Actuator Type:	Electric				
Valve Failure Position:	FL	Valve Function:	On / Off		
Size:	N/A	Effective Area:	N/A		
Actuator Orientation:	Top Mount	Spring action	N/A		
Hand Wheel Type:	None	Position	Position Pointer / LEDs		
Air Failure Valve:	N/A	Set at	N/A		
Available Air Supply Pressure:					
Min:	N/A	Max:	N/A		
Allowable Pressure Requirements:					
Min:	N/A	Max:	N/A		
Bench Range:	N/A				
Required Stroke Time to Open:	10 sec				
Required Stroke Time to Close:	10 sec				
Manufacturer:	*Bray				
Model:	73-0602-113D4-536				

TAG NO.	LLW-MOBV-1510	ON/OFF Control Valves	DATA SHEET NO.	SHEET	OF
			MOBV-1510	2	2

NOTES

Valves to be tested in accordance with ASTM D5162, ANSI B16.34 or B16.42 and MSS SP-61 (Pressure Testing of Valves). All dimensions are to be in accordance with ANSI B16.42 (ductile iron) or ANSI B16 5 (steel) and MSS SP-72 (Ball Valves with Flanged or Butt-Welding Ends for General Service). Valves are to be certified Fire-Safe in accordance with API-607.

*Recommended Manufacturer

Valve Model 7-3-07-3-U-U-EL:
- 7 - Body Material: 316 Stainless Steel (CF8M)
- 3 - End Connection: Butt Weld
- 07 - Valve Size: 1.5"
- 3 - Ball and Stem: 316 Stainless Steel
- U - Seat: UHMWPE
- U - Seals: UHMWPE
- EL - Operator: Electric Actuator

Actuator Model 73-0602-113D4-536:
- 73 - Actuator Type: Bray Series 73 Electric Actuator
- 060 - Torque: 600 in-lbs
- 2 - Speed: 10 seconds (stroke time)
- 113 - (N/A)
- D - Drive Type: Double D 600 in-lbs Torque
- 4 - Voltage: 24VDC
- 536 - (N/A)
- Add Option: 2 voltage free travel limit switches for remote indication

Actuator to Valve Mounting Kit: ISO Mounting Kit EZ-004S

AECOM

On/Off Control Valves

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
MOBV-1512			A
SHEET	OF	DATE	
1	2	1-17-13	
BY	CHK'D	PROC.	APPR.
AME	NCC		
P.O.			
REQ.			

Project:	RLWTF
TAG NO:	LLW-MOBV-1512
Asset No:	
Service Description:	Tank TK-1501 Treated Effluent Recycle Feed
Safety Class	NS

Spec No:	40 9200			Line / Vessel Number:	LLW-305		
P&ID:	D-6410			Line ID:	3.068"	Size: 3.0"	Schedule: 40
Manufacturer:	*Flow-Tek						
Model:	7-3-10-3-U-U-EL						
Quality Assurance Level:	ML-4						

PROCESS CONDITIONS

Process Data Case:	Normal								Units:
Sizing Case:	Normal								-
Required Cv:	950 to 1350								-
Travel:	NA								-
Sound Pressure Level:	NA								-
	Inlet:	Outlet:	Inlet:	Outlet:	Inlet:	Outlet:	Inlet:	Outlet:	
Liquid Flow:	100	100							gpm
Vapor Flow:	NA	NA							cfm
Temperature:	75	75							°F
Pressure:	45	45							psig
Density:	1.02								-
Viscosity:	1.05								cP
Critical Pressure (Pseudo):	NA								psia
pH:	6.50								-
Compressibility (Z):	NA								-
Specific Heat Ratio (C_P/C_V):	NA								-

Fluid:	LLW (contaminated water)	Max Temperature:	125 °F	Inlet:	Outlet
Area Classification:		Max Upset Pressure (normal flow):			
Ambient Temperature Requirements:	5 to 110 °F	Max Upset Pressure (reverse flow):			

VALVE BODY / BONNET

Valve Type:	3 Piece Full Port Ball Valve		
Body Size:	3.0"	ANSI Class:	150
Max Rated Pressure:	1000 psi	Max Rated Temperature:	200 °F
Body/Bonnet Material:	316SS (ASTM A351 CF8M)		
Liner Material / ID:	N/A		
Inlet Connection Face:	Butt Weld		
Outlet Connection Face:	Butt Weld		
Flange Face Finish:	N/A		
Bonnet Style:	N/A		
Lube Iso Valve:	No	Lube:	N/A
Packing Style:	Seat Rings		
Packing Material:	UHMWPE		
Body/Bonnet Gasket Material:	N/A		
Manufacturer:	*Flow-Tek		
Model:	7000-316SS		

SWITCH

RELAY 1	Tag No:	ZSO-1512			
	Power Rating:	24V dc	Type:	N/O	
	Alarm Setting	N/A			
RELAY 2	Tag No:	ZSC-1512			
	Power Rating:	24V dc	Type:	N/O	
	Alarm Setting	N/A			
Sensor Type:	Limit Switch	Max. Load Current:	10A		
Conduit Connection:	N/A				
Manufacturer:	See Actuator				
Model No:	See Actuator Notes				
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1	N/A	IP2:	N/A

TRIM

TrimType:	Single Seat				
Size:	3.0"	Travel	N/A		
Rated Cv:	1150	Fl:	N/A	Xt:	N/A
Characteristic:	N/A				
Balanced/Unbalanced:	Balanced				
Plug Material:	316SS (ASTM A351 CF8M)				
Seat Material:	UHMWPE				
Stem Material:	316SS (ASTM A479)				
Ext Trim Material:	316SS (ASTM A351 CF3M)				
Seat Leakage Class:	FCI 70-2 Class IV	Flow Direction:	Bi-directional		
Manufacturer:	*Flow-Tek	Model:	7000-316SS		

ACTUATOR

Actuator Type:	Electric				
Valve Failure Position:	FL	Valve Function:	On / Off		
Size:	N/A	Effective Area:	N/A		
Actuator Orientation:	Top Mount	Spring action	N/A		
Hand Wheel Type:	Manual (Pull)	Position	Position Indicator		
Air Failure Valve:	N/A	Set at	N/A		
Available Air Supply Pressure:					
Min:	N/A	Max:	N/A		
Allowable Pressure Requirements:					
Min:	N/A	Max:	N/A		
Bench Range:	N/A				
Required Stroke Time to Open:	60 sec				
Required Stroke Time to Close:	60 sec				
Manufacturer:	*Bray				
Model:	70-0200-113A2-536				

TAG NO.	LLW-MOBV-1512	ON/OFF Control Valves	DATA SHEET NO.	SHEET	OF
			MOBV-1512	2	2

NOTES

Valves to be tested in accordance with ASTM D5162, ANSI B16.34 or B16.42 and MSS SP-61 (Pressure Testing of Valves). All dimensions are to be in accordance with ANSI B16.42 (ductile iron) or ANSI B16.5 (steel) and MSS SP-72 (Ball Valves with Flanged or Butt-Welding Ends for General Service). Valves are to be certified Fire-Safe in accordance with API-607.

*Recommended Manufacturer

Valve Model 7-3-10-3-U-U-EL:
- 7 - Body Material: 316 Stainless Steel (CF8M)
- 3 - End Connection: Butt Weld
- 10 - Valve Size: 3"
- 3 - Ball and Stem: 316 Stainless Steel
- U - Seat: UHMWPE
- U - Seals: UHMWPE
- EL - Operator: Electric Actuator

Actuator Model 70-0200-113A2-536:
- 70 - Actuator Type: Bray Series 70 Electric Actuator
- 020 - Torque: 2000 in-lbs
- 0 - Speed: 60 seconds (stroke time)
- 113 - (N/A)
- A - Style: Declutchable
- 2 - Voltage: 24VDC
- 536 - (N/A)
- Add Option: 2 dry-contact SPDT limit switches for remote indication

Actuator to Valve Mounting Kit: ISO Mounting Kit EZ-011S

AECOM

On/Off Control Valves

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
MOBV-1513			A
SHEET	OF	DATE	
1	2	1-17-13	
BY	CHK'D	PROC.	APPR.
AME	NCC		
P.O.			
REQ.			

Project:	RLWTF						
TAG NO:	LLW-MOBV-1513	Spec No:	40 9200	Line / Vessel Number:	LLW-291		
Asset No:		P&ID:	D-6410	Line ID: 3.068"	Size: 3.0"	Schedule:	40
Service Description:	Treated Effluent Discharged from Tank TK-1501			Manufacturer:	*Flow-Tek		
				Model:	7-3-10-3-U-U-EL		
Safety Class	NS	Quality Assurance Level:	ML-4				

PROCESS CONDITIONS

Process Data Case:	Normal									Units:
Sizing Case:	Normal									-
Required Cv:	950 to 1350									-
Travel:	NA									-
Sound Pressure Level:	NA									-
	Inlet:	Outlet:	Inlet:	Outlet:	Inlet:	Outlet:	Inlet:	Outlet:		
Liquid Flow:	100	100								gpm
Vapor Flow:	NA	NA								cfm
Temperature:	75	75								°F
Pressure:	45	45								psig
Density:	1.02									-
Viscosity:	1.05									cP
Critical Pressure (Pseudo):	NA									psia
pH:	6.50									-
Compressibility (Z):	NA									-
Specific Heat Ratio (C_P/C_V):	NA									-

Fluid:	LLW (contaminated water)	Max Temperature:	125 °F	Inlet:	Outlet
Area Classification:		Max Upset Pressure (normal flow):			
Ambient Temperature Requirements:	5 to 110 °F	Max Upset Pressure (reverse flow):			

VALVE BODY / BONNET

Valve Type:	3 Piece Full Port Ball Valve		
Body Size:	3.0"	ANSI Class:	150
Max Rated Pressure:	1000 psi	Max Rated Temperature:	200 °F
Body/Bonnet Material:	316SS (ASTM A351 CF8M)		
Liner Material / ID:	N/A		
Inlet Connection Face:	Butt Weld		
Outlet Connection Face:	Butt Weld		
Flange Face Finish:	N/A		
Bonnet Style:	N/A		
Lube Iso Valve:	No	Lube:	N/A
Packing Style:	Seat Rings		
Packing Material:	UHMWPE		
Body/Bonnet Gasket Material:	N/A		
Manufacturer:	*Flow-Tek		
Model:	7000-316SS		

SWITCH

RELAY 1	Tag No:	ZSO-1513			
	Power Rating:	24V dc	Type:	N/O	
	Alarm Setting	N/A			
RELAY 2	Tag No:	ZSC-1513			
	Power Rating:	24V dc	Type:	N/O	
	Alarm Setting	N/A			
Sensor Type:	Limit Switch	Max. Load Current:	10A		
Conduit Connection:	N/A				
Manufacturer:	See Actuator				
Model No.	See Actuator Notes				
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1	N/A	IP2:	N/A

TRIM

TrimType:	Single Seat				
Size:	3.0"	Travel	N/A		
Rated Cv:	1150	FI:	N/A	Xt:	N/A
Characteristic:	N/A				
Balanced/Unbalanced:	Balanced				
Plug Material:	316SS (ASTM A351 CF8M)				
Seat Material:	UHMWPE				
Stem Material:	316SS (ASTM A479)				
Ext Trim Material:	316SS (ASTM A351 CF3M)				
Seat Leakage Class:	FCI 70-2 Class IV	Flow Direction:	Bi-directional		
Manufacturer:	*Flow-Tek	Model:	7000-316SS		

ACTUATOR

Actuator Type:	Electric				
Valve Failure Position:	FL	Valve Function:	On / Off		
Size:	N/A	Effective Area:	N/A		
Actuator Orientation:	Top Mount	Spring action	N/A		
Hand Wheel Type:	Manual (Pull)	Position	Position Indicator		
Air Failure Valve:	N/A	Set at	N/A		
Available Air Supply Pressure:					
Min:	N/A	Max:	N/A		
Allowable Pressure Requirements:					
Min:	N/A	Max:	N/A		
Bench Range:	N/A				
Required Stroke Time to Open:	60 sec				
Required Stroke Time to Close:	60 sec				
Manufacturer:	*Bray				
Model:	70-0200-113A2-536				

TAG NO.	LLW-MOBV-1513	ON/OFF Control Valves	DATA SHEET NO.	SHEET	OF
			MOBV-1513	2	2

NOTES

Valves to be tested in accordance with ASTM D5162, ANSI B16.34 or B16.42 and MSS SP-61 (Pressure Testing of Valves). All dimensions are to be in accordance with ANSI B16.42 (ductile iron) or ANSI B16.5 (steel) and MSS SP-72 (Ball Valves with Flanged or Butt-Welding Ends for General Service). Valves are to be certified Fire-Safe in accordance with API-607.

*Recommended Manufacturer

Valve Model 7-3-10-3-U-U-EL:
- 7 - Body Material: 316 Stainless Steel (CF8M)
- 3 - End Connection: Butt Weld
- 10 - Valve Size: 3"
- 3 - Ball and Stem: 316 Stainless Steel
- U - Seat: UHMWPE
- U - Seals: UHMWPE
- EL - Operator: Electric Actuator

Actuator Model 70-0200-113A2-536:
- 70 - Actuator Type: Bray Series 70 Electric Actuator
- 020 - Torque: 2000 in-lbs
- 0 - Speed: 60 seconds (stroke time)
- 113 - (N/A)
- A - Style: Declutchable
- 2 - Voltage: 24VDC
- 536 - (N/A)
- Add Option: 2 dry-contact SPDT limit switches for remote indication

Actuator to Valve Mounting Kit: ISO Mounting Kit EZ-011S

AECOM

On/Off Control Valves

DATA SHEET NO.			REV.
MOBV-1529			A
SHEET	OF	DATE	
1	2	1-17-13	

NO.	BY	DATE	REVISION

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AME	NCC		

P.O.	
REQ.	

Project:	RLWTF						
TAG NO:	LLW-MOBV-1529	Spec No:	40 9200	Line / Vessel Number:	LLW-303		
Asset No:		P&ID:	D-6411	Line ID: 3.068"	Size: 3.0"	Schedule:	40
Service Description:	Treated Effluent Discharged from Tanks TK-1501, TK-1502 to ZLD, Outfall			Manufacturer:	*Flow-Tek		
				Model:	7-3-10-3-U-U-EL		
Safety Class	NS			Quality Assurance Level:	ML-4		

PROCESS CONDITIONS

Process Data Case:	Normal								Units:
Sizing Case:	Normal								-
Required Cv:	950 to 1350								-
Travel:	NA								-
Sound Pressure Level:	NA								-
	Inlet:	Outlet:	Inlet:	Outlet:	Inlet:	Outlet:	Inlet:	Outlet:	
Liquid Flow:	100	100							gpm
Vapor Flow:	NA	NA							cfm
Temperature:	75	75							°F
Pressure:	45	45							psig
Density:	1.02								-
Viscosity:	1.05								cP
Critical Pressure (Pseudo):	NA								psia
pH:	6.50								-
Compressibility (Z):	NA								-
Specific Heat Ratio (C_p/C_v):	NA								-

Fluid:	LLW (contaminated water)	Max Temperature:	125 °F	Inlet:	Outlet
Area Classification:		Max Upset Pressure (normal flow):			
Ambient Temperature Requirements:	5 to 110 °F	Max Upset Pressure (reverse flow):			

VALVE BODY / BONNET

Valve Type:	3 Piece Full Port Ball Valve		
Body Size:	3.0"	ANSI Class:	150
Max Rated Pressure:	1000 psi	Max Rated Temperature:	200 °F
Body/Bonnet Material:	316SS (ASTM A351 CF8M)		
Liner Material / ID:	N/A		
Inlet Connection Face:	Butt Weld		
Outlet Connection Face:	Butt Weld		
Flange Face Finish:	N/A		
Bonnet Style:	N/A		
Lube Iso Valve:	No	Lube:	N/A
Packing Style:	Seat Rings		
Packing Material:	UHMWPE		
Body/Bonnet Gasket Material:	N/A		
Manufacturer:	*Flow-Tek		
Model:	7000-316SS		

SWITCH

RELAY 1 Tag No:	ZSO-1529		
Power Rating:	24V dc	Type:	N/O
Alarm Setting	N/A		
RELAY 2 Tag No:	ZSC-1529		
Power Rating:	24V dc	Type:	N/O
Alarm Setting	N/A		
Sensor Type:	Limit Switch	Max. Load Current:	10A
Conduit Connection:	N/A		
Manufacturer:	See Actuator		
Model No.	See Actuator Notes		
Electrical Protection:	N/A	Temperature Category:	N/A
Gas Group:	N/A	Enclosure Protection IP1	N/A IP2: N/A

TRIM

TrimType:	Single Seat				
Size:	3.0"	Travel	N/A		
Rated Cv:	1150	FI:	N/A	Xt:	N/A
Characteristic:	N/A				
Balanced/Unbalanced:	Balanced				
Plug Material:	316SS (ASTM A351 CF8M)				
Seat Material:	UHMWPE				
Stem Material:	316SS (ASTM A479)				
Ext Trim Material:	316SS (ASTM A351 CF3M)				
Seat Leakage Class:	FCI 70-2 Class IV	Flow Direction:	Bi-directional		
Manufacturer:	*Flow-Tek	Model:	7000-316SS		

ACTUATOR

Actuator Type:	Electric		
Valve Failure Position:	FL	Valve Function:	On / Off
Size:	N/A	Effective Area:	N/A
Actuator Orientation:	Top Mount	Spring action	N/A
Hand Wheel Type:	Manual (Pull)	Position	Position Indicator
Air Failure Valve:	N/A	Set at	N/A
Available Air Supply Pressure:			
Min:	N/A	Max:	N/A
Allowable Pressure Requirements:			
Min:	N/A	Max:	N/A
Bench Range:	N/A		
Required Stroke Time to Open:	60 sec		
Required Stroke Time to Close:	60 sec		
Manufacturer:	*Bray		
Model:	70-0200-113A2-536		

TAG NO.	LLW-MOBV-1529	ON/OFF Control Valves	DATA SHEET NO.	SHEET	OF
			MOBV-1529	2	2

NOTES

Valves to be tested in accordance with ASTM D5162, ANSI B16.34 or B16.42 and MSS SP-61 (Pressure Testing of Valves). All dimensions are to be in accordance with ANSI B16.42 (ductile iron) or ANSI B16.5 (steel) and MSS SP-72 (Ball Valves with Flanged or Butt-Welding Ends for General Service). Valves are to be certified Fire-Safe in accordance with API-607.

*Recommended Manufacturer

Valve Model 7-3-10-3-U-U-EL:
- 7 - Body Material: 316 Stainless Steel (CF8M)
- 3 - End Connection: Butt Weld
- 10 - Valve Size: 3"
- 3 - Ball and Stem: 316 Stainless Steel
- U - Seat: UHMWPE
- U - Seals: UHMWPE
- EL - Operator: Electric Actuator

Actuator Model 70-0200-113A2-536:
- 70 - Actuator Type: Bray Series 70 Electric Actuator
- 020 - Torque: 2000 in-lbs
- 0 - Speed: 60 seconds (stroke time)
- 113 - (N/A)
- A - Style: Declutchable
- 2 - Voltage: 24VDC
- 536 - (N/A)
- Add Option: 2 dry-contact SPDT limit switches for remote indication

Actuator to Valve Mounting Kit: ISO Mounting Kit EZ-011S

AECOM

On/Off Control Valves

DATA SHEET NO.	REV.
MOBV-1531	A

SHEET	OF	DATE
1	2	1-17-13

NO.	BY	DATE	REVISION

BY	CHK'D	PROC.	APPR.
AME	NCC		

P.O.	
REQ.	

Project:	RLWTF
TAG NO:	LLW-MOBV-1531
Asset No:	
Service Description:	Treated Effluent Discharged from Tank TK-1502
Safety Class	NS

Spec No	40 9200	Line / Vessel Number:	LLW-291
P&ID:	D-6411	Line ID: 3.068" Size: 3.0"	Schedule: 40
		Manufacturer:	*Flow-Tek
		Model:	7-3-10-3-U-U-EL
		Quality Assurance Level:	ML-4

PROCESS CONDITIONS

Process Data Case:	Normal								Units:
Sizing Case:	Normal								-
Required Cv:	950 to 1350								-
Travel:	NA								-
Sound Pressure Level:	NA								-
	Inlet:	Outlet:	Inlet:	Outlet:	Inlet:	Outlet:	Inlet:	Outlet:	
Liquid Flow:	100	100							gpm
Vapor Flow:	NA	NA							cfm
Temperature:	75	75							°F
Pressure:	45	45							psig
Density:	1.02								-
Viscosity:	1.05								cP
Critical Pressure (Pseudo):	NA								psia
pH:	6.50								-
Compressibility (Z):	NA								-
Specific Heat Ratio (C_P/C_V):	NA								-

Fluid:	LLW (contaminated water)	Max Temperature:	125 °F	Inlet:	Outlet
Area Classification:		Max Upset Pressure (normal flow):			
Ambient Temperature Requirements:	5 to 110 °F	Max Upset Pressure (reverse flow):			

VALVE BODY / BONNET

Valve Type:	3 Piece Full Port Ball Valve		
Body Size:	3.0"	ANSI Class:	150
Max Rated Pressure:	1000 psi	Max Rated Temperature:	200 °F
Body/Bonnet Material:	316SS (ASTM A351 CF8M)		
Liner Material / ID:	N/A		
Inlet Connection Face:	Butt Weld		
Outlet Connection Face:	Butt Weld		
Flange Face Finish:	N/A		
Bonnet Style:	N/A		
Lube Iso Valve:	No	Lube:	N/A
Packing Style:	Seat Rings		
Packing Material:	UHMWPE		
Body/Bonnet Gasket Material:	N/A		
Manufacturer:	*Flow-Tek		
Model:	7000-316SS		

SWITCH

RELAY 1 Tag No:	ZSO-1531				
Power Rating:	24V dc	Type:	N/O		
Alarm Setting	N/A				
RELAY 2 Tag No:	ZSC-1531				
Power Rating:	24V dc	Type:	N/O		
Alarm Setting	N/A				
Sensor Type:	Limit Switch	Max. Load Current:	10A		
Conduit Connection:	N/A				
Manufacturer:	See Actuator				
Model No.	See Actuator Notes				
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1	N/A	IP2:	N/A

TRIM

TrimType:	Single Seat				
Size:	3.0"	Travel	N/A		
Rated Cv:	1150	Fl:	N/A	Xt:	N/A
Characteristic:	N/A				
Balanced/Unbalanced:	Balanced				
Plug Material:	316SS (ASTM A351 CF8M)				
Seat Material:	UHMWPE				
Stem Material:	316SS (ASTM A479)				
Ext Trim Material:	316SS (ASTM A351 CF3M)				
Seat Leakage Class:	FCI 70-2 Class IV	Flow Direction:	Bi-directional		
Manufacturer:	*Flow-Tek	Model:	7000-316SS		

ACTUATOR

Actuator Type:	Electric		
Valve Failure Position:	FL	Valve Function:	On / Off
Size:	N/A	Effective Area:	N/A
Actuator Orientation:	Top Mount	Spring action	N/A
Hand Wheel Type:	Manual (Pull)	Position	Position Indicator
Air Failure Valve:	N/A	Set at	N/A
Available Air Supply Pressure:			
Min:	N/A	Max:	N/A
Allowable Pressure Requirements:			
Min:	N/A	Max:	N/A
Bench Range:	N/A		
Required Stroke Time to Open:	60 sec		
Required Stroke Time to Close:	60 sec		
Manufacturer:	*Bray		
Model:	70-0200-113A2-536		

TAG NO.	LLW-MOBV-1531	ON/OFF Control Valves	DATA SHEET NO.	SHEET	OF
			MOBV-1531	2	2

NOTES

Valves to be tested in accordance with ASTM D5162, ANSI B16.34 or B16.42 and MSS SP-61 (Pressure Testing of Valves). All dimensions are to be in accordance with ANSI B16.42 (ductile iron) or ANSI B16.5 (steel) and MSS SP-72 (Ball Valves with Flanged or Butt-Welding Ends for General Service). Valves are to be certified Fire-Safe in accordance with API-607.

*Recommended Manufacturer

Valve Model 7-3-10-3-U-U-EL:
- 7 - Body Material: 316 Stainless Steel (CF8M)
- 3 - End Connection: Butt Weld
- 10 - Valve Size: 3"
- 3 - Ball and Stem: 316 Stainless Steel
- U - Seat: UHMWPE
- U - Seals: UHMWPE
- EL - Operator: Electric Actuator

Actuator Model 70-0200-113A2-536:
- 70 - Actuator Type: Bray Series 70 Electric Actuator
- 020 - Torque: 2000 in-lbs
- 0 - Speed: 60 seconds (stroke time)
- 113 - (N/A)
- A - Style: Declutchable
- 2 - Voltage: 24VDC
- 536 - (N/A)
- Add Option: 2 dry-contact SPDT limit switches for remote indication

Actuator to Valve Mounting Kit: ISO Mounting Kit EZ-011S

AECOM

On/Off Control Valves

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
MOBV-1549			A
SHEET	OF	DATE	
1	2	1-17-13	
BY	CHK'D	PROC.	APPR.
AME	NCC		
P.O.			
REQ.			

Project: RLWTF

TAG NO:	LLW-MOBV-1549	Spec No:	40 9200	Line / Vessel Number:	LLW-307		
Asset No:		P&ID:	D-6411	Line ID: 3.068"	Size: 3.0"	Schedule:	40
Service Description:	Tank TK-1502 Treated Effluent Recycle Feed			Manufacturer:	*Flow-Tek		
				Model:	7-3-10-3-U-U-EL		
Safety Class	NS	Quality Assurance Level:	ML-4				

PROCESS CONDITIONS

Process Data Case:	Normal									Units:
Sizing Case:	Normal									-
Required Cv:	950 to 1350									-
Travel:	NA									-
Sound Pressure Level:	NA									-
	Inlet:	Outlet:	Inlet:	Outlet:	Inlet:	Outlet:	Inlet:	Outlet:		
Liquid Flow:	100	100								gpm
Vapor Flow:	NA	NA								cfm
Temperature:	75	75								°F
Pressure:	45	45								psig
Density:	1.02									-
Viscosity:	1.05									cP
Critical Pressure (Pseudo):	NA									psia
pH:	6.50									-
Compressibility (Z):	NA									-
Specific Heat Ratio (C_p/C_v):	NA									-

Fluid:	LLW (contaminated water)	Max Temperature:	125 °F	Inlet:	Outlet
Area Classification:		Max Upset Pressure (normal flow):			
Ambient Temperature Requirements:	5 to 110 °F	Max Upset Pressure (reverse flow):			

VALVE BODY / BONNET

Valve Type:	3 Piece Full Port Ball Valve		
Body Size:	3.0"	ANSI Class:	150
Max Rated Pressure:	1000 psi	Max Rated Temperature:	200 °F
Body/Bonnet Material:	316SS (ASTM A351 CF8M)		
Liner Material / ID:	N/A		
Inlet Connection Face:	Butt Weld		
Outlet Connection Face:	Butt Weld		
Flange Face Finish:	N/A		
Bonnet Style:	N/A		
Lube Iso Valve:	No	Lube:	N/A
Packing Style:	Seat Rings		
Packing Material:	UHMWPE		
Body/Bonnet Gasket Material:	N/A		
Manufacturer:	*Flow-Tek		
Model:	7000-316SS		

SWITCH

RELAY 1	Tag No:	ZSO-1549			
	Power Rating:	24V dc	Type:	N/O	
	Alarm Setting	N/A			
RELAY 2	Tag No:	ZSC-1549			
	Power Rating:	24V dc	Type:	N/O	
	Alarm Setting	N/A			
Sensor Type:	Limit Switch	Max. Load Current:	10A		
Conduit Connection:	N/A				
Manufacturer:	See Actuator				
Model No.	See Actuator Notes				
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1	N/A	IP2:	N/A

TRIM

TrimType:	Single Seat				
Size:	3.0"	Travel	N/A		
Rated Cv:	1150	Ft:	N/A	Xt:	N/A
Characteristic:	N/A				
Balanced/Unbalanced:	Balanced				
Plug Material:	316SS (ASTM A351 CF8M)				
Seat Material:	UHMWPE				
Stem Material:	316SS (ASTM A479)				
Ext Trim Material:	316SS (ASTM A351 CF3M)				
Seat Leakage Class:	FCI 70-2 Class IV	Flow Direction:	Bi-directional		
Manufacturer:	*Flow-Tek	Model:	7000-316SS		

ACTUATOR

Actuator Type:	Bectric				
Valve Failure Position:	FL	Valve Function:	On / Off		
Size:	N/A	Effective Area:	N/A		
Actuator Orientation:	Top Mount	Spring action	N/A		
Hand Wheel Type:	Manual (Pull)	Position	Position Indicator		
Air Failure Valve:	N/A	Set at	N/A		
Available Air Supply Pressure:					
Min:	N/A	Max:	N/A		
Allowable Pressure Requirements:					
Min:	N/A	Max:	N/A		
Bench Range:	N/A				
Required Stroke Time to Open:	60 sec				
Required Stroke Time to Close:	60 sec				
Manufacturer:	*Bray				
Model:	70-0200-113A2-536				

TAG NO.	LLW-MOBV-1549	ON/OFF Control Valves	DATA SHEET NO.	SHEET	OF
			MOBV-1549	2	2

NOTES

Valves to be tested in accordance with ASTM D5162, ANSI B16.34 or B16.42 and MSS SP-61 (Pressure Testing of Valves). All dimensions are to be in accordance with ANSI B16.42 (ductile iron) or ANSI B16.5 (steel) and MSS SP-72 (Ball Valves with Flanged or Butt-Welding Ends for General Service). Valves are to be certified Fire-Safe in accordance with API-607.

*Recommended Manufacturer

Valve Model 7-3-10-3-U-U-EL:
- 7 - Body Material: 316 Stainless Steel (CF8M)
- 3 - End Connection: Butt Weld
- 10 - Valve Size: 3"
- 3 - Ball and Stem: 316 Stainless Steel
- U - Seat: UHMWPE
- U - Seals: UHMWPE
- EL - Operator: Electric Actuator

Actuator Model 70-0200-113A2-536:
- 70 - Actuator Type: Bray Series 70 Electric Actuator
- 020 - Torque: 2000 in-lbs
- 0 - Speed: 60 seconds (stroke time)
- 113 - (N/A)
- A - Style: Declutchable
- 2 - Voltage: 24VDC
- 536 - (N/A)
- Add Option: 2 dry-contact SPDT limit switches for remote indication

Actuator to Valve Mounting Kit: ISO Mounting Kit EZ-011S

AECOM

On/Off Control Valves

DATA SHEET NO.			REV.
MOBV-1550			A
SHEET	OF	DATE	
1	2	1-17-13	

NO.	BY	DATE	REVISION

BY	CHK'D	PROC.	APPR.
AME	NCC		

P.O.	
REQ.	

Project:	RLWTF						
TAG NO:	LLW-MOBV-1550	Spec No:	40 9200	Line / Vessel Number:	LLW-293		
Asset No:		P&ID:	D-6411	Line ID: 1.610"	Size: 1.5"	Schedule:	40
Service Description:	Treated Effluent Feed to Tank TK-1502			Manufacturer:	*Flow-Tek		
				Model:	7-3-07-3-U-U-EL		
Safety Class	NS			Quality Assurance Level:	ML-4		

PROCESS CONDITIONS

Process Data Case:	Normal									Units:
Sizing Case:	Normal									-
Required Cv:	225 to 325									-
Travel:	NA									-
Sound Pressure Level:	NA									-
	Inlet:	Outlet:	Inlet:	Outlet:	Inlet:	Outlet:	Inlet:	Outlet:		
Liquid Flow:	100	100								gpm
Vapor Flow:	NA	NA								cfm
Temperature:	75	75								°F
Pressure:	45	45								psig
Density:	1.02									-
Viscosity:	1.05									cP
Critical Pressure (Pseudo):	NA									psia
pH:	6.50									-
Compressibility (Z):	NA									-
Specific Heat Ratio (C_p/C_v):	NA									-

Fluid:	LLW (contaminated water)	Max Temperature:	125 °F	Inlet:	Outlet
Area Classification:		Max Upset Pressure (normal flow):			
Ambient Temperature Requirements:	5 to 110 °F	Max Upset Pressure (reverse flow):			

VALVE BODY / BONNET

Valve Type:	3 Piece Full Port Ball Valve		
Body Size:	1.5"	ANSI Class:	150
Max Rated Pressure:	1000 psi	Max Rated Temperature:	200 °F
Body/Bonnet Material:	316SS (ASTM A351 CF8M)		
Liner Material / ID:	N/A		
Inlet Connection Face:	Butt Weld		
Outlet Connection Face:	Butt Weld		
Flange Face Finish:	N/A		
Bonnet Style:	N/A		
Lube Iso Valve:	No	Lube:	N/A
Packing Style:	Seat Rings		
Packing Material:	UHMWPE		
Body/Bonnet Gasket Material:	N/A		
Manufacturer:	*Flow-Tek		
Model:	7000-316SS		

SWITCH

RELAY 1	Tag No:	ZSO-1550			
	Power Rating:	24V dc	Type:	N/O	
	Alarm Setting	N/A			
RELAY 2	Tag No:	ZSC-1550			
	Power Rating:	24V dc	Type:	N/O	
	Alarm Setting	N/A			
Sensor Type:	Limit Switch	Max. Load Current:	10A		
Conduit Connection:	N/A				
Manufacturer:	See Actuator				
Model No.	See Actuator Notes				
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1	N/A	IP2:	N/A

TRIM

TrimType:	Single Seat				
Size:	1.5"	Travel	N/A		
Rated Cv:	275	Ft:	N/A	Xt:	N/A
Characteristic:	N/A				
Balanced/Unbalanced:	Balanced				
Plug Material:	316SS (ASTM A351 CF8M)				
Seat Material:	UHMWPE				
Stem Material:	316SS (ASTM A479)				
Ext Trim Material:	316SS (ASTM A351 CF3M)				
Seat Leakage Class:	FCI 70-2 Class IV	Flow Direction:	Bi-directional		
Manufacturer:	*Flow-Tek	Model:	7000-316SS		

ACTUATOR

Actuator Type:	Electric				
Valve Failure Position:	FL	Valve Function:	On / Off		
Size:	N/A	Effective Area:	N/A		
Actuator Orientation:	Top Mount	Spring action	N/A		
Hand Wheel Type:	None	Position	Position Pointer / LEDs		
Air Failure Valve:	N/A	Set at	N/A		
Available Air Supply Pressure:					
Min:	N/A	Max:	N/A		
Allowable Pressure Requirements:					
Min:	N/A	Max:	N/A		
Bench Range:	N/A				
Required Stroke Time to Open:	10 sec				
Required Stroke Time to Close:	10 sec				
Manufacturer:	*Bray				
Model:	73-0602-113D4-536				

TAG NO.	LLW-MOBV-1550	ON/OFF Control Valves	DATA SHEET NO.	SHEET	OF
			MOBV-1550	2	2

NOTES

Valves to be tested in accordance with ASTM D5162, ANSI B16.34 or B16.42 and MSS SP-61 (Pressure Testing of Valves). All dimensions are to be in accordance with ANSI B16.42 (ductile iron) or ANSI B16.5 (steel) and MSS SP-72 (Ball Valves with Flanged or Butt-Welding Ends for General Service). Valves are to be certified Fire-Safe in accordance with API-607.

*Recommended Manufacturer

Valve Model 7-3-07-3-U-U-EL:
- 7 - Body Material: 316 Stainless Steel (CF8M)
- 3 - End Connection: Butt Weld
- 07 - Valve Size: 1.5"
- 3 - Ball and Stem: 316 Stainless Steel
- U - Seat: UHMWPE
- U - Seals: UHMWPE
- EL - Operator: Electric Actuator

Actuator Model 73-0602-113D4-536:
- 73 - Actuator Type: Bray Series 73 Electric Actuator
- 060 - Torque: 600 in-lbs
- 2 - Speed: 10 seconds (stroke time)
- 113 - (N/A)
- D - Drive Type: Double D 600 in-lbs Torque
- 4 - Voltage: 24VDC
- 536 - (N/A)
- Add Option: 2 voltage free travel limit switches for remote indication

Actuator to Valve Mounting Kit: ISO Mounting Kit EZ-004S

AECOM

On/Off Control Valves

DATA SHEET NO.	REV.
AOBV-1706	A

SHEET	OF	DATE
1	2	1-17-13

NO.	BY	DATE	REVISION

BY	CHK'D	PROC.	APPR.
AME	NCC		

P.O.	
REQ.	

Project:	RLWTF						
TAG NO:	LLW-AOBV-1706	Spec No	40 9200	Line / Vessel Number:	LLW-153		
Asset No:		P&ID:	D-6024	Line ID: 0.622"	Size: 0.5"	Schedule:	40
Service Description:	Microfilter Sludge Supply to Tank TK-1702			Manufacturer:	*Flow-Tek		
				Model:	7-3-03-3-U-U-SR		
Safety Class	NS			Quality Assurance Level:	ML-4		

PROCESS CONDITIONS

Process Data Case:	Normal									Units:
Sizing Case:	Normal									-
Required Cv:	25 to 40									-
Travel:	NA									-
Sound Pressure Level:	NA									-
	Inlet:	Outlet:	Inlet:	Outlet:	Inlet:	Outlet:	Inlet:	Outlet:		
Liquid Flow:	NA	NA								gpm
Vapor Flow:	NA	NA								cfm
Temperature:	75	75								°F
Pressure:	45	45								psig
Density:	1.02									g/ml
Viscosity:	1.05									cP
Critical Pressure (Pseudo):	NA									psia
pH:	10.8									-
Compressibility (Z):	NA									-
Specific Heat Ratio (C_P/C_V):	NA									-

Fluid:	LLW (contaminated water)	Max Temperature:	125 °F	Inlet:	Outlet
Area Classification:		Max Upset Pressure (normal flow):			
Ambient Temperature Requirements:	55 to 95 °F	Max Upset Pressure (reverse flow):			

VALVE BODY / BONNET

Valve Type:	3 Piece Full Port Ball Valve		
Body Size:	0.5"	ANSI Class:	150
Max Rated Pressure:	1000 psi	Max Rated Temperature:	200 °F
Body/Bonnet Material:	316SS (ASTM A351 CF8M)		
Liner Material / ID:	N/A		
Inlet Connection Face:	Butt Weld		
Outlet Connection Face:	Butt Weld		
Flange Face Finish:	N/A		
Bonnet Style:	N/A		
Lube Iso Valve:	No	Lube:	N/A
Packing Style:	Seat Rings		
Packing Material:	UHMWPE		
Body/Bonnet Gasket Material:	N/A		
Manufacturer:	*Flow-Tek		
Model:	7000-316SS		

SWITCH

RELAY 1	Tag No:	ZSO-1706			
	Power Rating:	24V dc	Type:	N/O	
	Alarm Setting	N/A			
RELAY 2	Tag No:	ZSC-1706			
	Power Rating:	24V dc	Type:	N/O	
	Alarm Setting	N/A			
Sensor Type:	Proximity	Max. Load Current:	200 mA		
Conduit Connection:	1/2" NPT				
Manufacturer:	*Flow-Tek (Bray)				
Model No.	2N1 (Series 52)				
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1	5	IP2:	6

TRIM

TrimType:	Single Seat				
Size:	0.5"	Travel	N/A		
Rated Cv:	32	FI:	N/A	Xt:	N/A
Characteristic:	N/A				
Balanced/Unbalanced:	Balanced				
Plug Material:	316SS (ASTM A351 CF8M)				
Seat Material:	UHMWPE				
Stem Material:	316SS (ASTM A479)				
Ext Trim Material:	316SS (ASTM A351 CF3M)				
Seat Leakage Class:	FCI 70-2 Class IV	Flow Direction:	Bi-directional		
Manufacturer:	*Flow-Tek	Model:	7000-316SS		

ACTUATOR

Actuator Type:	Pneumatic				
Valve Air Failure Position:	FC	Valve Function:	On / Off		
Size:	N/A	Effective Area:	N/A		
Actuator Orientation:	Top Mount	Spring action	Close		
Hand Wheel Type:	None	Position	Indicator Pointer		
Air Failure Valve:	None	Set at	N/A		
Available Air Supply Pressure:					
Min:	105 psig	Max:	120 psig		
Allowable Pressure Requirements:					
Min:	80 psig	Max:	140 psig		
Bench Range:	N/A				
Required Stroke Time to Open:	1/4 s @ 80 psig				
Required Stroke Time to Close:	1/4 s @ 80 psig				
Manufacturer:	*Flow-Tek				
Model:	Series 93: Size 63-4				

TAG NO.	LLW-AOBV-1706	ON/OFF Control Valves	DATA SHEET NO.	SHEET	OF
			AOBV-1706	2	2

SOLENOID

Tag No:	HS-1706	Fluid:	Air		
Type:	3-Way	Coil:	Class F		
Coil Housing:	NEMA 4X	Watts:	6.9		
Voltage:	24V dc				
Power Wiring:	N/A	Signal Type:	N/A		
Communication Protocol:	N/A	Location:	Direct Mounted		
Smart:	N/A	Indicate:	No	Isolate:	No
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1:	5	IP2:	6
Main Valve Action when Coil is Deenergized:	Close				
Conduit Connection:	1/2" NPT				
Body Material:	Anodized Aluminum				
Manufacturer:	*Bray	Model:	Series 63		

NOTES

Valves to be tested in accordance with ASTM D5162, ANSI B16.34 or B16.42 and MSS SP-61 (Pressure Testing of Valves). All dimensions are to be in accordance with ANSI B16.42 (ductile iron) or ANSI B16.5 (steel) and MSS SP-72 (Ball Valves with Flanged or Butt-Welding Ends for General Service). Valves are to be certified Fire-Safe in accordance with API-607.

*Recommended Manufacturer

Valve Model 7-3-03-3-U-U-SR:
- 7 - Body Material: 316 Stainless Steel (CF8M)
- 3 - End Connection: Butt Weld
- 03 - Valve Size: 0.5"
- 3 - Ball and Stem: 316 Stainless Steel
- U - Seat: UHMWPE
- U - Seals: UHMWPE
- SR - Operator: Spring Return Pneumatic Actuator

Actuator Model Series 93, Size 63-4:
- 93 - Actuator Type: Pneumatic Spring Return Actuator
- 63 - Actuator Size Designation (5.58" l x 3.11" w x 4.53" h)
- 4 - No. of Springs per Piston

Actuator to Valve Mounting Kit: ISO Mounting Kit EZ-002S

AECOM

On/Off Control Valves

DATA SHEET NO.			REV.
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AME	NCC		
P.O.			
REQ.			

NO.	BY	DATE	REVISION

Project:	RLWTF
TAG NO:	LLW-AOBV-1708
Asset No:	
Service Description:	Rotary Press Filtrate Tank TK-1707 Discharge
Safety Class	NS

Spec No:	40 9200	Line / Vessel Number:	LLW-088
P&ID:	D-6023	Line ID: 0.622" Size: 0.5"	Schedule: 40
Manufacturer:	*Flow-Tek		
Model:	7-3-03-3-U-U-SR		
Quality Assurance Level:	ML-4		

PROCESS CONDITIONS

Process Data Case:	Normal									Units:
Sizing Case:	Normal									-
Required Cv:	25 to 40									-
Travel:	NA									-
Sound Pressure Level:	NA									-
	Inlet:	Outlet:	Inlet:	Outlet:	Inlet:	Outlet:	Inlet:	Outlet:		
Liquid Flow:	5	5								gpm
Vapor Flow:	NA	NA								cfm
Temperature:	75	75								°F
Pressure:	45	45								psig
Density:	1.02									g/ml
Viscosity:	1.05									cP
Critical Pressure (Pseudo):	NA									psia
pH:	10.8									-
Compressibility (Z):	NA									-
Specific Heat Ratio (C_P/C_V):	NA									-

Fluid:	LLW (contaminated w ater)	Max Temperature:	125 °F	Inlet:	Outlet
Area Classification:		Max Upset Pressure (normal flow):			
Ambient Temperature Requirements:	55 to 95 °F	Max Upset Pressure (reverse flow):			

VALVE BODY / BONNET

Valve Type:	3 Piece Full Port Ball Valve		
Body Size:	0.5"	ANSI Class:	150
Max Rated Pressure:	1000 psi	Max Rated Temperature:	200 °F
Body/Bonnet Material:	316SS (ASTM A351 CF8M)		
Liner Material / ID:	N/A		
Inlet Connection Face:	Butt Weld		
Outlet Connection Face:	Butt Weld		
Flange Face Finish:	N/A		
Bonnet Style:	N/A		
Lube Iso Valve:	No	Lube:	N/A
Packing Style:	Seat Rings		
Packing Material:	UHMWPE		
Body/Bonnet Gasket Material:	N/A		
Manufacturer:	*Flow-Tek		
Model:	7000-316SS		

SWITCH

RELAY 1	Tag No:	ZSO-1708			
	Pow er Rating	24V dc	Type:	N/O	
	Alarm Setting	N/A			
RELAY 2	Tag No:	ZSC-1708			
	Pow er Rating	24V dc	Type:	N/O	
	Alarm Setting	N/A			
Sensor Type:	Proximity	Max. Load Current:	200 mA		
Conduit Connection:	1/2" NPT				
Manufacturer:	*Flow-Tek (Bray)				
Model No.	2N1 (Series 52)				
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1	5	IP2:	6

TRIM

TrimType:	Single Seat				
Size:	0.5"	Travel	N/A		
Rated Cv:	32	FI:	N/A	Xt:	N/A
Characteristic:	N/A				
Balanced/Unbalanced:	Balanced				
Plug Material:	316SS (ASTM A351 CF8M)				
Seat Material:	UHMWPE				
Stem Material:	316SS (ASTM A479)				
Ext Trim Material:	316SS (ASTM A351 CF3M)				
Seat Leakage Class:	FCI 70-2 Class IV	Flow Direction:	Bi-directional		
Manufacturer:	*Flow-Tek	Model:	7000-316SS		

ACTUATOR

Actuator Type:	Pneumatic				
Valve Air Failure Position:	FC	Valve Function:	On / Off		
Size:	N/A	Effective Area:	N/A		
Actuator Orientation:	Top Mount	Spring action	Close		
Hand Wheel Type:	None	Position	Indicator Pointer		
Air Failure Valve:	None	Set at	N/A		
Available Air Supply Pressure:					
Min:	105 psig	Max:	120 psig		
Allowable Pressure Requirements:					
Min:	80 psig	Max:	140 psig		
Bench Range:	N/A				
Required Stroke Time to Open:	1/4 s @ 80 psig				
Required Stroke Time to Close:	1/4 s @ 80 psig				
Manufacturer:	*Flow-Tek				
Model:	Series 93: Size 63-4				

TAG NO.	LLW-AOBV-1708	ON/OFF Control Valves	DATA SHEET NO.	SHEET	OF
			AOBV-1708	2	2

SOLENOID

Tag No:	HS-1708	Fluid:	Air		
Type:	3-Way	Coil:	Class F		
Coil Housing:	NEMA 4X	Watts:	6.9		
Voltage:	24V dc				
Power Wiring:	N/A	Signal Type:	N/A		
Communication Protocol:	N/A	Location:	Direct Mounted		
Smart:	N/A	Indicate:	No	Isolate:	No
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1	5	IP2:	6
Main Valve Action when Coil is Deenergized:	Close				
Conduit Connection:	1/2" NPT				
Body Material:	Anodized Aluminum				
Manufacturer:	*Bray	Model:	Series 63		

NOTES

Valves to be tested in accordance with ASTM D5162, ANSI B16.34 or B16.42 and MSS SP-61 (Pressure Testing of Valves). All dimensions are to be in accordance with ANSI B16.42 (ductile iron) or ANSI B16.5 (steel) and MSS SP-72 (Ball Valves with Flanged or Butt-Welding Ends for General Service). Valves are to be certified Fire-Safe in accordance with API-607.

*Recommended Manufacturer

Valve Model 7-3-03-3-U-U-SR:
- 7 - Body Material: 316 Stainless Steel (CF8M)
- 3 - End Connection: Butt Weld
- 03 - Valve Size: 0.5"
- 3 - Ball and Stem: 316 Stainless Steel
- U - Seat: UHMWPE
- U - Seals: UHMWPE
- SR - Operator: Spring Return Pneumatic Actuator

Actuator Model Series 93, Size 63-4:
- 93 - Actuator Type: Pneumatic Spring Return Actuator
- 63 - Actuator Size Designation (5.58" l x 3.11" w x 4.53" h)
- 4 - No. of Springs per Piston

Actuator to Valve Mounting Kit: ISO Mounting Kit EZ-002S

AECOM

On/Off Control Valves

DATA SHEET NO.			REV.
AOBV-1717			A
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Project:	RLWTF						
TAG NO:	LLW-AOBV-1717	Spec No:	40 9200	Line / Vessel Number:	LLW-172		
Asset No:		P&ID:	D-6025	Line ID: 0.622"	Size: 0.5"	Schedule:	40
Service Description:	Tank TK-1702 Decant Discharge			Manufacturer:	*Flow-Tek		
				Model:	7-3-03-3-U-U-SR		
Safety Class	NS			Quality Assurance Level:	ML-4		

PROCESS CONDITIONS

Process Data Case:	Normal								Units:
Sizing Case:	Normal								-
Required Cv:	25 to 40								-
Travel:	NA								-
Sound Pressure Level:	NA								-
	Inlet:	Outlet:	Inlet:	Outlet:	Inlet:	Outlet:	Inlet:	Outlet:	
Liquid Flow:	NA	NA							gpm
Vapor Flow:	NA	NA							cfm
Temperature:	75	75							°F
Pressure:	45	45							psig
Density:	1.02								g/ml
Viscosity:	1.05								cP
Critical Pressure (Pseudo):	NA								psia
pH:	7.0								-
Compressibility (Z):	NA								-
Specific Heat Ratio ($^{Cp}/_{Cv}$):	NA								-

Fluid:	LLW (contaminated water)	Max Temperature:	125 °F	Inlet:	Outlet
Area Classification:		Max Upset Pressure (normal flow):			
Ambient Temperature Requirements:	55 to 95 °F	Max Upset Pressure (reverse flow):			

VALVE BODY / BONNET

Valve Type:	3 Piece Full Port Ball Valve		
Body Size:	0.5"	ANSI Class:	150
Max Rated Pressure:	1000 psi	Max Rated Temperature:	200 °F
Body/Bonnet Material:	316SS (ASTM A351 CF8M)		
Liner Material / ID:	N/A		
Inlet Connection Face:	Butt Weld		
Outlet Connection Face:	Butt Weld		
Flange Face Finish:	N/A		
Bonnet Style:	N/A		
Lube Iso Valve:	No	Lube:	N/A
Packing Style:	Seat Rings		
Packing Material:	UHMWPE		
Body/Bonnet Gasket Material:	N/A		
Manufacturer:	*Flow-Tek		
Model:	7000-316SS		

SWITCH

RELAY 1	Tag No:	ZSO-1717			
	Power Rating:	24V dc	Type:	N/O	
	Alarm Setting	N/A			
RELAY 2	Tag No:	ZSC-1717			
	Power Rating:	24V dc	Type:	N/O	
	Alarm Setting	N/A			
Sensor Type:	Proximity	Max. Load Current:	200 mA		
Conduit Connection:	1/2" NPT				
Manufacturer:	*Flow-Tek (Bray)				
Model No.	2N1 (Series 52)				
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1	5	IP2:	6

TRIM

TrimType:	Single Seat				
Size:	0.5"	Travel	N/A		
Rated Cv:	32	Fl:	N/A	Xt:	N/A
Characteristic:	N/A				
Balanced/Unbalanced:	Balanced				
Plug Material:	316SS (ASTM A351 CF8M)				
Seat Material:	UHMWPE				
Stem Material:	316SS (ASTM A479)				
Ext Trim Material:	316SS (ASTM A351 CF3M)				
Seat Leakage Class:	FCI 70-2 Class IV	Flow Direction:	Bi-directional		
Manufacturer:	*Flow-Tek	Model:	7000-316SS		

ACTUATOR

Actuator Type:	Pneumatic		
Valve Air Failure Position:	FC	Valve Function:	On / Off
Size:	N/A	Effective Area:	N/A
Actuator Orientation:	Top Mount	Spring action	Close
Hand Wheel Type:	None	Position	Indicator Pointer
Air Failure Valve:	None	Set at	N/A
Available Air Supply Pressure:			
Min:	105 psig	Max:	120 psig
Allowable Pressure Requirements:			
Min:	80 psig	Max:	140 psig
Bench Range:	N/A		
Required Stroke Time to Open:	1/4 s @ 80 psig		
Required Stroke Time to Close:	1/4 s @ 80 psig		
Manufacturer:	*Flow-Tek		
Model:	Series 93: Size 63-4		

TAG NO.	LLW-AOBV-1717	ON/OFF Control Valves	DATA SHEET NO.	SHEET	OF
			AOBV-1717	2	2

SOLENOID

Tag No:	HS-1717	Fluid:	Air		
Type:	3-Way	Coil:	Class F		
Coil Housing:	NEMA 4X	Watts:	6.9		
Voltage:	24V dc				
Power Wiring:	N/A	Signal Type:	N/A		
Communication Protocol:	N/A	Location:	Direct Mounted		
Smart:	N/A	Indicate:	No	Isolate:	No
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1	5	IP2:	6
Main Valve Action when Coil is Deenergized:	Close				
Conduit Connection:	1/2" NPT				
Body Material:	Anodized Aluminum				
Manufacturer:	*Bray	Model:	Series 63		

NOTES

Valves to be tested in accordance with ASTM D5162, ANSI B16.34 or B16.42 and MSS SP-61 (Pressure Testing of Valves). All dimensions are to be in accordance with ANSI B16.42 (ductile iron) or ANSI B16.5 (steel) and MSS SP-72 (Ball Valves with Flanged or Butt-Welding Ends for General Service). Valves are to be certified Fire-Safe in accordance with API-607.

*Recommended Manufacturer

Valve Model 7-3-03-3-U-U-SR:
- 7 - Body Material: 316 Stainless Steel (CF8M)
- 3 - End Connection: Butt Weld
- 03 - Valve Size: 0.5"
- 3 - Ball and Stem: 316 Stainless Steel
- U - Seat: UHMWPE
- U - Seals: UHMWPE
- SR - Operator: Spring Return Pneumatic Actuator

Actuator Model Series 93, Size 63-4:
- 93 - Actuator Type: Pneumatic Spring Return Actuator
- 63 - Actuator Size Designation (5.58" l x 3.11" w x 4.53" h)
- 4 - No. of Springs per Piston

Actuator to Valve Mounting Kit: ISO Mounting Kit EZ-002S

AECOM

On/Off Control Valves

DATA SHEET NO.	REV.
AOBV-1728	A

NO.	BY	DATE	REVISION

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BY	CHK'D	PROC.	APPR.
AME	NCC		

P.O.	
REQ.	

Project:	RLWTF

TAG NO:	LLW-AOBV-1728	Spec No:	40 9200	Line / Vessel Number:	LLW-091
Asset No:		P&ID:	D-6029	Line ID: 0.622" Size: 0.5"	Schedule: 40
Service Description:	Evaporator EVAP-1702 Feed			Manufacturer:	*Flow-Tek
				Model:	7-3-03-3-U-U-SR
Safety Class	NS	Quality Assurance Level:	ML-4		

PROCESS CONDITIONS

Process Data Case:	Normal									Units:
Sizing Case:	Normal									-
Required Cv:	25 to 40									-
Travel:	NA									-
Sound Pressure Level:	NA									-
	Inlet:	Outlet:	Inlet:	Outlet:	Inlet:	Outlet:	Inlet:	Outlet:		
Liquid Flow:	NA	NA								gpm
Vapor Flow:	NA	NA								cfm
Temperature:	75	75								°F
Pressure:	45	45								psig
Density:	1.02									g/ml
Viscosity:	1.05									cP
Critical Pressure (Pseudo):	NA									psia
pH:	7.7									-
Compressibility (Z):	NA									-
Specific Heat Ratio (C_P/C_V):	NA									-

Fluid:	LLW (contaminated water)	Max Temperature:	125 °F	Inlet:	Outlet
Area Classification:		Max Upset Pressure (normal flow):			
Ambient Temperature Requirements:	55 to 95 °F	Max Upset Pressure (reverse flow):			

VALVE BODY / BONNET

Valve Type:	3 Piece Full Port Ball Valve		
Body Size:	0.5"	ANSI Class:	150
Max Rated Pressure:	1000 psi	Max Rated Temperature:	200 °F
Body/Bonnet Material:	316SS (ASTM A351 CF8M)		
Liner Material / ID:	N/A		
Inlet Connection Face:	Butt Weld		
Outlet Connection Face:	Butt Weld		
Flange Face Finish:	N/A		
Bonnet Style:	N/A		
Lube Iso Valve:	No	Lube:	N/A
Packing Style:	Seat Rings		
Packing Material:	UHMWPE		
Body/Bonnet Gasket Material:	N/A		
Manufacturer:	*Flow-Tek		
Model:	7000-316SS		

SWITCH

RELAY 1	Tag No:	ZSO-1728			
	Power Rating:	24V dc	Type:	N/O	
	Alarm Setting	N/A			
RELAY 2	Tag No:	ZSC-1728			
	Power Rating:	24V dc	Type:	N/O	
	Alarm Setting	N/A			
Sensor Type:	Proximity	Max. Load Current:	200 mA		
Conduit Connection:	1/2" NPT				
Manufacturer:	*Flow-Tek (Bray)				
Model No.	2N1 (Series 52)				
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1	5	IP2:	6

TRIM

TrimType:	Single Seat				
Size:	0.5"	Travel	N/A		
Rated Cv:	32	Fl:	N/A	Xt:	N/A
Characteristic:	N/A				
Balanced/Unbalanced:	Balanced				
Plug Material:	316SS (ASTM A351 CF8M)				
Seat Material:	UHMWPE				
Stem Material:	316SS (ASTM A479)				
Ext Trim Material:	316SS (ASTM A351 CF3M)				
Seat Leakage Class:	FCI 70-2 Class IV	Flow Direction:	Bi-directional		
Manufacturer:	*Flow-Tek	Model:	7000-316SS		

ACTUATOR

Actuator Type:	Pneumatic				
Valve Air Failure Position:	FC	Valve Function:	On / Off		
Size:	N/A	Effective Area:	N/A		
Actuator Orientation:	Top Mount	Spring action	Close		
Hand Wheel Type:	None	Position	Indicator Pointer		
Air Failure Valve:	None	Set at	N/A		
Available Air Supply Pressure:					
Min:	105 psig	Max:	120 psig		
Allowable Pressure Requirements:					
Min:	80 psig	Max:	140 psig		
Bench Range:	N/A				
Required Stroke Time to Open:	1/4 s @ 80 psig				
Required Stroke Time to Close:	1/4 s @ 80 psig				
Manufacturer:	*Flow-Tek				
Model:	Series 93: Size 63-4				

TAG NO.	LLW-AOBV-1728	ON/OFF Control Valves	DATA SHEET NO.	SHEET	OF
			AOBV-1728	2	2

SOLENOID

Tag No:	HS-1728			Fluid:	Air		
Type:	3-Way			Coil:	Class F		
Coil Housing:	NEMA 4X			Watts:	6.9		
Voltage:	24V dc						
Power Wiring:	N/A			Signal Type:	N/A		
Communication Protocol:	N/A			Location:	Direct Mounted		
Smart:	N/A	Indicate:	No	Isolate:	No		
Electrical Protection:	N/A			Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1	5	IP2:	6		
Main Valve Action when Coil is Deenergized:	Close						
Conduit Connection:	1/2" NPT						
Body Material:	Anodized Aluminum						
Manufacturer:	*Bray			Model:	Series 63		

NOTES

Valves to be tested in accordance with ASTM D5162, ANSI B16.34 or B16.42 and MSS SP-61 (Pressure Testing of Valves). All dimensions are to be in accordance with ANSI B16.42 (ductile iron) or ANSI B16.5 (steel) and MSS SP-72 (Ball Valves with Flanged or Butt-Welding Ends for General Service). Valves are to be certified Fire-Safe in accordance with API-607.

*Recommended Manufacturer

Valve Model 7-3-03-3-U-U-SR:
- 7 - Body Material: 316 Stainless Steel (CF8M)
- 3 - End Connection: Butt Weld
- 03 - Valve Size: 0.5"
- 3 - Ball and Stem: 316 Stainless Steel
- U - Seat: UHMWPE
- U - Seals: UHMWPE
- SR - Operator: Spring Return Pneumatic Actuator

Actuator Model Series 93, Size 63-4:
- 93 - Actuator Type: Pneumatic Spring Return Actuator
- 63 - Actuator Size Designation (5.58" l x 3.11" w x 4.53" h)
- 4 - No. of Springs per Piston

Actuator to Valve Mounting Kit: ISO Mounting Kit EZ-002S

AECOM

On/Off Control Valves

DATA SHEET NO.			REV.
AOBV-1737			A
SHEET	OF	DATE	
1	2	1-17-13	

NO.	BY	DATE	REVISION

BY	CHK'D	PROC.	APPR.
AME	NCC		

P.O.	
REQ.	

Project:	RLWTF						
TAG NO:	LLW-AOBV-1737	Spec No:	40 9200	Line / Vessel Number:	LLW-200		
Asset No:		P&ID:	D-6028	Line ID: 0.622"	Size: 0.5"	Schedule:	40
Service Description:	Evaporator Concentrate Recycle to Tank TK-1705			Manufacturer:	*Flow-Tek		
				Model:	7-3-03-3-U-U-SR		
Safety Class	NS	Quality Assurance Level:	ML-4				

PROCESS CONDITIONS

Process Data Case:	Normal									Units:
Sizing Case:	Normal									-
Required Cv:	25 to 40									-
Travel:	NA									-
Sound Pressure Level:	NA									-
	Inlet:	Outlet:	Inlet:	Outlet:	Inlet:	Outlet:	Inlet:	Outlet:		
Liquid Flow:	4	4								gpm
Vapor Flow:	NA	NA								cfm
Temperature:	75	75								°F
Pressure:	45	45								psig
Density:	1.02									g/ml
Viscosity:	1.05									cP
Critical Pressure (Pseudo):	NA									psia
pH:	9.8									-
Compressibility (Z):	NA									-
Specific Heat Ratio ($C^p/_{Cv}$):	NA									-

Fluid:	LLW (contaminated w ater)	Max Temperature:	125 °F	Inlet:	Outlet
Area Classification:		Max Upset Pressure (normal flow):			
Ambient Temperature Requirements:	55 to 95 °F	Max Upset Pressure (reverse flow):			

VALVE BODY / BONNET

Valve Type:	3 Piece Full Port Ball Valve		
Body Size:	0.5"	ANSI Class:	150
Max Rated Pressure:	1000 psi	Max Rated Temperature:	200 °F
Body/Bonnet Material:	316SS (ASTM A351 CF8M)		
Liner Material / ID:	N/A		
Inlet Connection Face:	Butt Weld		
Outlet Connection Face:	Butt Weld		
Flange Face Finish:	N/A		
Bonnet Style:	N/A		
Lube Iso Valve:	No	Lube:	N/A
Packing Style:	Seat Rings		
Packing Material:	UHMWPE		
Body/Bonnet Gasket Material:	N/A		
Manufacturer:	*Flow-Tek		
Model:	7000-316SS		

SWITCH

RELAY 1	Tag No:	ZSO-1737			
	Pow er Rating:	24V dc	Type:	N/O	
	Alarm Setting	N/A			
RELAY 2	Tag No:	ZSC-1737			
	Pow er Rating:	24V dc	Type:	N/O	
	Alarm Setting	N/A			
Sensor Type:	Proximity	Max. Load Current:	200 mA		
Conduit Connection:	1/2" NPT				
Manufacturer:	*Flow-Tek (Bray)				
Model No.	2N1 (Series 52)				
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1	5	IP2:	6

TRIM

TrimType:	Single Seat				
Size:	0.5"	Travel	N/A		
Rated Cv:	32	Fl:	N/A	Xt:	N/A
Characteristic:	N/A				
Balanced/Unbalanced:	Balanced				
Plug Material:	316SS (ASTM A351 CF8M)				
Seat Material:	UHMWPE				
Stem Material:	316SS (ASTM A479)				
Ext Trim Material:	316SS (ASTM A351 CF3M)				
Seat Leakage Class:	FCI 70-2 Class IV	Flow Direction:	Bi-directional		
Manufacturer:	*Flow-Tek	Model:	7000-316SS		

ACTUATOR

Actuator Type:	Pneumatic				
Valve Air Failure Position:	FC	Valve Function:	On / Off		
Size:	N/A	Effective Area:	N/A		
Actuator Orientation:	Top Mount	Spring action	Close		
Hand Wheel Type:	None	Position	Indicator Pointer		
Air Failure Valve:	None	Set at	N/A		
Available Air Supply Pressure:					
Min:	105 psig	Max:	120 psig		
Allow able Pressure Requirements:					
Min:	80 psig	Max:	140 psig		
Bench Range:	N/A				
Required Stroke Time to Open:	1/4 s @ 80 psig				
Required Stroke Time to Close:	1/4 s @ 80 psig				
Manufacturer:	*Flow-Tek				
Model:	Series 93: Size 63-4				

TAG NO.	LLW-AOBV-1737	ON/OFF Control Valves	DATA SHEET NO.	SHEET	OF
			AOBV-1737	2	2

SOLENOID

Tag No:	HS-1737	Fluid:	Air		
Type:	3-Way	Coil:	Class F		
Coil Housing:	NEMA 4X	Watts:	6.9		
Voltage:	24V dc				
Power Wiring:	N/A	Signal Type:	N/A		
Communication Protocol:	N/A	Location:	Direct Mounted		
Smart:	N/A	Indicate:	No	Isolate:	No
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1	5	IP2:	6
Main Valve Action when Coil is Deenergized:	Close				
Conduit Connection:	1/2" NPT				
Body Material:	Anodized Aluminum				
Manufacturer:	*Bray	Model:	Series 63		

NOTES

Valves to be tested in accordance with ASTM D5162, ANSI B16.34 or B16.42 and MSS SP-61 (Pressure Testing of Valves). All dimensions are to be in accordance with ANSI B16.42 (ductile iron) or ANSI B16.5 (steel) and MSS SP-72 (Ball Valves with Flanged or Butt-Welding Ends for General Service). Valves are to be certified Fire-Safe in accordance with API-607.

*Recommended Manufacturer

Valve Model 7-3-03-3-U-U-SR:
- 7 - Body Material: 316 Stainless Steel (CF8M)
- 3 - End Connection: Butt Weld
- 03 - Valve Size: 0.5"
- 3 - Ball and Stem: 316 Stainless Steel
- U - Seat: UHMWPE
- U - Seals: UHMWPE
- SR - Operator: Spring Return Pneumatic Actuator

Actuator Model Series 93, Size 63-4:
- 93 - Actuator Type: Pneumatic Spring Return Actuator
- 63 - Actuator Size Designation (5.58" l x 3.11" w x 4.53" h)
- 4 - No. of Springs per Piston

Actuator to Valve Mounting Kit: ISO Mounting Kit EZ-002S

AECOM

On/Off Control Valves

DATA SHEET NO.			REV.
AOBV-5622			A
SHEET	OF	DATE	
1	2	1-17-13	

NO.	BY	DATE	REVISION

BY	CHK'D	PROC.	APPR.
AME	NCC		

P.O.	
REQ.	

Project:	RLWTF						
TAG NO:	NPWC-AOBV-5622	Spec No:	40 9200	Line / Vessel Number:	NPWC-103		
Asset No:		P&ID:	D-6012	Line ID: 1.049"	Size: 1.0"	Schedule:	40
Service Description:	NPWC Supply to Tank TK-1101			Manufacturer:	*Flow-Tek		
				Model:	7-3-05-3-U-U-SR		
Safety Class	NS			Quality Assurance Level:	ML-4		

PROCESS CONDITIONS

Process Data Case:	Normal									Units:
Sizing Case:	Normal									-
Required Cv:	85 to 125									-
Travel:	N/A									-
Sound Pressure Level:	N/A									-
	Inlet:	Outlet:	Inlet:	Outlet:	Inlet:	Outlet:	Inlet:	Outlet:		
Liquid Flow :	25	25								gpm
Vapor Flow :	N/A	N/A								cfm
Temperature:	75	75								°F
Pressure:	65	65								psig
Density:	1.02									g/ml
Viscosity:	1.05									cP
Critical Pressure (Pseudo):	N/A									psia
pH:	7.5									-
Compressibility (Z):	N/A									-
Specific Heat Ratio (C_P/C_V):	N/A									-

Fluid:	Water	Max Temperature:	125 °F	Inlet:	Outlet
Area Classification:		Max Upset Pressure (normal flow):			
Ambient Temperature Requirements:	55 to 95 °F	Max Upset Pressure (reverse flow):			

VALVE BODY / BONNET

Valve Type:	3 Piece Full Port Ball Valve		
Body Size:	1.0"	ANSI Class:	150
Max Rated Pressure:	1000 psi	Max Rated Temperature	200 °F
Body/Bonnet Material:	316SS (ASTM A351 CF8M)		
Liner Material / ID:	N/A		
Inlet Connection Face:	Butt Weld		
Outlet Connection Face:	Butt Weld		
Flange Face Finish:	N/A		
Bonnet Style:	N/A		
Lube Iso Valve:	No	Lube:	N/A
Packing Style:	Seat Rings		
Packing Material:	UHMWPE		
Body/Bonnet Gasket Material:	N/A		
Manufacturer:	*Flow-Tek		
Model:	7000-316SS		

SWITCH

RELAY 1	Tag No:	ZSO-5622			
	Power Rating:	24V dc	Type:	N/O	
	Alarm Setting	N/A			
RELAY 2	Tag No:	ZSC-5622			
	Power Rating:	24V dc	Type:	N/O	
	Alarm Setting	N/A			
Sensor Type:	Proximity	Max. Load Current:	200 mA		
Conduit Connection:	1/2" NPT				
Manufacturer:	*Flow-Tek (Bray)				
Model No.	2N1 (Series 52)				
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1	5	IP2:	6

TRIM

TrimType:	Single Seat				
Size:	1.0"	Travel	N/A		
Rated Cv:	105	Fl:	N/A	Xt:	N/A
Characteristic:	N/A				
Balanced/Unbalanced:	Balanced				
Plug Material:	316SS (ASTM A351 CF8M)				
Seat Material:	UHMWPE				
Stem Material:	316SS (ASTM A479)				
Ext Trim Material:	316SS (ASTM A351 CF3M)				
Seat Leakage Class:	FCI 70-2 Class IV	Flow Direction:	Bi-directional		
Manufacturer:	*Flow-Tek	Model:	7000-316SS		

ACTUATOR

Actuator Type:	Pneumatic				
Valve Air Failure Position:	FC	Valve Function:	On / Off		
Size:	N/A	Effective Area:	N/A		
Actuator Orientation:	Top Mount	Spring action	Close		
Hand Wheel Type:	None	Position	Indicator Pointer		
Air Failure Valve:	None	Set at	N/A		
Available Air Supply Pressure:					
Min:	105 psig	Max:	120 psig		
Allowable Pressure Requirements:					
Min:	80 psig	Max:	140 psig		
Bench Range:	N/A				
Required Stroke Time to Open:	1/4 s @ 80 psig				
Required Stroke Time to Close:	1/4 s @ 80 psig				
Manufacturer:	*Flow-Tek				
Model:	Series 93: Size 83-5				

TAG NO.	NPWC-AOBV-5622	ON/OFF Control Valves	DATA SHEET NO.	SHEET	OF
			AOBV-5622	2	2

SOLENOID

Tag No:	HS-5622	Fluid:	Air		
Type:	3-Way	Coil:	Class F		
Coil Housing:	NEMA 4X	Watts:	6.9		
Voltage:	24V dc				
Power Wiring:	N/A	Signal Type:	N/A		
Communication Protocol:	N/A	Location:	Direct Mounted		
Smart:	N/A	Indicate:	No	Isolate:	No
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1	5	IP2:	6
Main Valve Action when Coil is Deenergized:	Close				
Conduit Connection:	1/2" NPT				
Body Material:	Anodized Aluminum				
Manufacturer:	*Bray	Model:	Series 63		

NOTES

Valves to be tested in accordance with ASTM D5162, ANSI B16.34 or B16.42 and MSS SP-61 (Pressure Testing of Valves). All dimensions are to be in accordance with ANSI B16.42 (ductile iron) or ANSI B16.5 (steel) and MSS SP-72 (Ball Valves with Flanged or Butt-Welding Ends for General Service). Valves are to be certified Fire-Safe in accordance with API-607.

*Recommended Manufacturer

Valve Model 7-3-05-3-U-U-SR:
- 7 - Body Material: 316 Stainless Steel (CF8M)
- 3 - End Connection: Butt Weld
- 05 - Valve Size: 1.0"
- 3 - Ball and Stem: 316 Stainless Steel
- U - Seat: UHMWPE
- U - Seals: UHMWPE
- SR - Operator: Spring Return Pneumatic Actuator

Actuator Model Series 93, Size 63-4:
- 93 - Actuator Type: Pneumatic Spring Return Actuator
- 83 - Actuator Size Designation (7.40" l x 3.83" w x 5.43" h)
- 5 - No. of Springs per Piston

Actuator to Valve Mounting Kit: ISO Mounting Kit EZ-009S

AECOM

On/Off Control Valves

DATA SHEET NO.			REV.
AOBV-5623			A
SHEET	OF	DATE	
1	2	1-17-13	
BY	CHK'D	PROC.	APPR.
AME	NCC		
P.O.			
REQ.			

NO.	BY	DATE	REVISION

Project:	RLWTF				
TAG NO:	NPWC-AOBV-5623	Spec No:	40 9200	Line / Vessel Number:	NPWC-113
Asset No:		P&ID:	D-6013	Line ID: 1.049" Size: 1.0"	Schedule: 40
Service Description:	NPWC Supply to Tank TK-1102			Manufacturer:	*Flow-Tek
				Model:	7-3-05-3-U-U-SR
Safety Class	NS	Quality Assurance Level:	ML-4		

PROCESS CONDITIONS

Process Data Case:	Normal								Units:
Sizing Case:	Normal								-
Required Cv:	85 to 125								-
Travel:	NA								-
Sound Pressure Level:	NA								-
	Inlet:	Outlet:	Inlet:	Outlet:	Inlet:	Outlet:	Inlet:	Outlet:	
Liquid Flow:	N/A	N/A							gpm
Vapor Flow:	N/A	N/A							cfm
Temperature:	75	75							°F
Pressure:	65	65							psig
Density:	1.02								g/ml
Viscosity:	1.05								cP
Critical Pressure (Pseudo):	NA								psia
pH:	7.5								-
Compressibility (Z):	N/A								-
Specific Heat Ratio (C_P/C_V):	N/A								-

Fluid:	Water	Max Temperature:	125 °F	Inlet:	Outlet
Area Classification:		Max Upset Pressure (normal flow):			
Ambient Temperature Requirements:	55 to 95 °F	Max Upset Pressure (reverse flow):			

VALVE BODY / BONNET

Valve Type:	3 Piece Full Port Ball Valve		
Body Size:	1.0"	ANSI Class:	150
Max Rated Pressure:	1000 psi	Max Rated Temperature:	200 °F
Body/Bonnet Material:	316SS (ASTM A351 CF8M)		
Liner Material / ID:	N/A		
Inlet Connection Face:	Butt Weld		
Outlet Connection Face:	Butt Weld		
Flange Face Finish:	N/A		
Bonnet Style:	N/A		
Lube Iso Valve:	No	Lube:	N/A
Packing Style:	Seat Rings		
Packing Material:	UHMWPE		
Body/Bonnet Gasket Material:	N/A		
Manufacturer:	*Flow-Tek		
Model:	7000-316SS		

SWITCH

RELAY 1	Tag No:	ZSO-5623			
	Power Rating:	24V dc	Type:	N/O	
	Alarm Setting:	N/A			
RELAY 2	Tag No:	ZSC-5623			
	Power Rating:	24V dc	Type:	N/O	
	Alarm Setting:	N/A			
Sensor Type:	Proximity	Max. Load Current:	200 mA		
Conduit Connection:	1/2" NPT				
Manufacturer:	*Flow-Tek (Bray)				
Model No.	2N1 (Series 52)				
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1:	5	IP2:	6

TRIM

TrimType:	Single Seat				
Size:	1.0"	Travel:	N/A		
Rated Cv:	105	Fl:	N/A	Xt:	N/A
Characteristic:	N/A				
Balanced/Unbalanced:	Balanced				
Plug Material:	316SS (ASTM A351 CF8M)				
Seat Material:	UHMWPE				
Stem Material:	316SS (ASTM A479)				
Ext Trim Material:	316SS (ASTM A351 CF3M)				
Seat Leakage Class:	FCI 70-2 Class IV	Flow Direction:	Bi-directional		
Manufacturer:	*Flow-Tek	Model:	7000-316SS		

ACTUATOR

Actuator Type:	Pneumatic				
Valve Air Failure Position:	FC	Valve Function:	On / Off		
Size:	N/A	Effective Area:	N/A		
Actuator Orientation:	Top Mount	Spring action	Close		
Hand Wheel Type:	None	Position	Indicator Pointer		
Air Failure Valve:	None	Set at	N/A		
Available Air Supply Pressure:					
Min:	105 psig	Max:	120 psig		
Allowable Pressure Requirements:					
Min:	80 psig	Max:	140 psig		
Bench Range:	N/A				
Required Stroke Time to Open:	1/4 s @ 80 psig				
Required Stroke Time to Close:	1/4 s @ 80 psig				
Manufacturer:	*Flow-Tek				
Model:	Series 93: Size 83-5				

TAG NO.	NPWC-AOBV-5623	ON/OFF Control Valves	DATA SHEET NO.	SHEET	OF
			AOBV-5623	2	2

SOLENOID

Tag No:	HS-5623	Fluid:	Air		
Type:	3-Way	Coil:	Class F		
Coil Housing:	NEMA 4X	Watts:	6.9		
Voltage:	24V dc				
Power Wiring:	N/A	Signal Type:	N/A		
Communication Protocol:	N/A	Location:	Direct Mounted		
Smart:	N/A	Indicate:	No	Isolate:	No
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1	5	IP2:	6
Main Valve Action when Coil is Deenergized:	Close				
Conduit Connection:	1/2" NPT				
Body Material:	Anodized Aluminum				
Manufacturer:	*Bray	Model:	Series 63		

NOTES

Valves to be tested in accordance with ASTM D5162, ANSI B16.34 or B16.42 and MSS SP-61 (Pressure Testing of Valves). All dimensions are to be in accordance with ANSI B16.42 (ductile iron) or ANSI B16.5 (steel) and MSS SP-72 (Ball Valves with Flanged or Butt-Welding Ends for General Service). Valves are to be certified Fire-Safe in accordance with API-607.

*Recommended Manufacturer

Valve Model 7-3-05-3-U-U-SR:
- 7 - Body Material: 316 Stainless Steel (CF8M)
- 3 - End Connection: Butt Weld
- 05 - Valve Size: 1.0"
- 3 - Ball and Stem: 316 Stainless Steel
- U - Seat: UHMWPE
- U - Seals: UHMWPE
- SR - Operator: Spring Return Pneumatic Actuator

Actuator Model Series 93, Size 63-4:
- 93 - Actuator Type: Pneumatic Spring Return Actuator
- 83 - Actuator Size Designation (7.40" l x 3.83" w x 5.43" h)
- 5 - No. of Springs per Piston

Actuator to Valve Mounting Kit: ISO Mounting Kit EZ-009S

AECOM

On/Off Control Valves

DATA SHEET NO.			REV.
AOBV-5624			A
SHEET	OF	DATE	
1	2	1-17-13	
BY	CHK'D	PROC.	APPR.
AME	NCC		
P.O.			
REQ.			

NO.	BY	DATE	REVISION

Project:	RLWTF						
TAG NO:	NPWC-AOBV-5624	Spec No	40 9200	Line / Vessel Number:	NPWC-440		
Asset No:		P&ID:	D-6019	Line ID: 0.622"	Size: 0.5"	Schedule:	40
Service Description:	NPWC Supply to Tank TAC-4302			Manufacturer:	*Flow-Tek		
				Model:	7-3-03-3-U-U-SR		
Safety Class	NS			Quality Assurance Level:	ML-4		

PROCESS CONDITIONS

Process Data Case:	Normal								Units:
Sizing Case:	Normal								-
Required Cv:	25 to 40								-
Travel:	N/A								-
Sound Pressure Level:	N/A								-
	Inlet:	Outlet:	Inlet:	Outlet:	Inlet:	Outlet:	Inlet:	Outlet:	
Liquid Flow:	N/A	N/A							gpm
Vapor Flow:	N/A	N/A							cfm
Temperature:	75	75							°F
Pressure:	65	65							psig
Density:	1.02								g/ml
Viscosity:	1.05								cP
Critical Pressure (Pseudo):	N/A								psia
pH:	7.5								-
Compressibility (Z):	N/A								-
Specific Heat Ratio (C_P/C_V):	N/A								-

Fluid:	Water	Max Temperature:	125 °F	Inlet:	Outlet
Area Classification:		Max Upset Pressure (normal flow):			
Ambient Temperature Requirements:	55 to 95 °F	Max Upset Pressure (reverse flow):			

VALVE BODY / BONNET

Valve Type:	3 Piece Full Port Ball Valve		
Body Size:	0.5"	ANSI Class:	150
Max Rated Pressure:	1000 psi	Max Rated Temperature:	200 °F
Body/Bonnet Material:	316SS (ASTM A351 CF8M)		
Liner Material / ID:	N/A		
Inlet Connection Face:	Butt Weld		
Outlet Connection Face:	Butt Weld		
Flange Face Finish:	N/A		
Bonnet Style:	N/A		
Lube Iso Valve:	No	Lube:	N/A
Packing Style:	Seat Rings		
Packing Material:	UHMWPE		
Body/Bonnet Gasket Material:	N/A		
Manufacturer:	*Flow-Tek		
Model:	7000-316SS		

SWITCH

RELAY 1	Tag No:	ZSO-5624			
	Power Rating:	24V dc	Type:	N/O	
	Alarm Setting	N/A			
RELAY 2	Tag No:	ZSC-5624			
	Power Rating:	24V dc	Type:	N/O	
	Alarm Setting	N/A			
Sensor Type:	Proximity	Max. Load Current:	200 mA		
Conduit Connection:	1/2" NPT				
Manufacturer:	*Flow-Tek (Bray)				
Model No.	2N1 (Series 52)				
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1	5	IP2:	6

TRIM

TrimType:	Single Seat				
Size:	0.5"	Travel	N/A		
Rated Cv:	32	Fl:	N/A	Xt:	N/A
Characteristic:	N/A				
Balanced/Unbalanced:	Balanced				
Plug Material:	316SS (ASTM A351 CF8M)				
Seat Material:	UHMWPE				
Stem Material:	316SS (ASTM A479)				
Ext Trim Material:	316SS (ASTM A351 CF3M)				
Seat Leakage Class:	FCI 70-2 Class IV	Flow Direction:	Bi-directional		
Manufacturer:	*Flow-Tek	Model:	7000-316SS		

ACTUATOR

Actuator Type:	Pneumatic		
Valve Air Failure Position:	FC	Valve Function:	On / Off
Size:	N/A	Effective Area:	N/A
Actuator Orientation:	Top Mount	Spring action	Close
Hand Wheel Type:	None	Position	Indicator Pointer
Air Failure Valve:	None	Set at	N/A
Available Air Supply Pressure:			
Min:	105 psig	Max:	120 psig
Allowable Pressure Requirements:			
Min:	80 psig	Max:	140 psig
Bench Range:	N/A		
Required Stroke Time to Open:	1/4 s @ 80 psig		
Required Stroke Time to Close:	1/4 s @ 80 psig		
Manufacturer:	*Flow-Tek		
Model:	Series 93: Size 63-4		

TAG NO.	NPWC-AOBV-5624	ON/OFF Control Valves	DATA SHEET NO.	SHEET	OF
			AOBV-5624	2	2

SOLENOID

Tag No:	HS-5624	Fluid:	Air		
Type:	3-Way	Coil:	Class F		
Coil Housing:	NEMA 4X	Watts:	6.9		
Voltage:	24V dc				
Power Wiring:	N/A	Signal Type:	N/A		
Communication Protocol:	N/A	Location:	Direct Mounted		
Smart:	N/A	Indicate:	No	Isolate:	No
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1	5	IP2:	6
Main Valve Action when Coil is Deenergized:	Close				
Conduit Connection:	1/2" NPT				
Body Material:	Anodized Aluminum				
Manufacturer:	*Bray	Model:	Series 63		

NOTES

Valves to be tested in accordance with ASTM D5162, ANSI B16.34 or B16.42 and MSS SP-61 (Pressure Testing of Valves). All dimensions are to be in accordance with ANSI B16.42 (ductile iron) or ANSI B16.5 (steel) and MSS SP-72 (Ball Valves with Flanged or Butt-Welding Ends for General Service). Valves are to be certified Fire-Safe in accordance with API-607.

*Recommended Manufacturer

Valve Model 7-3-03-3-U-U-SR:
- 7 - Body Material: 316 Stainless Steel (CF8M)
- 3 - End Connection: Butt Weld
- 03 - Valve Size: 0.5"
- 3 - Ball and Stem: 316 Stainless Steel
- U - Seat: UHMWPE
- U - Seals: UHMWPE
- SR - Operator: Spring Return Pneumatic Actuator

Actuator Model Series 93, Size 63-4:
- 93 - Actuator Type: Pneumatic Spring Return Actuator
- 63 - Actuator Size Designation (5.58" l x 3.11" w x 4.53" h)
- 4 - No. of Springs per Piston

Actuator to Valve Mounting Kit: ISO Mounting Kit EZ-002S

AECOM

On/Off Control Valves

DATA SHEET NO.			REV.
AOBV-5625			A
SHEET	OF	DATE	
1	2	1-17-13	
BY	CHK'D	PROC.	APPR.
AME	NCC		
P.O.			
REQ.			

NO.	BY	DATE	REVISION

Project:	RLWTF
TAG NO:	NPWC-AOBV-5625
Asset No:	
Service Description:	NPWC Supply to Tank TK-1102
Safety Class	NS
Spec No:	40 9200
P&ID:	D-6025
Line / Vessel Number:	NPWC-114
Line ID:	1.049"
Size:	1.0"
Schedule:	40
Manufacturer:	*Flow-Tek
Model:	7-3-05-3-U-U-SR
Quality Assurance Level:	ML-4

PROCESS CONDITIONS

Process Data Case:	Normal									Units:
Sizing Case:	Normal									-
Required Cv:	85 to 125									-
Travel:	N/A									-
Sound Pressure Level:	N/A									-
	Inlet:	Outlet:	Inlet:	Outlet:	Inlet:	Outlet:	Inlet:	Outlet:		
Liquid Flow:	25	25								gpm
Vapor Flow:	N/A	N/A								cfm
Temperature:	75	75								°F
Pressure:	65	65								psig
Density:	1.02									g/ml
Viscosity:	1.05									cP
Critical Pressure (Pseudo):	N/A									psia
pH:	7.5									-
Compressibility (Z):	N/A									-
Specific Heat Ratio (C_P/C_V):	N/A									-

Fluid:	Water	Max Temperature:	125 °F	Inlet:	Outlet
Area Classification:		Max Upset Pressure (normal flow):			
Ambient Temperature Requirements:	55 to 95 °F	Max Upset Pressure (reverse flow):			

VALVE BODY / BONNET

Valve Type:	3 Piece Full Port Ball Valve		
Body Size:	1.0"	ANSI Class:	150
Max Rated Pressure:	1000 psi	Max Rated Temperature	200 °F
Body/Bonnet Material:	316SS (ASTM A351 CF8M)		
Liner Material / ID:	N/A		
Inlet Connection Face:	Butt Weld		
Outlet Connection Face:	Butt Weld		
Flange Face Finish:	N/A		
Bonnet Style:	N/A		
Lube Iso Valve:	No	Lube:	N/A
Packing Style:	Seat Rings		
Packing Material:	UHMWPE		
Body/Bonnet Gasket Material:	N/A		
Manufacturer:	*Flow-Tek		
Model:	7000-316SS		

SWITCH

RELAY 1	Tag No:	ZSO-5625			
	Power Rating:	24V dc	Type:	N/O	
	Alarm Setting	N/A			
RELAY 2	Tag No:	ZSC-5625			
	Power Rating:	24V dc	Type:	N/O	
	Alarm Setting	N/A			
Sensor Type:	Proximity	Max. Load Current:	200 mA		
Conduit Connection:	1/2" NPT				
Manufacturer:	*Flow-Tek (Bray)				
Model No.	2N1 (Series 52)				
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1	5	IP2:	6

TRIM

TrimType:	Single Seat				
Size:	1.0"	Travel	N/A		
Rated Cv:	105	Fl:	N/A	Xt:	N/A
Characteristic:	N/A				
Balanced/Unbalanced:	Balanced				
Plug Material:	316SS (ASTM A351 CF8M)				
Seat Material:	UHMWPE				
Stem Material:	316SS (ASTM A479)				
Ext Trim Material:	316SS (ASTM A351 CF3M)				
Seat Leakage Class:	FCI 70-2 Class IV	Flow Direction:	Bi-directional		
Manufacturer:	*Flow-Tek	Model:	7000-316SS		

ACTUATOR

Actuator Type:	Pneumatic				
Valve Air Failure Position:	FC	Valve Function:	On / Off		
Size:	N/A	Effective Area:	N/A		
Actuator Orientation:	Top Mount	Spring action	Close		
Hand Wheel Type:	None	Position	Indicator Pointer		
Air Failure Valve:	None	Set at	N/A		
Available Air Supply Pressure:					
Min:	105 psig	Max:	120 psig		
Allowable Pressure Requirements:					
Min:	80 psig	Max:	140 psig		
Bench Range:	N/A				
Required Stroke Time to Open:	1/4 s @ 80 psig				
Required Stroke Time to Close:	1/4 s @ 80 psig				
Manufacturer:	*Flow-Tek				
Model:	Series 93: Size 83-5				

TAG NO.	NPWC-AOBV-5625	ON/OFF Control Valves	DATA SHEET NO.	SHEET	OF
			AOBV-5625	2	2

SOLENOID

Tag No:	HS-5625	Fluid:	Air		
Type:	3-Way	Coil:	Class F		
Coil Housing:	NEMA 4X	Watts:	6.9		
Voltage:	24V dc				
Power Wiring:	N/A	Signal Type:	N/A		
Communication Protocol:	N/A	Location:	Direct Mounted		
Smart:	N/A	Indicate:	No	Isolate:	No
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1	5	IP2:	6
Main Valve Action when Coil is Deenergized:	Close				
Conduit Connection:	1/2" NPT				
Body Material:	Anodized Aluminum				
Manufacturer:	*Bray	Model:	Series 63		

NOTES

Valves to be tested in accordance with ASTM D5162, ANSI B16.34 or B16.42 and MSS SP-61 (Pressure Testing of Valves). All dimensions are to be in accordance with ANSI B16.42 (ductile iron) or ANSI B16.5 (steel) and MSS SP-72 (Ball Valves with Flanged or Butt-Welding Ends for General Service). Valves are to be certified Fire-Safe in accordance with API-607.

*Recommended Manufacturer

Valve Model 7-3-05-3-U-U-SR:
- 7 - Body Material: 316 Stainless Steel (CF8M)
- 3 - End Connection: Butt Weld
- 05 - Valve Size: 1.0"
- 3 - Ball and Stem: 316 Stainless Steel
- U - Seat: UHMWPE
- U - Seals: UHMWPE
- SR - Operator: Spring Return Pneumatic Actuator

Actuator Model Series 93, Size 63-4:
- 93 - Actuator Type: Pneumatic Spring Return Actuator
- 83 - Actuator Size Designation (7.40" l x 3.83" w x 5.43" h)
- 5 - No. of Springs per Piston

Actuator to Valve Mounting Kit: ISO Mounting Kit EZ-009S

AECOM

On/Off Control Valves

DATA SHEET NO.			REV.
AOBV-5626			A
SHEET	OF	DATE	
1	2	1-17-13	
BY	CHK'D	PROC.	APPR.
AME	NCC		
P.O.			
REQ.			

NO.	BY	DATE	REVISION

Project:	RLWTF						
TAG NO:	NPWC-AOBV-5626	Spec No:	40 9200	Line / Vessel Number:	NPWC-116		
Asset No:		P&ID:	D-6028	Line ID: 1.049"	Size: 1.0"	Schedule:	40
Service Description:	NPWC Supply to Tank TK-1705			Manufacturer:	*Flow-Tek		
				Model:	7-3-05-3-U-U-SR		
Safety Class	NS			Quality Assurance Level:	ML-4		

PROCESS CONDITIONS

Process Data Case:	Normal								Units:
Sizing Case:	Normal								-
Required Cv:	85 to 125								-
Travel:	N/A								-
Sound Pressure Level:	N/A								-
	Inlet:	Outlet:	Inlet:	Outlet:	Inlet:	Outlet:	Inlet:	Outlet:	
Liquid Flow:	25	25							gpm
Vapor Flow:	N/A	N/A							cfm
Temperature:	75	75							°F
Pressure:	65	65							psig
Density:	1.02								g/ml
Viscosity:	1.05								cP
Critical Pressure (Pseudo):	N/A								psia
pH:	7.5								-
Compressibility (Z):	N/A								-
Specific Heat Ratio (C_P/C_v):	N/A								-

Fluid:	Water	Max Temperature:	125 °F	Inlet:	Outlet
Area Classification:		Max Upset Pressure (normal flow):			
Ambient Temperature Requirements:	55 to 95 °F	Max Upset Pressure (reverse flow):			

VALVE BODY / BONNET

Valve Type:	3 Piece Full Port Ball Valve		
Body Size:	1.0"	ANSI Class:	150
Max Rated Pressure:	1000 psi	Max Rated Temperature:	200 °F
Body/Bonnet Material:	316SS (ASTM A351 CF8M)		
Liner Material / ID:	N/A		
Inlet Connection Face:	Butt Weld		
Outlet Connection Face:	Butt Weld		
Flange Face Finish:	N/A		
Bonnet Style:	N/A		
Lube Iso Valve:	No	Lube:	N/A
Packing Style:	Seat Rings		
Packing Material:	UHMWPE		
Body/Bonnet Gasket Material:	N/A		
Manufacturer:	*Flow-Tek		
Model:	7000-316SS		

SWITCH

RELAY 1	Tag No:	ZSO-5626			
	Power Rating:	24V dc	Type:	N/O	
	Alarm Setting	N/A			
RELAY 2	Tag No:	ZSC-5626			
	Power Rating:	24V dc	Type:	N/O	
	Alarm Setting	N/A			
Sensor Type:	Proximity	Max. Load Current:	200 mA		
Conduit Connection:	1/2" NPT				
Manufacturer:	*Flow-Tek (Bray)				
Model No.	2N1 (Series 52)				
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1	5	IP2:	6

TRIM

TrimType:	Single Seat				
Size:	1.0"	Travel	N/A		
Rated Cv:	105	FI:	N/A	Xt:	N/A
Characteristic:	N/A				
Balanced/Unbalanced:	Balanced				
Plug Material:	316SS (ASTM A351 CF8M)				
Seat Material:	UHMWPE				
Stem Material:	316SS (ASTM A479)				
Ext Trim Material:	316SS (ASTM A351 CF3M)				
Seat Leakage Class:	FCI 70-2 Class IV	Flow Direction:	Bi-directional		
Manufacturer:	*Flow-Tek	Model:	7000-316SS		

ACTUATOR

Actuator Type:	Pneumatic				
Valve Air Failure Position:	FC	Valve Function:	On / Off		
Size:	N/A	Effective Area:	N/A		
Actuator Orientation:	Top Mount	Spring action	Close		
Hand Wheel Type:	None	Position	Indicator Pointer		
Air Failure Valve:	None	Set at	N/A		
Available Air Supply Pressure:					
Min:	105 psig	Max:	120 psig		
Allowable Pressure Requirements:					
Min:	80 psig	Max:	140 psig		
Bench Range:	N/A				
Required Stroke Time to Open:	1/4 s @ 80 psig				
Required Stroke Time to Close:	1/4 s @ 80 psig				
Manufacturer:	*Flow-Tek				
Model:	Series 93: Size 83-5				

TAG NO.	NPWC-AOBV-5626	ON/OFF Control Valves	DATA SHEET NO.	SHEET	OF
			AOBV-5626	2	2

SOLENOID

Tag No:	HS-5626	Fluid:	Air		
Type:	3-Way	Coil:	Class F		
Coil Housing:	NEMA 4X	Watts:	6.9		
Voltage:	24V dc				
Power Wiring:	N/A	Signal Type:	N/A		
Communication Protocol:	N/A	Location:	Direct Mounted		
Smart:	N/A	Indicate:	No	Isolate:	No
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1	5	IP2:	6
Main Valve Action when Coil is Deenergized:	Close				
Conduit Connection:	1/2" NPT				
Body Material:	Anodized Aluminum				
Manufacturer:	*Bray	Model:	Series 63		

NOTES

Valves to be tested in accordance with ASTM D5162, ANSI B16.34 or B16.42 and MSS SP-61 (Pressure Testing of Valves). All dimensions are to be in accordance with ANSI B16.42 (ductile iron) or ANSI B16.5 (steel) and MSS SP-72 (Ball Valves with Flanged or Butt-Welding Ends for General Service). Valves are to be certified Fire-Safe in accordance with API-607.

*Recommended Manufacturer

Valve Model 7-3-05-3-U-U-SR:
- 7 - Body Material: 316 Stainless Steel (CF8M)
- 3 - End Connection: Butt Weld
- 05 - Valve Size: 1.0"
- 3 - Ball and Stem: 316 Stainless Steel
- U - Seat: UHMWPE
- U - Seals: UHMWPE
- SR - Operator: Spring Return Pneumatic Actuator

Actuator Model Series 93, Size 63-4:
- 93 - Actuator Type: Pneumatic Spring Return Actuator
- 83 - Actuator Size Designation (7.40" l x 3.83" w x 5.43" h)
- 5 - No. of Springs per Piston

Actuator to Valve Mounting Kit: ISO Mounting Kit EZ-009S

AECOM

On/Off Control Valves

DATA SHEET NO.			REV.
AOBV-5627			A
SHEET	OF	DATE	
1	2	1-17-13	

NO.	BY	DATE	REVISION

BY	CHK'D	PROC.	APPR.
AME	NCC		

P.O.

REQ.

Project: RLWTF

TAG NO: NPWC-AOBV-5627

Spec No:	40 9200	Line / Vessel Number:	NPWC-124				
Asset No:		P&ID:	D-6013	Line ID:	0.622"	Size:	0.5"
Service Description:	Tank TK-1102 NPWC Bypass to Microfilter Sludge	Manufacturer:	*Flow-Tek				
		Model:	7-3-03-3-U-U-SR				
Safety Class	NS	Quality Assurance Level:	ML-4				

Schedule: 40

PROCESS CONDITIONS

Process Data Case:	Normal									Units:
Sizing Case:	Normal									-
Required Cv:	25 to 40									-
Travel:	NA									-
Sound Pressure Level:	NA									-
	Inlet:	Outlet:	Inlet:	Outlet:	Inlet:	Outlet:	Inlet:	Outlet:		
Liquid Flow:	NA	NA								gpm
Vapor Flow:	NA	NA								cfm
Temperature:	75	75								°F
Pressure:	45	45								psig
Density:	1.02									g/ml
Viscosity:	1.05									cP
Critical Pressure (Pseudo):	NA									psia
pH:	7.5									-
Compressibility (Z):	NA									-
Specific Heat Ratio ($^{C_P}/_{C_V}$):	NA									-

Fluid:	Water	Max Temperature:	125 °F	Inlet:	Outlet
Area Classification:		Max Upset Pressure (normal flow):			
Ambient Temperature Requirements:	55 to 95 °F	Max Upset Pressure (reverse flow):			

VALVE BODY / BONNET

Valve Type:	3 Piece Full Port Ball Valve		
Body Size:	0.5"	ANSI Class:	150
Max Rated Pressure:	1000 psi	Max Rated Temperature:	200 °F
Body/Bonnet Material:	316SS (ASTM A351 CF8M)		
Liner Material / ID:	N/A		
Inlet Connection Face:	Butt Weld		
Outlet Connection Face:	Butt Weld		
Flange Face Finish:	N/A		
Bonnet Style:	N/A		
Lube Iso Valve:	No	Lube:	N/A
Packing Style:	Seat Rings		
Packing Material:	UHMWPE		
Body/Bonnet Gasket Material:	N/A		
Manufacturer:	*Flow-Tek		
Model:	7000-316SS		

SWITCH

RELAY 1	Tag No:	ZSO-1728			
	Power Rating:	24V dc	Type:	N/O	
	Alarm Setting	N/A			
RELAY 2	Tag No:	ZSC-1728			
	Power Rating:	24V dc	Type:	N/O	
	Alarm Setting	N/A			
Sensor Type:	Proximity	Max. Load Current:	200 mA		
Conduit Connection:	1/2" NPT				
Manufacturer:	*Flow-Tek (Bray)				
Model No.	2N1 (Series 52)				
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1	5	IP2:	6

TRIM

TrimType:	Single Seat				
Size:	0.5"	Travel	N/A		
Rated Cv:	32	Fl:	N/A	Xt:	N/A
Characteristic:	N/A				
Balanced/Unbalanced:	Balanced				
Plug Material:	316SS (ASTM A351 CF8M)				
Seat Material:	UHMWPE				
Stem Material:	316SS (ASTM A479)				
Ext Trim Material:	316SS (ASTM A351 CF3M)				
Seat Leakage Class:	FCI 70-2 Class IV	Flow Direction:	Bi-directional		
Manufacturer:	*Flow-Tek	Model:	7000-316SS		

ACTUATOR

Actuator Type:	Pneumatic				
Valve Air Failure Position:	FC	Valve Function:	On / Off		
Size:	N/A	Effective Area:	N/A		
Actuator Orientation:	Top Mount	Spring action	Close		
Hand Wheel Type:	None	Position	Indicator Pointer		
Air Failure Valve:	None	Set at	N/A		
Available Air Supply Pressure:					
Min:	105 psig	Max:	120 psig		
Allowable Pressure Requirements:					
Min:	80 psig	Max:	140 psig		
Bench Range:	N/A				
Required Stroke Time to Open:	1/4 s @ 80 psig				
Required Stroke Time to Close:	1/4 s @ 80 psig				
Manufacturer:	*Flow-Tek				
Model:	Series 93 Size 63-4				

TAG NO.	NPWC-AOBV-5627	ON/OFF Control Valves	DATA SHEET NO.	SHEET	OF
			AOBV-5627	2	2

SOLENOID

Tag No:	HS-1728	Fluid:	Air		
Type:	3-Way	Coil:	Class F		
Coil Housing:	NEMA 4X	Watts:	6.9		
Voltage:	24V dc				
Power Wiring:	N/A	Signal Type:	N/A		
Communication Protocol:	N/A	Location:	Direct Mounted		
Smart:	N/A	Indicate:	No	Isolate:	No
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1	5	IP2:	6
Main Valve Action when Coil is Deenergized:	Close				
Conduit Connection:	1/2" NPT				
Body Material:	Anodized Aluminum				
Manufacturer:	*Bray	Model:	Series 63		

NOTES

Valves to be tested in accordance with ASTM D5162, ANSI B16.34 or B16.42 and MSS SP-61 (Pressure Testing of Valves). All dimensions are to be in accordance with ANSI B16.42 (ductile iron) or ANSI B16.5 (steel) and MSS SP-72 (Ball Valves with Flanged or Butt-Welding Ends for General Service). Valves are to be certified Fire-Safe in accordance with API-607.

*Recommended Manufacturer

Valve Model 7-3-03-3-U-U-SR:
- 7 - Body Material: 316 Stainless Steel (CF8M)
- 3 - End Connection: Butt Weld
- 03 - Valve Size: 0.5"
- 3 - Ball and Stem: 316 Stainless Steel
- U - Seat: UHMWPE
- U - Seals: UHMWPE
- SR - Operator: Spring Return Pneumatic Actuator

Actuator Model Series 93, Size 63-4:
- 93 - Actuator Type: Pneumatic Spring Return Actuator
- 63 - Actuator Size Designation (5.58" l x 3.11" w x 4.53" h)
- 4 - No. of Springs per Piston

Actuator to Valve Mounting Kit: ISO Mounting Kit EZ-002S

AECOM

Flow Control Valves

DATA SHEET NO.			REV.
FCV-1206			0
SHEET	OF	DATE	
1	2	1-17-13	

NO.	BY	DATE	REVISION

BY	CHK'D	PROC.	APPR.
AME	NCC		

P.O.	
REQ.	

Project:	RLWTF						
TAG NO:	LLW-FCV-1206	Spec No:	40 9200	Line / Vessel Number:	LLW-180		
Asset No:		P&ID:	D-6014	Line ID: 2.067"	Size: 2"	Schedule:	40
Service Description:	Microfilter FLT-1201 Outlet			Manufacturer:	*Fisher		
				Model:	2" GX DVC6200 SS		
Safety Class	GS			Quality Assurance Level:	ML-4		

PROCESS CONDITIONS

Process Data Case:	Normal								Units:
Sizing Case:	Normal								-
Required Cv:	0 to 50								-
Travel:	N/A								-
Sound Pressure Level:	N/A								-
	Inlet:	Outlet:	Inlet:	Outlet:	Inlet:	Outlet:	Inlet:	Outlet:	
Liquid Flow:	40	40							gpm
Vapor Flow:	NA	NA							cfm
Temperature:	75	75							°F
Pressure:	45	45							psig
Density:	1.02								g/ml
Viscosity:	1.05								cP
Critical Pressure (Pseudo):	N/A								psia
Vapour Pressure:	N/A								psia
pH:	10.8								-
Specific Heat Ratio (C_P/C_V):	N/A								-

Fluid:	LLW (contaminated water)	Max Temperature Upset:	125 °F	Inlet:	Outlet
Area Classification:		Max Upset Pressure (normal flow):			
Ambient Temperature Requirements:	55 to 95 °F	Max Upset Pressure (reverse flow):			

VALVE BODY / BONNET

Valve Type:	Globe Valve for Flow Control		
Body Size:	2"	ANSI Class:	150
Max Rated Pressure:	200 psi	Max Rated Temperature:	450 deg F
Body/Bonnet Material:	CF3M SST		
Liner Material / ID:	N/A		
Inlet Connection Face:	CL 150 Flange		
Outlet Connection Face:	CL 150 Flange		
Flange Face Finish:	Raise Face		
Bonnet Style:	Standard		
Lube Iso Valve:	No	Lube:	N/A
Packing Style:	Live Loaded PTFE V-Ring		
Packing Material:	Live Loaded PTFE		
Body/Bonnet Gasket Material:	N/A		
Manufacturer:	*Fisher		
Model:	By Vendor		

SWITCH

RELAY 1	Tag No:	N/A			
	Power Rating:	N/A	Type:	N/A	
	Alarm Setting	N/A			
RELAY 2	Tag No:	N/A			
	Power Rating:	N/A	Type:	N/A	
	Alarm Setting	N/A			
Sensor Type:	N/A	Contact Rating:	N/A		
Conduit Connection:	N/A				
Manufacturer:	N/A				
Model No.	N/A				
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1	5	IP2:	6

TRIM

TrimType:	Dual Seat				
Size:	2"	Travel	N/A		
Max. Rated Cv:	43.7	Fl:	N/A	Xt:	N/A
Characteristic:	Equal Percent				
Balanced/Unbalanced:	Unbalanced				
Plug Material:	CF3M SST				
Seat Ring Material:	CF3M SST				
Stem Material:	S31603 SST				
Ext Trim Material:	SST				
Seat Leakage Class:	FCI 70-2 CL-IV	Flow Direction:	Flow-Up		
Manufacturer:	*Fisher	Model:	By Vendor		

ACTUATOR

Actuator Type:	Pneumatic		
Valve Air Failure Position:	Fail Closed	Valve Function:	Modulating
Type/Size:	GX/225	Travel:	20 mm (0.79")
Actuator Orientation:	Vertical up	Spring action	Close
Hand Wheel Type:	None	Position	N/A
Air Failure Valve:	None	Set at	N/A
Available Air Supply Pressure:			
Min:	105 psig	Max:	120 psig
Allowable Pressure Requirements:			
Min:	58 psig	Max:	87 psig
Bench Range:	N/A		
Required Stroke Time to Open:	N/A		
Required Stroke Time to Close:	N/A		
Manufacturer:	*Fisher		
Model:	By Vendor		

TAG NO.	LLW-FCV-1206	Flow Control Valves	DATA SHEET NO.	SHEET	OF
			FCV-1206	2	2

POSITIONER

Positioner Type:	DVC6200, Hart Communicating-HC
Input Signal:	4 to 20 mA dc
Regulator:	67CS T14115T0012 Filter/Regulator
Relief:	Generant IRVD-4V-V-80-X w/o 0.312" orifice
Gauges:	0-160 psig
Action:	Direct
Manufacturer:	*Fisher

NOTES

Valves to be hydrotested tested in accordance with ANSI B16.34 or MSS SP-61 (Pressure Testing of Valves) and Leak Tested in accordance with FCI 70-2 for Class IV as a minimum. All dimensions are to be in accordance with ANSI B16.5 and B16.10 and MSS SP-72 (Ball Valves with Flanged or Butt-Welding Ends for General Service). Valves are to be certified Fire-Safe in accordance with API-607.

*Recommended Manufacturer

AECOM

Flow Control Valves

DATA SHEET NO.			REV.
FCV-1311			0
SHEET	OF	DATE	
1	2	1-17-13	

NO.	BY	DATE	REVISION

BY	CHK'D	PROC.	APPR.
AME	NCC		

P.O.	
REQ.	

Project:	RLWTF						
TAG NO:	LLW-FCV-1311	Spec No:	40 9200	Line / Vessel Number:	LLW-220		
Asset No:		P&ID:	D-6017	Line ID: 0.622"	Size: 0.5"	Schedule:	40
Service Description:	RO Recycle to Tank TK-1301			Manufacturer:	*Fisher		
				Model:	1/2" GX DVC6200 SS		
Safety Class	GS			Quality Assurance Level:	ML-4		

PROCESS CONDITIONS

Process Data Case:	Normal									Units:
Sizing Case:	Normal									-
Required Cv:	0 to 4									-
Travel:	N/A									-
Sound Pressure Level:	N/A									-
	Inlet:	Outlet:	Inlet:	Outlet:	Inlet:	Outlet:	Inlet:	Outlet:		
Liquid Flow:	5	5								gpm
Vapor Flow:	NA	NA								cfm
Temperature:	75	75								°F
Pressure:	45	45								psig
Density:	1.02									g/ml
Viscosity:	1.05									cP
Critical Pressure (Pseudo):	N/A									psia
Vapour Pressure:	N/A									psia
pH:	7.5									-
Specific Heat Ratio (C_P/C_V):	NA									-

Fluid:	LLW (contaminated water)	Max Temperature Upset:	125 °F	Inlet:	Outlet
Area Classification:		Max Upset Pressure (normal flow):			
Ambient Temperature Requirements:	55 to 95 °F	Max Upset Pressure (reverse flow):			

VALVE BODY / BONNET

Valve Type:	Globe Valve for Flow Control		
Body Size:	0.5"	ANSI Class:	150
Max Rated Pressure:	200 psi	Max Rated Temperature:	450 deg F
Body/Bonnet Material:	CF3M SST		
Liner Material / ID:	N/A		
Inlet Connection Face:	CL 150 Flange		
Outlet Connection Face:	CL 150 Flange		
Flange Face Finish:	Raise Face		
Bonnet Style:	Standard		
Lube Iso Valve:	No	Lube:	N/A
Packing Style:	Live Loaded PTFE V-Ring		
Packing Material:	Live Loaded PTFE		
Body/Bonnet Gasket Material:	N/A		
Manufacturer:	*Fisher		
Model:	By Vendor		

SWITCH

RELAY 1	Tag No:	N/A			
	Power Rating:	N/A	Type:	N/A	
	Alarm Setting	N/A			
RELAY 2	Tag No:	N/A			
	Power Rating:	N/A	Type:	N/A	
	Alarm Setting	N/A			
Sensor Type:	N/A	Contact Rating:	N/A		
Conduit Connection:	N/A				
Manufacturer:	N/A				
Model No.	N/A				
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1	5	IP2:	6

TRIM

TrimType:	Dual Seat				
Size:	0.5"	Travel	N/A		
Max. Rated Cv:	3.34	Fl:	N/A	Xt:	N/A
Characteristic:	Equal Percent				
Balanced/Unbalanced:	Unbalanced				
Plug Material:	S31603 SST				
Seat Ring Material:	CF3M SST				
Stem Material:	S31603 SST				
Ext Trim Material:	SST				
Seat Leakage Class:	FCI70-2 CL-IV	Flow Direction:	Flow-Up		
Manufacturer:	*Fisher	Model:	By Vendor		

ACTUATOR

Actuator Type:	Pneumatic		
Valve Air Failure Position:	Fail Closed	Valve Function:	Modulating
Type/Size:	GX/225	Travel:	20 mm (0.79")
Actuator Orientation:	Vertical up	Spring action	Close
Hand Wheel Type:	None	Position	N/A
Air Failure Valve:	None	Set at	N/A
Available Air Supply Pressure:			
Min:	105 psig	Max:	120 psig
Allowable Pressure Requirements:			
Min:	58 psig	Max:	87 psig
Bench Range:	N/A		
Required Stroke Time to Open:	N/A		
Required Stroke Time to Close:	N/A		
Manufacturer:	*Fisher		
Model:	By Vendor		

TAG NO.	LLW-FCV-1311	Flow Control Valves	DATA SHEET NO.	SHEET	OF
			FCV-1311	2	2

POSITIONER

Positioner Type:	DVC6200, Hart Communicating-HC
Input Signal:	4 to 20 mA dc
Access:	67CS T14115T0012 Filter/Regulator
Relief:	Generant IRVD-4V-V-80-X w/o 0.312" orifice
Gauges:	0-160 psig
Action:	Direct
Manufacturer:	*Fisher

NOTES

Valves to be hydrotested tested in accordance with ANSI B16.34 or MSS SP-61 (Pressure Testing of Valves) and Leak Tested in accordance with FCI 70-2 for Class IV as a minimum. All dimensions are to be in accordance with ANSI B16.5 and B16.10 and MSS SP-72 (Ball Valves with Flanged or Butt-Welding Ends for General Service). Valves are to be certified Fire-Safe in accordance with API-607.

*Recommended Manufacturer

AECOM

Flow Control Valves

DATA SHEET NO.			REV.
FCV-1315			0
SHEET	OF	DATE	
1	2	1-17-13	

NO.	BY	DATE	REVISION

BY	CHK'D	PROC.	APPR.
AME	NCC		

P.O.	
REQ.	

Project:	RLWTF						
TAG NO:	LLW-FCV-1315	Spec No:	40 9200	Line / Vessel Number:	LLW-228		
Asset No:		P&ID:	D-6017	Line ID: 1.610"	Size: 1.5"	Schedule:	40
Service Description:	RO Feed			Manufacturer:	*Fisher		
				Model:	1-1/2" GX DVC6200 SS		
Safety Class	GS	Quality Assurance Level:	ML-4				

PROCESS CONDITIONS

Process Data Case:	Normal								Units:
Sizing Case:	Normal								-
Required Cv:	0 to 30								-
Travel:	N/A								-
Sound Pressure Level:	N/A								-
	Inlet:	Outlet:	Inlet:	Outlet:	Inlet:	Outlet:	Inlet:	Outlet:	
Liquid Flow:	33.1	33.1							gpm
Vapor Flow:	NA	NA							cfm
Temperature:	75	75							°F
Pressure:	45	45							psig
Density:	1.02								g/ml
Viscosity:	1.05								cP
Critical Pressure (Pseudo):	N/A								psia
Vapour Pressure:	N/A								psia
pH:	7.5								-
Specific Heat Ratio (C_P/C_V):	NA								-

Fluid:	LLW (contaminated w ater)	Max Temperature Upset:	125 °F	Inlet:	Outlet
Area Classification:		Max Upset Pressure (normal flow):			
Ambient Temperature Requirements:	55 to 95 °F	Max Upset Pressure (reverse flow):			

VALVE BODY / BONNET

Valve Type:	Globe Valve for Flow Control		
Body Size:	1.5"	ANSI Class:	150
Max Rated Pressure:	200 psi	Max Rated Temperature:	450 deg F
Body/Bonnet Material:	CF3M SST		
Liner Material / ID:	N/A		
Inlet Connection Face:	CL 150 Flange		
Outlet Connection Face:	CL 150 Flange		
Flange Face Finish:	Raise Face		
Bonnet Style:	Standard		
Lube Iso Valve:	No	Lube:	N/A
Packing Style:	Live Loaded PTFE V-Ring		
Packing Material:	Live Loaded PTFE		
Body/Bonnet Gasket Material:	N/A		
Manufacturer:	*Fisher		
Model:	By Vendor		

SWITCH

RELAY 1	Tag No:	N/A			
	Pow er Rating:	N/A	Type:	N/A	
	Alarm Setting	N/A			
RELAY 2	Tag No:	N/A			
	Pow er Rating:	N/A	Type:	N/A	
	Alarm Setting	N/A			
Sensor Type:	N/A	Contact Rating:	N/A		
Conduit Connection:	N/A				
Manufacturer:	N/A				
Model No.	N/A				
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1	5	IP2:	6

TRIM

TrimType:	Dual Seat				
Size:	1.5"	Travel	N/A		
Max. Rated Cv:	27.2	Ft:	N/A	Xt:	N/A
Characteristic:	Equal Percent				
Balanced/Unbalanced:	Unbalanced				
Plug Material:	CF3M SST				
Seat Ring Material:	CF3M SST				
Stem Material:	S31603 SST				
Ext Trim Material:	SST				
Seat Leakage Class:	FCI 70-2 CL-IV	Flow Direction:	Flow-Up		
Manufacturer:	*Fisher	Model:	By Vendor		

ACTUATOR

Actuator Type:	Pneumatic		
Valve Air Failure Position:	Fail Closed	Valve Function:	Modulating
Type/Size:	GX/225	Travel:	20 mm (0.79")
Actuator Orientation:	Vertical up	Spring action	Close
Hand Wheel Type:	None	Position	N/A
Air Failure Valve:	None	Set at	N/A
Available Air Supply Pressure:			
Min:	105 psig	Max:	120 psig
Allow able Pressure Requirements:			
Min:	58 psig	Max:	87 psig
Bench Range:	N/A		
Required Stroke Time to Open:	N/A		
Required Stroke Time to Close:	N/A		
Manufacturer:	*Fisher		
Model:	By Vendor		

TAG NO.	LLW-FCV-1315	Flow Control Valves	DATA SHEET NO.	SHEET	OF
			FCV-1315	2	2

POSITIONER

Positioner Type:	DVC6200, Hart Communicating-HC
Input Signal:	4 to 20 mA dc
Access:	67CS T14115T0012 Filter/Regulator
Relief:	Generant IRVD-4V-V-80-X w/o 0.312" orifice
Gauges:	0-160 psig
Action:	Direct
Manufacturer:	*Fisher

NOTES

Valves to be hydrotested tested in accordance with ANSI B16.34 or MSS SP-61 (Pressure Testing of Valves) and Leak Tested in accordance with FCI 70-2 for Class IV as a minimum. All dimensions are to be in accordance with ANSI B16.5 and B16.10 and MSS SP-72 (Ball Valves with Flanged or Butt-Welding Ends for General Service). Valves are to be certified Fire-Safe in accordance with API-607.

*Recommended Manufacturer

AECOM

Flow Control Valves

DATA SHEET NO.			REV.
FCV-1403			0
SHEET	OF	DATE	
1	2	1-17-13	

NO.	BY	DATE	REVISION

BY	CHK'D	PROC.	APPR.
AME	NCC		

P.O.	
REQ.	

Project:	RLWTF						
TAG NO:	LLW-FCV-1403	Spec No:	40 9200	Line / Vessel Number:	LLW-449		
Asset No:		P&ID:	D-6021	Line ID: 1.610"	Size: 1.5"	Schedule:	40
Service Description:	RO Permeate Recycle			Manufacturer:	*Fisher		
				Model:	1-1/2" GX DVC6200 SS		
Safety Class	GS			Quality Assurance Level:	ML-4		

PROCESS CONDITIONS

Process Data Case:	Normal								Units:
Sizing Case:	Normal								-
Required Cv:	0 to 30								-
Travel:	N/A								-
Sound Pressure Level:	N/A								-
	Inlet:	Outlet:	Inlet:	Outlet:	Inlet:	Outlet:	Inlet:	Outlet:	
Liquid Flow:	25.5	25.5							gpm
Vapor Flow:	NA	NA							cfm
Temperature:	75	75							°F
Pressure:	45	45							psig
Density:	1.02								g/ml
Viscosity:	1.05								cP
Critical Pressure (Pseudo):	N/A								psia
Vapour Pressure:	N/A								psia
pH:	6.5								-
Specific Heat Ratio (C_p/C_v):	NA								-

Fluid:	LLW (contaminated water)	Max Temperature Upset:	125 °F	Inlet:	Outlet	
Area Classification:		Max Upset Pressure (normal flow):				
Ambient Temperature Requirements:	55 to 95 °F	Max Upset Pressure (reverse flow):				

VALVE BODY / BONNET

Valve Type:	Globe Valve for Flow Control		
Body Size:	1.5"	ANSI Class:	150
Max Rated Pressure:	200 psi	Max Rated Temperature:	450 deg F
Body/Bonnet Material:	CF3M SST		
Liner Material / ID:	N/A		
Inlet Connection Face:	CL 150 Flange		
Outlet Connection Face:	CL 150 Flange		
Flange Face Finish:	Raise Face		
Bonnet Style:	Standard		
Lube Iso Valve:	No	Lube:	N/A
Packing Style:	Live Loaded PTFE V-Ring		
Packing Material:	Live Loaded PTFE		
Body/Bonnet Gasket Material:	N/A		
Manufacturer:	*Fisher		
Model:	By Vendor		

SWITCH

RELAY 1	Tag No:	N/A			
	Power Rating:	N/A	Type:	N/A	
	Alarm Setting	N/A			
RELAY 2	Tag No:	N/A			
	Power Rating:	N/A	Type:	N/A	
	Alarm Setting	N/A			
Sensor Type:	N/A	Contact Rating:	N/A		
Conduit Connection:	N/A				
Manufacturer:	N/A				
Model No.	N/A				
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1	5	IP2:	6

TRIM

TrimType:	Dual Seat				
Size:	1.5"	Travel	N/A		
Max. Rated Cv:	27.2	FI:	N/A	Xt:	N/A
Characteristic:	Equal Percent				
Balanced/Unbalanced:	Unbalanced				
Plug Material:	CF3M SST				
Seat Ring Material:	CF3M SST				
Stem Material:	S31603 SST				
Ext Trim Material:	SST				
Seat Leakage Class:	FCI 70-2 CL-IV	Flow Direction:	Flow-Up		
Manufacturer:	*Fisher	Model:	By Vendor		

ACTUATOR

Actuator Type:	Pneumatic		
Valve Air Failure Position:	Fail Closed	Valve Function:	Modulating
Type/Size:	GX/225	Travel:	20 mm (0.79")
Actuator Orientation:	Vertical up	Spring action	Close
Hand Wheel Type:	None	Position	N/A
Air Failure Valve:	None	Set at	N/A
Available Air Supply Pressure:			
Min:	105 psig	Max:	120 psig
Allowable Pressure Requirements:			
Min:	58 psig	Max:	87 psig
Bench Range:	N/A		
Required Stroke Time to Open:	N/A		
Required Stroke Time to Close:	N/A		
Manufacturer:	*Fisher		
Model:	By Vendor		

TAG NO.	LLW-FCV-1403	Flow Control Valves	DATA SHEET NO.	SHEET	OF
			FCV-1403	2	2

POSITIONER

Positioner Type:	DVC6200, Hart Communicating-HC
Input Signal:	4 to 20 mA dc
Access:	67CS T14115T0012 Filter/Regulator
Relief:	Generant IRVD-4V-V-80-X w/o 0.312" orifice
Gauges:	0-160 psig
Action:	Direct
Manufacturer:	*Fisher

NOTES

Valves to be hydrotested tested in accordance with ANSI B16.34 or MSS SP-61 (Pressure Testing of Valves) and Leak Tested in accordance with FCI 70-2 for Class IV as a minimum. All dimensions are to be in accordance with ANSI B16.5 and B16.10 and MSS SP-72 (Ball Valves with Flanged or Butt-Welding Ends for General Service). Valves are to be certified Fire-Safe in accordance with API-607.

*Recommended Manufacturer

AECOM

Flow Control Valves

DATA SHEET NO.			REV.
FCV-1515			0
SHEET	OF	DATE	
1	2	1-17-13	

NO.	BY	DATE	REVISION

BY	CHK'D	PROC.	APPR.
AME	NCC		

P.O.	
REQ.	

Project: RLWTF

TAG NO: LLW-FCV-1515

Spec No:	40 9200			Line / Vessel Number:	LLW-303		
Asset No:		P&ID:	D-6412	Line ID: 3.068"	Size: 3.0"	Schedule:	40
Service Description:	Effluent Recycle			Manufacturer:	*Fisher / Emerson		
				Model:	3" GX DVC6200 SS / M2CP-1000		
Safety Class	GS			Quality Assurance Level:	ML-4		

PROCESS CONDITIONS

Process Data Case:	Normal									Units:
Sizing Case:	Normal									-
Required Cv:	0 to 100									-
Travel:	N/A									-
Sound Pressure Level:	N/A									-
	Inlet:	Outlet:	Inlet:	Outlet:	Inlet:	Outlet:	Inlet:	Outlet:		
Liquid Flow:	100	100								gpm
Vapor Flow:	NA	NA								cfm
Temperature:	75	75								°F
Pressure:	45	45								psig
Density:	1.02									g/ml
Viscosity:	1.05									cP
Critical Pressure (Pseudo):	N/A									psia
Vapour Pressure:	N/A									psia
pH:	6.5									-
Specific Heat Ratio ($^{Cp}/_{Cv}$):	NA									-

Fluid:	LLW (contaminated water)	Max Temperature Upset:	125 °F	Inlet:	Outlet
Area Classification:		Max Upset Pressure (normal flow):			
Ambient Temperature Requirements:	55 to 95 °F	Max Upset Pressure (reverse flow):			

VALVE BODY / BONNET

Valve Type:	Globe Valve for Flow Control		
Body Size:	3.0"	ANSI Class:	150
Max Rated Pressure:	200 psi	Max Rated Temperature	450 deg F
Body/Bonnet Material:	CF3M SST		
Liner Material / ID:	N/A		
Inlet Connection Face:	CL 150 Flange		
Outlet Connection Face	CL 150 Flange		
Flange Face Finish	Raise Face		
Bonnet Style:	Standard		
Lube Iso Valve:	No	Lube:	N/A
Packing Style	Live Loaded PTFE V-Ring		
Packing Material:	Live Loaded PTFE		
Body/Bonnet Gasket Material:	N/A		
Manufacturer:	*Fisher		
Model:	By Vendor		

SWITCH

RELAY 1	Tag No:	N/A			
	Power Rating:	N/A	Type:	N/A	
	Alarm Setting	N/A			
RELAY 2	Tag No:	N/A			
	Power Rating:	N/A	Type:	N/A	
	Alarm Setting	N/A			
Sensor Type:	N/A	Contact Rating:	N/A		
Conduit Connection:	N/A				
Manufacturer:	N/A				
Model No.	N/A				
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP	5	IP2:	6

TRIM

TrimType:	Dual Seat				
Size:	3.0"	Travel	N/A		
Max. Rated Cv:	95.1	FI:	N/A	Xt:	N/A
Characteristic:	Equal Percent				
Balanced/Unbalanced:	Unbalanced				
Plug Material:	CF3M SST				
Seat Ring Material	CF3M SST				
Stem Material:	S31603 SST				
Ext Trim Material:	SST				
Seat Leakage Class:	FCI 70-2 CL-IV	Flow Direction:	Flow-Up		
Manufacturer:	*Fisher	Model:	By Vendor		

ACTUATOR

Actuator Type:	Electric				
Valve Air Failure Position:	FC	Valve Function:	Modulating		
Type/Size:	Multi-Turn	Travel:	40 mm (1.57")		
Actuator Orientation:	Vertical up	Spring action	Close		
Hand Wheel Type:	Handle	Position	N/A		
Air Failure Valve:	N/A	Set at	N/A		
Torque:	130 ft-lbs	Thrust:	10,000 lbs		
Max Stem Dia:	1.38 in	RPM:	8-144 @60Hz		
Mounting Base:	F07				
Required Stroke Time to Open:	N/A				
Required Stroke Time to Close:	N/A				
Manufacturer:	*Emerson				
Model:	M2CP-1000				

TAG NO.	LLW-FCV-1515	Flow Control Valves	DATA SHEET NO.	SHEET	OF
			FCV-1515	2	2

POSITIONER

Control Module:	Futronic™
Input Signal:	4 to 20 mA dc
Access:	N/A
Gauges:	Mechanical Dial Position Indicator
Action:	Direct
Manufacturer:	*Emerson

NOTES

Valves to be hydrotested tested in accordance with ANSI B16.34 or MSS SP-61 (Pressure Testing of Valves) and Leak Tested in accordance with FCI 70-2 for Class IV as a minimum. All dimensions are to be in accordance with ANSI B16.5 and B16.10 and MSS SP-72 (Ball Valves with Flanged or Butt-Welding Ends for General Service). Valves are to be certified Fire-Safe in accordance with API-607.

*Recommended Manufacturer

AECOM

Flow Control Valves

DATA SHEET NO.			REV.
FCV-1700			0
SHEET	OF	DATE	
1	2	1-17-13	

NO.	BY	DATE	REVISION

BY	CHK'D	PROC.	APPR.
AME	NCC		

P.O.	
REQ.	

Project:	RLWTF						
TAG NO:	LLW-FCV-1700	Spec No:	40 9200	Line / Vessel Number:	LLW-397		
Asset No:		P&ID:	D-6030	Line ID: 0.622"	Size: 0.5"	Schedule:	40
Service Description:	Tank TK-1706 Condensate Recycle to Tank TK-1301			Manufacturer:	*Fisher		
				Model:	1/2" GX DVC6200 SS		
Safety Class	GS	Quality Assurance Level:	ML-4				

PROCESS CONDITIONS

Process Data Case:	Normal									Units:
Sizing Case:	Normal									-
Required Cv:	0 to 4									-
Travel:	N/A									-
Sound Pressure Level:	N/A									-
	Inlet:	Outlet:	Inlet:	Outlet:	Inlet:	Outlet:	Inlet:	Outlet:		
Liquid Flow:	5	5								gpm
Vapor Flow:	NA	NA								cfm
Temperature:	75	75								°F
Pressure:	45	45								psig
Density:	1.02									g/ml
Viscosity:	1.05									cP
Critical Pressure (Pseudo):	N/A									psia
Vapour Pressure:	N/A									psia
pH:	8.2									-
Specific Heat Ratio (C_P/C_V):	NA									-

Fluid:	LLW (contaminated water)	Max Temperature Upset:	125 °F	Inlet:	Outlet
Area Classification:		Max Upset Pressure (normal flow):			
Ambient Temperature Requirements:	55 to 95 °F	Max Upset Pressure (reverse flow):			

VALVE BODY / BONNET

Valve Type:	Globe Valve for Flow Control		
Body Size:	0.5"	ANSI Class:	150
Max Rated Pressure:	200 psi	Max Rated Temperature:	450 deg F
Body/Bonnet Material:	CF3M SST		
Liner Material / ID:	N/A		
Inlet Connection Face:	CL 150 Flange		
Outlet Connection Face:	CL 150 Flange		
Flange Face Finish:	Raise Face		
Bonnet Style:	Standard		
Lube Iso Valve:	No	Lube:	N/A
Packing Style:	Live Loaded PTFE V-Ring		
Packing Material:	Live Loaded PTFE		
Body/Bonnet Gasket Material:	N/A		
Manufacturer:	*Fisher		
Model:	By Vendor		

SWITCH

RELAY 1	Tag No:	N/A			
	Power Rating:	N/A	Type:	N/A	
	Alarm Setting	N/A			
RELAY 2	Tag No:	N/A			
	Power Rating:	N/A	Type:	N/A	
	Alarm Setting	N/A			
Sensor Type:	N/A	Contact Rating:	N/A		
Conduit Connection:	N/A				
Manufacturer:	N/A				
Model No.	N/A				
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1	5	IP2:	6

TRIM

TrimType:	Dual Seat				
Size:	0.5"	Travel	N/A		
Max. Rated Cv:	3.34	Fl:	N/A	Xt:	N/A
Characteristic:	Equal Percent				
Balanced/Unbalanced:	Unbalanced				
Plug Material:	S31603 SST				
Seat Ring Material:	CF3M SST				
Stem Material:	S31603 SST				
Ext Trim Material:	SST				
Seat Leakage Class:	FCI 70-2 CL-IV	Flow Direction:	Flow-Up		
Manufacturer:	*Fisher	Model:	By Vendor		

ACTUATOR

Actuator Type:	Pneumatic				
Valve Air Failure Position:	Fail Closed	Valve Function:	Modulating		
Type/Size:	GX/225	Travel:	20 mm (0.79")		
Actuator Orientation:	Vertical up	Spring action	Close		
Hand Wheel Type:	None	Position	N/A		
Air Failure Valve:	None	Set at	N/A		
Available Air Supply Pressure:					
Min:	105 psig	Max:	120 psig		
Allowable Pressure Requirements:					
Min:	58 psig	Max:	87 psig		
Bench Range:	N/A				
Required Stroke Time to Open:	N/A				
Required Stroke Time to Close:	N/A				
Manufacturer:	*Fisher				
Model:	By Vendor				

TAG NO.	LLW-FCV-1700	Flow Control Valves	DATA SHEET NO.	SHEET	OF
			FCV-1700	2	2

POSITIONER

Positioner Type:	DVC6200, Hart Communicating-HC
Input Signal:	4 to 20 mA dc
Access:	67CS T1411510012 Filter/Regulator
Relief:	Generant IRVD-4V-V-80-X w/o 0.312" orifice
Gauges:	0-160 psig
Action:	Direct
Manufacturer:	*Fisher

NOTES

Valves to be hydrotested tested in accordance with ANSI B16.34 or MSS SP-61 (Pressure Testing of Valves) and Leak Tested in accordance with FCI 70-2 for Class IV as a minimum. All dimensions are to be in accordance with ANSI B16.5 and B16.10 and MSS SP-72 (Ball Valves with Flanged or Butt-Welding Ends for General Service). Valves are to be certified Fire-Safe in accordance with API-607.

*Recommended Manufacturer

AECOM

Flow Control Valves

DATA SHEET NO.			REV.
FCV-1701			0
SHEET	OF	DATE	
1	2	1-17-13	

NO.	BY	DATE	REVISION

BY	CHK'D	PROC.	APPR.
AME	NCC		

P.O.	
REQ.	

Project:	RLWTF						
TAG NO:	LLW-FCV-1701	Spec No:	40 9200	Line / Vessel Number:	LLW-234		
Asset No:		P&ID:	D-6030	Line ID: 0.622"	Size: 0.5"	Schedule:	40
Service Description:	Tank TK-1706 Condensate Recycle			Manufacturer:	*Fisher		
				Model:	1/2" GX DVC6200 SS		
Safety Class	GS			Quality Assurance Level:	ML-4		

PROCESS CONDITIONS

Process Data Case:	Normal								Units:
Sizing Case:	Normal								-
Required Cv:	0 to 4								-
Travel:	N/A								-
Sound Pressure Level:	N/A								-
	Inlet:	Outlet:	Inlet:	Outlet:	Inlet:	Outlet:	Inlet:	Outlet:	
Liquid Flow:	5	5							gpm
Vapor Flow:	NA	NA							cfm
Temperature:	75	75							°F
Pressure:	45	45							psig
Density:	1.02								g/ml
Viscosity:	1.05								cP
Critical Pressure (Pseudo):	N/A								psia
Vapour Pressure:	N/A								psia
pH:	8.2								-
Specific Heat Ratio (C_P/C_V):	NA								-

Fluid:	LLW (contaminated water)	Max Temperature Upset:	125 °F	Inlet:	Outlet
Area Classification:		Max Upset Pressure (normal flow):			
Ambient Temperature Requirements:	55 to 95 °F	Max Upset Pressure (reverse flow):			

VALVE BODY / BONNET

Valve Type:	Globe Valve for Flow Control		
Body Size:	0.5"	ANSI Class:	150
Max Rated Pressure:	200 psi	Max Rated Temperature:	450 deg F
Body/Bonnet Material:	CF3M SST		
Liner Material / ID:	N/A		
Inlet Connection Face:	CL 150 Flange		
Outlet Connection Face:	CL 150 Flange		
Flange Face Finish:	Raise Face		
Bonnet Style:	Standard		
Lube Iso Valve:	No	Lube:	N/A
Packing Style:	Live Loaded PTFE V-Ring		
Packing Material:	Live Loaded PTFE		
Body/Bonnet Gasket Material:	N/A		
Manufacturer:	*Fisher		
Model:	By Vendor		

SWITCH

RELAY 1	Tag No:	N/A			
	Power Rating:	N/A	Type:	N/A	
	Alarm Setting	N/A			
RELAY 2	Tag No:	N/A			
	Power Rating:	N/A	Type:	N/A	
	Alarm Setting	N/A			
Sensor Type:	N/A	Contact Rating:	N/A		
Conduit Connection:	N/A				
Manufacturer:	N/A				
Model No.	N/A				
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1	5	IP2:	6

TRIM

TrimType:	Dual Seat				
Size:	0.5"	Travel	N/A		
Max. Rated Cv:	3.34	Fl:	N/A	Xt:	N/A
Characteristic:	Equal Percent				
Balanced/Unbalanced:	Unbalanced				
Plug Material:	S31603 SST				
Seat Ring Material:	CF3M SST				
Stem Material:	S31603 SST				
Ext Trim Material:	SST				
Seat Leakage Class:	FCI 70-2 CL-IV	Flow Direction:	Flow-Up		
Manufacturer:	*Fisher	Model:	By Vendor		

ACTUATOR

Actuator Type:	Pneumatic		
Valve Air Failure Position:	Fail Closed	Valve Function:	Modulating
Type/Size:	GX/225	Travel:	20 mm (0.79")
Actuator Orientation:	Vertical up	Spring action	Close
Hand Wheel Type:	None	Position	N/A
Air Failure Valve:	None	Set at	N/A
Available Air Supply Pressure:			
Min:	105 psig	Max:	120 psig
Allowable Pressure Requirements:			
Min:	58 psig	Max:	87 psig
Bench Range:	N/A		
Required Stroke Time to Open:	N/A		
Required Stroke Time to Close:	N/A		
Manufacturer:	*Fisher		
Model:	By Vendor		

TAG NO.	LLW-FCV-1701	Flow Control Valves	DATA SHEET NO.	SHEET	OF
			FCV-1701	2	2

POSITIONER

Positioner Type:	DVC6200, Hart Communicating-HC
Input Signal:	4 to 20 mA dc
Access:	67CS T14115T0012 Filter/Regulator
Relief:	Generant IRVD-4V-V-80-X w/o 0.312" orifice
Gauges:	0-160 psig
Action:	Direct
Manufacturer:	*Fisher

NOTES

Valves to be hydrotested tested in accordance with ANSI B16.34 or MSS SP-61 (Pressure Testing of Valves) and Leak Tested in accordance with FCI 70-2 for Class IV as a minimum. All dimensions are to be in accordance with ANSI B16.5 and B16.10 and MSS SP-72 (Ball Valves with Flanged or Butt-Welding Ends for General Service). Valves are to be certified Fire-Safe in accordance with API-607.

*Recommended Manufacturer

AECOM

Flow Control Valves

DATA SHEET NO.			REV.
FCV-1707			0
SHEET	OF	DATE	
1	2	1-17-13	

NO.	BY	DATE	REVISION

BY	CHK'D	PROC.	APPR.
AME	NCC		

P.O.	
REQ.	

Project:	RLWTF						
TAG NO:	LLW-FCV-1707	Spec No:	40 9200	Line / Vessel Number:	LLW-089		
Asset No:		P&ID:	D-6023	Line ID: 1.049"	Size: 1.0"	Schedule:	40
Service Description:	Tank TK-1707 Rotary Press Filtrate Recycle			Manufacturer:	*Fisher		
				Model:	1" GX DVC6200 SS		
Safety Class	GS	Quality Assurance Level:	ML-4				

PROCESS CONDITIONS

Process Data Case:	Normal								Units:
Sizing Case:	Normal								-
Required Cv:	0 to 14								-
Travel:	N/A								-
Sound Pressure Level:	N/A								-
	Inlet:	Outlet:	Inlet:	Outlet:	Inlet:	Outlet:	Inlet:	Outlet:	
Liquid Flow:	12	12							gpm
Vapor Flow:	NA	NA							cfm
Temperature:	75	75							°F
Pressure:	45	45							psig
Density:	1.02								g/ml
Viscosity:	1.05								cP
Critical Pressure (Pseudo):	N/A								psia
Vapour Pressure:	N/A								psia
pH:	10.8								-
Specific Heat Ratio (C_p/C_v):	NA								-

Fluid:	LLW (contaminated w ater)	Max Temperature Upset:	125 °F	Inlet:	Outlet
Area Classification:		Max Upset Pressure (normal flow):			
Ambient Temperature Requirements:	55 to 95 °F	Max Upset Pressure (reverse flow):			

VALVE BODY / BONNET

Valve Type:	Globe Valve for Flow Control		
Body Size:	1.0"	ANSI Class:	150
Max Rated Pressure:	200 psi	Max Rated Temperature:	450 deg F
Body/Bonnet Material:	CF3M SST		
Liner Material / ID:	N/A		
Inlet Connection Face:	CL 150 Flange		
Outlet Connection Face:	CL 150 Flange		
Flange Face Finish:	Raise Face		
Bonnet Style:	Standard		
Lube Iso Valve:	No	Lube:	N/A
Packing Style:	Live Loaded PTFE V-Ring		
Packing Material:	Live Loaded PTFE		
Body/Bonnet Gasket Material:	N/A		
Manufacturer:	*Fisher		
Model:	By Vendor		

SWITCH

RELAY 1	Tag No:	N/A			
	Pow er Rating:	N/A	Type:	N/A	
	Alarm Setting	N/A			
RELAY 2	Tag No:	N/A			
	Pow er Rating:	N/A	Type:	N/A	
	Alarm Setting	N/A			
Sensor Type:	N/A	Contact Rating:	N/A		
Conduit Connection:	N/A				
Manufacturer:	N/A				
Model No.	N/A				
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1	5	IP2:	6

TRIM

TrimType:	Dual Seat				
Size:	1.0"	Travel	N/A		
Max. Rated Cv:	13.7	Fl:	N/A	Xt:	N/A
Characteristic:	Equal Percent				
Balanced/Unbalanced:	Unbalanced				
Plug Material:	S31603 SST				
Seat Ring Material:	CF3M SST				
Stem Material:	S31603 SST				
Ext Trim Material:	SST				
Seat Leakage Class:	FCI 70-2 CL-IV	Flow Direction:	Flow-Up		
Manufacturer:	*Fisher	Model:	By Vendor		

ACTUATOR

Actuator Type:	Pneumatic		
Valve Air Failure Position:	Fail Closed	Valve Function:	Modulating
Type/Size:	GX/225	Travel:	20 mm (0.79")
Actuator Orientation:	Vertical up	Spring action	Close
Hand Wheel Type:	None	Position	N/A
Air Failure Valve:	None	Set at	N/A
Available Air Supply Pressure:			
Min:	105 psig	Max:	120 psig
Allow able Pressure Requirements:			
Min:	58 psig	Max:	87 psig
Bench Range:	N/A		
Required Stroke Time to Open:	N/A		
Required Stroke Time to Close:	N/A		
Manufacturer:	*Fisher		
Model:	By Vendor		

TAG NO.	LLW-FCV-1707	Flow Control Valves	DATA SHEET NO.	SHEET	OF
			FCV-1707	2	2

POSITIONER

Positioner Type:	DVC6200, Hart Communicating-HC
Input Signal:	4 to 20 mA dc
Access:	67CS T141151T0012 Filter/Regulator
Relief:	Generant IRVD-4V-V-80-X w/o 0.312" orifice
Gauges:	0-160 psig
Action:	Direct
Manufacturer:	*Fisher

NOTES

Valves to be hydrotested tested in accordance with ANSI B16.34 or MSS SP-61 (Pressure Testing of Valves) and Leak Tested in accordance with FCI 70-2 for Class IV as a minimum. All dimensions are to be in accordance with ANSI B16.5 and B16.10 and MSS SP-72 (Ball Valves with Flanged or Butt-Welding Ends for General Service). Valves are to be certified Fire-Safe in accordance with API-607.

*Recommended Manufacturer

AECOM

Flow Control Valves

DATA SHEET NO.			REV.
FCV-1719			0
SHEET	OF	DATE	
1	2	1-17-13	

NO.	BY	DATE	REVISION

BY	CHK'D	PROC.	APPR.
AME	NCC		

P.O.	
REQ.	

Project:	RLWTF						
TAG NO:	LLW-FCV-1719	Spec No:	40 9200	Line / Vessel Number:	LLW-179		
Asset No:		P&ID:	D-6027	Line ID: 1.049"	Size: 1.0"	Schedule:	40
Service Description:	Tank TK-1703 Decant Recycle			Manufacturer:	*Fisher		
				Model:	1" GX DVC6200 SS		
Safety Class	GS			Quality Assurance Level:	ML-4		

PROCESS CONDITIONS

Process Data Case:	Normal									Units:
Sizing Case:	Normal									-
Required Cv:	0 to 14									-
Travel:	N/A									-
Sound Pressure Level:	N/A									-
	Inlet:	Outlet:	Inlet:	Outlet:	Inlet:	Outlet:	Inlet:	Outlet:		
Liquid Flow:	12	12								gpm
Vapor Flow:	NA	NA								cfm
Temperature:	75	75								°F
Pressure:	45	45								psig
Density:	1.02									g/ml
Viscosity:	1.05									cP
Critical Pressure (Pseudo):	N/A									psia
Vapour Pressure:	N/A									psia
pH:	10.8									-
Specific Heat Ratio (C_P/C_V):	NA									-

Fluid:	LLW (contaminated w ater)	Max Temperature Upset:	125 °F	Inlet:	Outlet
Area Classification:		Max Upset Pressure (normal flow):			
Ambient Temperature Requirements:	55 to 95 °F	Max Upset Pressure (reverse flow):			

VALVE BODY / BONNET

Valve Type:	Globe Valve for Flow Control		
Body Size:	1.0"	ANSI Class:	150
Max Rated Pressure:	200 psi	Max Rated Temperature:	450 deg F
Body/Bonnet Material:	CF3M SST		
Liner Material / ID:	N/A		
Inlet Connection Face:	CL 150 Flange		
Outlet Connection Face:	CL 150 Flange		
Flange Face Finish:	Raise Face		
Bonnet Style:	Standard		
Lube Iso Valve:	No	Lube:	N/A
Packing Style:	Live Loaded PTFE V-Ring		
Packing Material:	Live Loaded PTFE		
Body/Bonnet Gasket Material:	N/A		
Manufacturer:	*Fisher		
Model:	By Vendor		

SWITCH

RELAY 1	Tag No:	N/A			
	Pow er Rating:	N/A	Type:	N/A	
	Alarm Setting	N/A			
RELAY 2	Tag No:	N/A			
	Pow er Rating:	N/A	Type:	N/A	
	Alarm Setting	N/A			
Sensor Type:	N/A	Contact Rating:	N/A		
Conduit Connection:	N/A				
Manufacturer:	N/A				
Model No.	N/A				
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1	5	IP2:	6

TRIM

TrimType:	Dual Seat				
Size:	1.0"	Travel	N/A		
Max. Rated Cv:	13.7	Fl:	N/A	Xt:	N/A
Characteristic:	Equal Percent				
Balanced/Unbalanced:	Unbalanced				
Plug Material:	S31603 SST				
Seat Ring Material:	CF3M SST				
Stem Material:	S31603 SST				
Ext Trim Material:	SST				
Seat Leakage Class:	FCI 70-2 CL-IV	Flow Direction:	Flow-Up		
Manufacturer:	*Fisher	Model:	By Vendor		

ACTUATOR

Actuator Type:	Pneumatic				
Valve Air Failure Position:	Fail Closed	Valve Function:	Modulating		
Type/Size:	GX/225	Travel:	20 mm (0.79")		
Actuator Orientation:	Vertical up	Spring action	Close		
Hand Wheel Type:	None	Position	N/A		
Air Failure Valve:	None	Set at	N/A		
Available Air Supply Pressure:					
Min:	105 psig	Max:	120 psig		
Allow able Pressure Requirements:					
Min:	58 psig	Max:	87 psig		
Bench Range:	N/A				
Required Stroke Time to Open:	N/A				
Required Stroke Time to Close:	N/A				
Manufacturer:	*Fisher				
Model:	By Vendor				

TAG NO.	LLW-FCV-1719	Flow Control Valves	DATA SHEET NO.	SHEET	OF
			FCV-1719	2	2

POSITIONER

Positioner Type:	DVC6200, Hart Communicating-HC
Input Signal:	4 to 20 mA dc
Regulator:	67CS T14115T0012 Filter/Regulator
Relief:	Generant IRVD-4V-V-80-X w/o 0.312" orifice
Gauges:	0-160 psig
Action:	Direct
Manufacturer:	*Fisher

NOTES

Valves to be hydrotested tested in accordance with ANSI B16.34 or MSS SP-61 (Pressure Testing of Valves) and Leak Tested in accordance with FCI 70-2 for Class IV as a minimum. All dimensions are to be in accordance with ANSI B16.5 and B16.10 and MSS SP-72 (Ball Valves with Flanged or Butt-Welding Ends for General Service). Valves are to be certified Fire-Safe in accordance with API-607.

*Recommended Manufacturer

AECOM

Level Control Valves

DATA SHEET NO.			REV.
LCV-1124			0
SHEET	OF	DATE	
1	2	1-17-13	

NO.	BY	DATE	REVISION

BY	CHK'D	PROC.	APPR.
AME	NCC		

P.O.

REQ.

Project: RLWTF

TAG NO: LLW-LCV-1124

Spec No:	40 9200	Line / Vessel Number:	LLW-167				
Asset No:	P&ID:	D-6012	Line ID:	1.610"	Size:	1.5"	Schedule: 40
Service Description:	Tank TK-1101 Reacted Influent Discharge	Manufacturer:	*Fisher				
		Model:	1-1/2" GX DVC6200 SS				
Safety Class	GS	Quality Assurance Level:	ML-4				

PROCESS CONDITIONS

Process Data Case:	Normal									Units:
Sizing Case:	Normal									-
Required Cv:	0 to 30									-
Travel:	N/A									-
Sound Pressure Level:	N/A									-
	Inlet:	Outlet:	Inlet:	Outlet:	Inlet:	Outlet:	Inlet:	Outlet:		
Liquid Flow:	36.6	36.6								gpm
Vapor Flow:	NA	NA								cfm
Temperature:	75	75								°F
Pressure:	45	45								psig
Density:	1.02									g/ml
Viscosity:	1.05									cP
Critical Pressure (Pseudo):	N/A									psia
Vapour Pressure:	N/A									psia
pH:	10.8									-
Specific Heat Ratio (C_p/C_v):	NA									-

Fluid:	LLW (contaminated w ater)	Max Temperature Upset:	125 °F	Inlet:	Outlet
Area Classification:		Max Upset Pressure (normal flow):			
Ambient Temperature Requirements:	55 to 95 °F	Max Upset Pressure (reverse flow):			

VALVE BODY / BONNET

Valve Type:	Globe Valve for Flow Control		
Body Size:	1.5"	ANSI Class:	150
Max Rated Pressure:	200 psi	Max Rated Temperature:	450 deg F
Body/Bonnet Material:	CF3M SST		
Liner Material / ID:	N/A		
Inlet Connection Face:	CL 150 Flange		
Outlet Connection Face:	CL 150 Flange		
Flange Face Finish:	Raise Face		
Bonnet Style:	Standard		
Lube Iso Valve:	No	Lube:	N/A
Packing Style:	Live Loaded PTFE V-Ring		
Packing Material:	Live Loaded PTFE		
Body/Bonnet Gasket Material:	N/A		
Manufacturer:	*Fisher		
Model:	By Vendor		

SWITCH

RELAY 1	Tag No:	N/A			
	Pow er Rating:	N/A	Type:	N/A	
	Alarm Setting	N/A			
RELAY 2	Tag No:	N/A			
	Pow er Rating:	N/A	Type:	N/A	
	Alarm Setting	N/A			
Sensor Type:	N/A	Contact Rating:	N/A		
Conduit Connection:	N/A				
Manufacturer:	N/A				
Model No.	N/A				
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1	5	IP2:	6

TRIM

TrimType:	Dual Seat				
Size:	1.5"	Travel	N/A		
Max. Rated Cv:	27.2	Fl:	N/A	Xt:	N/A
Characteristic:	Equal Percent				
Balanced/Unbalanced:	Unbalanced				
Plug Material:	CF3M SST				
Seat Ring Material:	CF3M SST				
Stem Material:	S31603 SST				
Ext Trim Material:	SST				
Seat Leakage Class:	FCI 70-2 CL-IV	Flow Direction:	Flow-Up		
Manufacturer:	*Fisher	Model:	By Vendor		

ACTUATOR

Actuator Type:	Pneumatic		
Valve Air Failure Position:	Fail Closed	Valve Function:	Modulating
Type/Size:	GX/225	Travel:	20 mm (0.79")
Actuator Orientation:	Vertical up	Spring action	Close
Hand Wheel Type:	None	Position	N/A
Air Failure Valve:	None	Set at	N/A
Available Air Supply Pressure:			
Min:	105 psig	Max:	120 psig
Allow able Pressure Requirements:			
Min:	58 psig	Max:	87 psig
Bench Range:	N/A		
Required Stroke Time to Open:	N/A		
Required Stroke Time to Close:	N/A		
Manufacturer:	*Fisher		
Model:	By Vendor		

TAG NO.	LLW-LCV-1124	Level Control Valves	DATA SHEET NO.	SHEET	OF
			LCV-1124	2	2

POSITIONER

Positioner Type:	DVC6200, Hart Communicating-HC
Input Signal:	4 to 20 mA dc
Access:	67CFR Filter/Regulator
Gauges:	0-160 psig
Action:	Direct
Manufacturer:	*Fisher

NOTES

Valves to be hydrotested tested in accordance with ANSI B16.34 or MSS SP-61 (Pressure Testing of Valves) and Leak Tested in accordance with FCI 70-2 for Class IV as a minimum. All dimensions are to be in accordance with ANSI B16.5 and B16.10 and MSS SP-72 (Ball Valves with Flanged or Butt-Welding Ends for General Service). Valves are to be certified Fire-Safe in accordance with API-607.

*Recommended Manufacturer

AECOM

On/Off Control Valves

DATA SHEET NO.			REV.
SOV-5409			A
SHEET	OF	DATE	
1	1	1-17-13	
BY	CHK'D	PROC.	APPR.
AME	NCC		
P.O.			
REQ.			

NO.	BY	DATE	REVISION

Project:	RLWTF						
TAG NO:	CA-SOV-5409	Spec No:	40 9200	Line / Vessel Number:	CA-102		
Asset No:		P&ID:	D-6012	Line ID: 0.622"	Size: 0.5"	Schedule:	40
Service Description:	P-1701 Compressed Air Supply Valve			Manufacturer:	*ASCO		
				Model:	8223 Series 8223G010		
Safety Class	GS	Quality Assurance Level:	ML-4				

PROCESS CONDITIONS

Process Data Case:	Normal						Units:
Sizing Case:	Normal						-
Fluid:	Air						-
Required Cv:	2.6 to 3.8						-
	Min.	Oper.	Max.				
Temperature:	55	75	95				°F
Pressure:	105	105 to 120	120				psig
Compressibility (Z):	N/A						-
Area Classification:	N/A						-
Ambient Temp. Requirements:	55 to 95 °F						-

SOLENOID

Tag No:	HS-1701 (SOV-5409)	Fluid:	Air		
Type:	2-Way	Coil:	Class F		
Coil Insulation:	Epoxy	Watt Rating:	22.6		
Voltage:	24V dc				
Power Wiring:	Loop	Signal Type:	N/A		
Communication Protocol:	N/A	Location:	N/A		
Smart:	No	Indicate:	No	Isolate:	No
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1	5	IP2:	6
Main Valve Action when Coil is Deenergized:	Close				
Conduit Connection:	1/2" NPT				
Body Material:	Stainless Steel				
Manufacturer:	*ASCO	Model:	8223 Series		

NOTES

*Recommended Manufacturer

AECOM

On/Off Control Valves

DATA SHEET NO.			REV.
SOV-5410			A
SHEET	OF	DATE	
1	1	1-17-13	

NO.	BY	DATE	REVISION

BY	CHK'D	PROC.	APPR.
AME	NCC		

P.O.	
REQ.	

Project:	RLWTF						
TAG NO:	CA-SOV-5410	Spec No:	40 9200	Line / Vessel Number:	CA-108		
Asset No:		P&ID:	D-6025	Line ID:	0.622"	Size: 0.5"	Schedule: 40
Service Description:	P-1702 Compressed Air Supply Valve			Manufacturer:	*ASCO		
				Model:	8223 Series: 8223G010		
Safety Class	GS			Quality Assurance Level:	ML-4		

PROCESS CONDITIONS

Process Data Case:	Normal					Units:
Sizing Case:	Normal					-
Fluid:	Air					-
Required Cv:	2.6 to 3.8					-
	Min.	Oper.	Max.			
Temperature:	55	75	95			°F
Pressure:	105	105 to 120	120			psig
Compressibility (Z):	N/A					-
Area Classification:	N/A					-
Ambient Temp. Requirements:	55 to 95 °F					-

SOLENOID

Tag No:	HS-1702 (SOV-5410)	Fluid:	Air		
Type:	2-Way	Coil:	Class F		
Coil Insulation:	Epoxy	Watt Rating:	22.6		
Voltage:	24V dc				
Power Wiring:	Loop	Signal Type:	N/A		
Communication Protocol:	N/A	Location:	N/A		
Smart:	No	Indicate:	No	Isolate:	No
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1:	5	IP2:	6
Main Valve Action when Coil is Deenergized:	Close				
Conduit Connection:	1/2" NPT				
Body Material:	Stainless Steel				
Manufacturer:	*ASCO	Model:	8223 Series		

NOTES

*Recommended Manufacturer

END OF SECTION

SECTION 40 9400

PROCESS CONTROL HARDWARE AND SOFTWARE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. This section includes the specification for development of the Process Control Hardware and Software.

B. It is the intent of this section to procure, install, connect, and configure the select Process Control Hardware and Software as necessary and as shown in the system drawings. Some equipment controls are specified in other portions of the subcontract documents. It is the responsibility of the bidder to read and conform to all sections of this specification, review all subcontract drawings of all divisions, and coordinate with all equipment suppliers of material specified under other sections of this specification.

C. The engineering, installation, supervision, startup, and checkout necessary for the process control hardware and software shall be provided under this section.

D. Provide the necessary materials and manpower to participate in the testing, adjusting, and balance of the commissioning process as required by those sections of this specification.

E. Process Control Hardware and Software

1. Programmable Logic Controllers.
2. Distributed Process Control Systems.
3. Commercial Off-the-Shelf (COTS) Programming Software.

1.2 RELATED SECTIONS

A. Section 01 2500, "Substitution Procedures."

B. Section 01 4000, "Quality Requirements."

C. Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

D. Section 01 6000, "Product Requirements."

E. Section 01 8116, "Facility Environmental Requirements."

F. Section 13 4800, "Sound, Vibration, and Seismic Control."

1.3 ABBREVIATIONS AND ACRONYMS, DEFINITIONS, AND REFERENCES

A. Refer to Section 01 4200, "Abbreviations and Acronyms, Definitions, and References."

B. Drawing C55864, Sheet E-6140, "Control System Block Diagram."

1.4 SUBMITTALS

A. Provide the following in accordance with the requirements of Exhibit I and the timeline specified.

1. Before Fabrication:

a. Documentation of International Organization for Standardization (ISO 9001) certification (if applicable).

b. Provide a copy of the Quality Assurance Plan identifying procurement, design, fabrication, test and inspection, material traceability, and nonconformity controls for approval by Los Alamos National Laboratory (LANL) prior to Contract award.

c. Catalog cut sheets on process control hardware and software, which show performance characteristics, dimensions, material of fabrication, and other characteristics necessary to ensure conformity with the design requirements.

d. Manufacturer's assembly drawings, wiring diagrams, and electrical schematics for process control hardware. To include general arrangement of all cabinet configurations and junction box configurations.

e. Provide functional test procedure.

f. Support plan that outlines part availability and product line availability. Identify which product lines to be supplied are available for 5 years or more. Identify if parts are "off-the-shelf".

2. Before Shipment:

a. Certificates of Conformance (COC) for process control hardware attesting that items are in accordance with specified requirements.

b. Detailed installation instructions for process control hardware.

c. Listing of configuration parameters.

d. Functional test report for process control hardware

e. Manufacturer's operating procedures, including safety and troubleshooting procedures, for process control software.

f. Manufacturer's maintenance procedures, including service schedules, recommended spare parts, and warranties, for process control hardware

g. Storage and handling procedure: long term storage, humidity trimming, temperature conditioning, shelf life limits.

3. With Shipment:

a. Evidence of nationally recognized testing laboratory (NRTL) or Underwriters Laboratories, Inc. (UL) listing or labeling for process control hardware.

b. Each shipment container shall include a packing list of all items contained in that shipment container. Also, a copy of each packing list shall be sent to the LANL Subcontractor Technical Representative (STR).

1.5 QUALITY ASSURANCE

A. Seller's Quality Assurance Requirements:

1. Work Identified in this section shall be done under a Quality Assurance Program in accordance with Section 01 4000, "Quality Requirements."

B. Receipt Inspection:

1. Generally, all equipment and accessories installed under this subcontract shall be inspected by the subcontractor in the presence of the LANL Startup and Commissioning Representative and approved before acceptance. The subcontractor shall be responsible for all repairs as required.

2. Upon receipt, process control hardware and software will be visually inspected by a qualified Subcontractor Quality Control Inspector for any damage or abnormalities that could affect their performance in accordance with the Quality Assurance Program.

3. Documentation will be reviewed by qualified Subcontractor Quality Control Inspector to determine that the required documentation as specified in Paragraph 1.4 is present and traceable to the process control hardware.

C. Storage and Handling:

1. In addition to the requirements in Section 01 6000, "Product Requirements," comply with the following requirements:

   a. Vendor shall comply with Section 01 4000, "Quality Requirements," The supplied equipment specified in this document shall be considered Level B for the shipping, handling, and storage requirements listed below.

   b. Vendor shall prepare, pack, handle, load, ship, and store all materials and equipment for shipment in accordance with Section 01 4000, "Quality Requirements."

   c. Vendor shall be responsible for any damage resulting from improper packing until acceptance. Subcontractor shall inspect all materials upon receipt.

   d. Each shipment container shall include a packing list of all items contained in that shipment container. Also, a copy of each packing list shall be sent to the LANL Subcontractor Technical Representative (STR).

   e. Vendor shall be responsible for providing any special devices needed for the delivery of any equipment and/or material.

   f. Vendor shall define any heating, air conditioning, humidity control, or other storage criteria for equipment that is to be installed for regular use or is intended to be used as spare.

   g. Vendor shall define long-term storage limits and maintenance procedures that are required to ensure these limits.

   h. Vendor shall define shelf-life limits of all supplied equipment.

   i. All openings shall be capped, plugged, or otherwise sealed against the intrusion or water, dirt, and debris. Water shall be removed from cavities to protect against damage caused by freezing and desiccant inserted, if appropriate.

D. Personnel Qualification:

1. Personnel installing and configuring process control hardware and software shall be familiar with type of hardware, and required installation practices. Refer to Vendor's Quality Assurance Plan for additional requirements for personnel qualification

E. Nonconformance:

1. Nonconformance of hardware and software shall be documented and corrected before shipment. If found on receipt, nonconformance shall be documented and corrected before installation at the expense of the subcontractor in accordance with Section 01 4000, "Quality Requirements."

F. Electrical Suitability:

1. All controllers and hardware shall be UL- or NRTL-listed or labeled.

2. Branch-Circuit Conductors. The branch-circuit conductors supplying one or more units of a data processing system shall have an ampacity not less than 125 percent of the total connected load [*National Electrical Code* (NEC) (NFPA 70, Article 645.5)].

3. Automatic Data Processing systems will be grounded in accordance with the mandatory power-grounding requirements of the NEC (NFPA 70, Article 250).

G. Commercial-Off-The-Shelf (COTS) Software:

1. Subcontractor shall provide Commercial-Off-The-Shelf embedded and utility software, tools, and drivers that are standard to the vendor's product line.

2. COTS software shall consist of system utilities, compliers, and associated libraries.

3. COTS software shall be controlled in accordance with the vendor's Quality Assurance Plan.

1.6 ENVIRONMENT REQUIREMENTS

A. Design the process components to operate at a design altitude of 7,500 ft above sea level and in the general environmental conditions specified in Section 01 8116, "Facility Environmental Requirements." Seismic requirements are located in Section 13 4800, "Sound, Vibration, and Seismic Control."

B. For compatibility issues, additional component-specific process conditions are listed on the data sheets (Attachments 1 through 10) and can include exposure to process streams with H_2SO_4, NaOH, $Fe_2(SO_4)_3$, and $MgSO_4$.

1.7 RECORDS

A. Furnish complete operating instruction, and maintenance literature.

B. Record drawings shall be provided, as required, by the general Contract requirements. Record drawings shall not be completed until after installation is complete. Any changes made during installation shall be recorded as redlines on the approved shop drawings as they are made. Redline drawings shall be available at all times for inspection by the LANL STR. At completion of the project, all hand-drawn field changes shall be incorporated into a clean

reproducible set of as-built drawings. These as-built drawings shall be provided to LANL electronically (current AutoCAD format) and used during the training sessions.

1.8 TESTING

A. Process control hardware software shall be subjected to clean-build test wherein the delivered configuration is verified to include all necessary hardware versions, software versions, firmware versions, additional patches, drivers, etc., keys, dongles required for the hardware to function.

1.9 TRAINING

A. Provide 40 hours of training to include a high-level description of the process control hardware to familiarize operator personnel.

B. Provide 200 hours startup support to LANL operating personnel. Support functions to include troubleshooting, point verification, performance trending.

1.10 SERVICE AND WARRANTY

A. For process control hardware provide one-year warranty including travel costs.

B. If manufacturer has a standard warranty that exceeds one year then the longer warranty shall be provided.

1.11 ENERGY CONSERVATION

A. Computers and monitors shall be energy star certified.

PART 2 PRODUCTS

2.1 PRODUCT OPTIONS AND SUBSTITUTIONS

A. Refer to Section 01 2500, "Substitution Procedures."

B. Select a PLC that is capable of communicating with new and existing equipment as depicted on Drawing C55864, Sheet E-6140 "Control System Block Diagram."

2.2 PROGRAMMABLE LOGIC CONTROLLERS

A. Chassis Manufacturer: Allen Bradley

1. 1756-A4 (4 slots).
2. 1756-A7 (7 slots).
3. 1756-A13 (13 slots).

B. Processor Manufacturer: Allen Bradley

1. 1756-L73.

C. Power Supply Manufacturer: Allen Bradley

1. 1756-PA75.
2. 85-265V.
3. 5 volt at 13 amperes.

2.3 DISTRIBUTED PROCESS CONTROL SYSTEMS

A. Distributed Process Control System Manufacturer: Dell.

1. Server model PowerEdge 415.
2. 8-Port CAT5 KVM Switch, Belkin F1DP108A.
3. Server Interface Module, Belkin F1DP101A-AU.
4. Rack mount console with touchpad, keyboard and 17"LCD Dell 1U KMM.

B. Workstations Manufacturer: Dell.

1. Workstation model OptiPlex Workstation 390.
2. Dell E Series E2213 22-inch Widescreen Flat Panel Monitor.
3. All-in-one printer copier scanner Epson Stylus NX515.
4. Dell 56K Internal Modem

2.4 COMMERCIAL OFF THE SHELF SOFTWARE

A. Logic Program Manufacturer: Allen Bradley

1. RS Logix 5000.

B. Human Machine Interface software Manufacturer: Allen Bradley

1. FactoryTalk View SE.

C. Communication Server: Allen Bradley

1. RSLinx Enterprise.
2. RSLinx Classic.

D. Paging Software:

1. Win911 Pro

PART 3 EXECUTION

3.1 GENERAL

A. Provide all control devices, conduit, wiring, etc. as specified in PART 2 and the cabinet/junction box layout drawings:

1. Drawing C55864, Sheets E-5110A and E-5110B, "CAB-101 Panel Layout."
2. Drawing C55864, Sheet sE-5111A and E-5111B, "CAB-102 Panel Layout."
3. Drawing C55864, Sheet E-5115, "IJB-101 Panel Layout."
4. Drawing C55864, Sheet E-5115, "IJB-102 Panel Layout."
5. Drawing C55864, Sheet E-5115, "IJB-103 Panel Layout."
6. Drawing C55864, Sheet E-5115, "IJB-104 Panel Layout."
7. Drawing C55864, Sheet E-5115, "IJB-105 Panel Layout."
8. Drawing C55864, Sheet E-5115, "IJB-106 Panel Layout."
9. Drawing C55864, Sheet E-5115, "IJB-107 Panel Layout."
10. Drawing C55864, Sheets E-5129A and E-5129B, "CAB-100 Panel Layout."
11. Drawing C55864, Sheet E-7120, "Cable Schedules."
12. Drawing C55865, Sheets E-5210A and E-5210B, "CAB-103 Panel Layout."

B. Drawing C55867, Sheets E-5413A and E-5413B, "CAB-104 Panel Layout."Install all aspects of the system in compliance with all applicable codes, regulations, and all related Subcontract documents.

C. Install all materials in accordance with the published manufacturer's recommendations without exception.

D. Where miscellaneous materials are required to complete an installation, supply the materials as defined in the relevant section of this specification. Install them under this section of this specification, unless otherwise noted.

E. Coordinate with other trades where installation of a particular component requires other trades to be involved.

F. All signal wiring requiring shielding shall have the shield terminated at the controller end only. Trim and insulate the shield wire at the device end.

G. Label all wiring with permanent labels indicating the point device identifier. Install a phenolic label mounted at the device indicating the device type and point identifier name.

H. Label all field devices with 1-in. by 3 in. phenolic labels. Labels shall include the point name and device name. Labels shall be glued, attached with screws, or stainless wire in the case of valves.

3.2 HARDWARE

A. Monitoring and Control Networks

1. Cabled Process Control Networks

a. Work under this section includes installation and troubleshooting of new equipment. Install equipment in a manner recommended by the manufacturer based on the environment, communications speed requirements, and distance.

b. Route wiring to minimize interference with equipment and personnel. Wiring should be neat and hidden as much as practical and as appropriate for an office.

c. Affix phenolic label onto device. Label content shall match unique equipment ID number shown on design prints.

d. All exposed terminals that carry greater than 24V dc shall be covered.

e. All monitors shall be configured to "sleep" after ten minutes of non-use.

PART 4 ATTACHMENTS

A. Attachment 1 – ControlLogix Chassis Data Sheet.
B. Attachment 2 – ControlLogix Controller Data Sheet.
C. Attachment 3 – ControlLogix Power Supply Data Sheet.
D. Attachment 4 – ControlLogix I/O Modules Data Sheet.
E. Attachment 5 – RS Logix 5000 Data Sheet.
F. Attachment 6 – RS FactoryTalk View SE Data Sheet.
G. Attachment 7 – RS FactoryTalk View SE System Requirements.
H. Attachment 8 – HMI Server Data Sheet.
I. Attachment 9 – HMI Workstation Data Sheet.
J. Attachment 10 – All-In-One Printer Copier Scanner Data Sheet.
K. Attachment 11 – Win911 Paging Software.

ControlLogix Chassis Data Sheet

Technical Data

Allen-Bradley

1756 ControlLogix Chassis Specifications

Catalog Numbers 1756-A4/B, 1756-A7/B, 1756-A10/B, 1756-A13/B, 1756-A17/B, 1756-A4LXT, 1756-A5XT, 1756-A7LXT, 1756-A7XT

Topic	Page
Standard ControlLogix Chassis Specifications	2
ControlLogix-XT Chassis Specifications	3
Spacing Requirements	5
ControlLogix Chassis with Standard Power Supplies Mounting Dimensions	6
ControlLogix Chassis with Redundant Power Supplies Mounting Dimensions	10
ControlLogix Chassis Accessories	12
Additional Resources	13

The ControlLogix® system is a modular system that requires a 1756 ControlLogix chassis. All of the chassis are designed for horizontal-only, back-panel mounting. Place any module into any slot. The backplane provides a high-speed communication path between modules.

AutoCAD product drawings are available at http://www.rockwellautomation.com/en/e-tools/drawings.html.

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Rockwell Automation

Standard ControlLogix Chassis Specifications

The chassis backplane provides a high-speed communication path between modules and distributes power to each of the modules within the chassis.

Table 1 - Technical Specifications - ControlLogix Standard Chassis

Attribute	1756-A4	1756-A7	1756-A10	1756-A13	1756-A17
Backplane current, chassis/slot max @ 1.2V DC	1.5 A/-				
Backplane current, chassis/slot max @ 3.3V DC	4 A/4 A				
Backplane current, chassis/slot max @ 5.1V DC	15 A/6 A				
Backplane current, chassis/slot max @ 24V DC	2.8 A/2.8 A				
Power dissipation, max	4 W	4.5 W	5 W	5.4 W	6 W
Isolation voltage	Determined by installed power supply and modules				
Slots	4	7	10	13	17
Mounting method	Horizontal only				
Cabinet size (HxWxD), min	50.8 x 50.8 x 20.3 cm (20 x 20 x 8 in.)	50.8 x 60.9 x 20.3 cm (20 x 24 x 8 in.)	50.8 x 76.2 x 20.3 cm (20 x 30 x 8 in.)	60.9 x 76.2 x 20.3 cm (24 x 30 x 8 in.)	76.2 x 91.4 x 20.3 cm (30 x 36 x 8 in.)
Weight, approx	0.75 kg (1.7 lb)	1.10 kg (2.4 lb)	1.45 kg (3.2 lb)	1.90 kg (4.2 lb)	2.20 kg (4.8 lb)
Location	Panel				
Wire size	Functional Earth Ground - 8.3 mm^2 (8 AWG) solid or stranded copper wire rated at 90 °C (194 °F) or greater Protective Earth Ground - 2.1 mm^2 (14 AWG) solid or stranded copper wire rated at 90 °C (194 °F) or greater				
North American temperature code	T5				
IEC temperature code	T6				
Enclosure type rating	None (open-style)				

Table 2 - Environmental Specifications - ControlLogix Standard Chassis

Attribute	1756-A4, 1756-A7, 1756-A10, 1756-A13, 1756-A17
Temperature, operating IEC 60068-2-1 (Test Ad, Operating Cold), IEC 60068-2-2 (Test Bd, Operating Dry Heat), IEC 60068-2-14 (Test Nb, Operating Thermal Shock)	0…60 °C (32…140 °F)
Temperature, surrounding air	60 °C (140 °F)
Temperature, nonoperating IEC 60068-2-1 (Test Ab, Unpackaged Nonoperating Cold), IEC 60068-2-2 (Test Bb, Unpackaged Nonoperating Dry Heat), IEC 60068-2-14 (Test Na, Unpackaged Nonoperating Thermal Shock)	-40…85 °C (-40…185 °F)
Relative humidity IEC 60068-2-30 (Test Db, Unpackaged Damp Heat)	5…95% noncondensing
Vibration IEC 60068-2-6 (Test Fc, Operating)	2 g @ 10…500 Hz
Shock, operating IEC 60068-2-27 (Test Ea, Unpackaged Shock)	30 g
Shock, nonoperating IEC 60068-2-27 (Test Ea, Unpackaged Shock)	50 g
Emissions	CISPR 11: Group 1, Class A
ESD immunity IEC 61000-4-2	6 kV contact discharges 8 kV air discharges
Radiated RF immunity IEC 61000-4-3	10V/m with 1 kHz sine-wave 80% AM from 80... 2000 MHz 10V/m with 200 Hz 50% Pulse 100% AM @ 900 MHz 10V/m with 200 Hz 50% Pulse 100% AM @ 1890 MHz 3V/m with 1 kHz sine-wave 80% AM from 2000…2700 MHz

Table 3 - Certifications - ControlLogix Standard Chassis

Certification[1]	1756-A4, 1756-A7, 1756-A10, 1756-A13, 1756-A17
c-UL-us	UL Listed Industrial Control Equipment, certified for US and Canada. See UL File E65584. UL Listed for Class I, Division 2 Group A,B,C,D Hazardous Locations, certified for U.S. and Canada. See UL File E194810.
CSA	CSA Certified Process Control Equipment. See CSA File LR54689C. CSA Certified Process Control Equipment for Class I, Division 2 Group A,B,C,D Hazardous Locations. See CSA File LR69960C.
FM	FM Approved Equipment for use in Class I Division 2 Group A,B,C,D Hazardous Locations
CE	European Union 2004/108/EC EMC Directive, compliant with: • EN 61326-1; Meas./Control/Lab., Industrial Requirements • EN 61000-6-2; Industrial Immunity • EN 61000-6-4; Industrial Emissions • EN 61131-2; Programmable Controllers (Clause 8, Zone A & B)
C-Tick	Australian Radiocommunications Act, compliant with: AS/NZS CISPR 11; Industrial Emissions
Ex	European Union 94/9/EC ATEX Directive, compliant with: EN 60079-15; Potentially Explosive Atmospheres, Protection "n" EN 60079-0; General Requirements II 3 G Ex nA IIC T6 X
KC	Korean Registration of Broadcasting and Communications Equipment, compliant with: Article 58-2 of Radio Waves Act, Clause 3

(1) When marked. See the Product Certification link at http://www.ab.com for Declarations of Conformity, Certificates, and other certification details.

ControlLogix-XT Chassis Specifications

The ControlLogix-XT™ chassis support extreme temperature environments. The chassis are conformally coated for increased survivability in ISA G3 environments.

Table 4 - Technical Specifications - ControlLogix-XT Chassis

Attribute	1756-A4LXT	1756-A7LXT	1756-A5XT	1756-A7XT
Backplane current, chassis/slot max @ 1.2V DC	1.5 A/-			
Backplane current, chassis/slot max @ 3.3V DC	4 A/4 A			
Backplane current, chassis/slot max @ 5.1V DC	10 A/6 A			
Backplane current, chassis/slot max @ 24V DC	2 A/2 A			
Power dissipation, max	3.7 W	4.1 W	4.4 W	4.4 W
Isolation voltage	Determined by installed power supply and modules			
Slots	4	7	5	7
Mounting method	Horizontal only			
Cabinet size (HxWxD), min	50.8 x 50.8 x 20.3 cm (20 x 20 x 8 in.)	50.8 x 60.9 x 20.3 cm (20 x 24 x 8 in.)	50.8 x 76.2 x 20.3 cm (20 x 30 x 8 in.)	50.8 x 76.2 x 20.3 cm (20 x 30 x 8 in.)
Weight, approx.	0.75 kg (1.7 lb)	1.1 kg (2.4 lb)	1.45 kg (3.2 lb)	1.45 kg (3.2 lb)
Location	Panel			
Wire size	Functional Earth Ground - 8.3 mm^2 (8 AWG) solid or stranded copper wire rated at 90 °C (194 °F) or greater Protective Earth Ground - 2.1 mm^2 (14 AWG) solid or stranded copper wire rated at 90 °C (194 °F) or greater			
North American temperature code	T5			T4A
IEC temperature code	T5			T4
Enclosure type rating	None (open-style)			
Isolation voltage	Determined by installed power supply and modules			

Table 5 - Environmental Specifications - ControlLogix-XT Chassis

Attribute	1756-A4LXT, 1756-A7LXT	1756-A5XT, 1756-A7XT
Temperature, operating IEC 60068-2-1 (Test Ad, Operating Cold), IEC 60068-2-2 (Test Bd, Operating Dry Heat), IEC 60068-2-14 (Test Nb, Operating Thermal Shock)	-25…60 °C (-13…140 °F)	-25…70 °C (-13…158 °F)
Temperature, surrounding air	60 °C (140 °F)	70 °C (158 °F)
Temperature, nonoperating IEC 60068-2-1 (Test Ab, Unpackaged Nonoperating Cold), IEC 60068-2-2 (Test Bb, Unpackaged Nonoperating Dry Heat), IEC 60068-2-14 (Test Na, Unpackaged Nonoperating Thermal Shock)	-40…85 °C (-40…185 °F)	
Relative humidity IEC 60068-2-30 (Test Db, Unpackaged Damp Heat)	5…95% noncondensing	
Vibration IEC 60068-2-6 (Test Fc, Operating)	2 g @ 10…500 Hz	
Shock, operating IEC 60068-2-27 (Test Ea, Unpackaged Shock)	30 g	
Shock, nonoperating IEC 60068-2-27 (Test Ea, Unpackaged Shock)	50 g	
Emissions	CISPR 11: Group 1, Class A	
ESD immunity IEC 61000-4-2	6 kV contact discharges 8 kV air discharges	
Radiated RF immunity IEC 61000-4-3	10V/m with 1 kHz sine-wave 80% AM from 80... 2000 MHz 10V/m with 200 Hz 50% Pulse 100% AM @ 900 MHz 10V/m with 200 Hz 50% Pulse 100% AM @ 1890 MHz 3V/m with 1 kHz sine-wave 80% AM from 2000...2700 MHz	

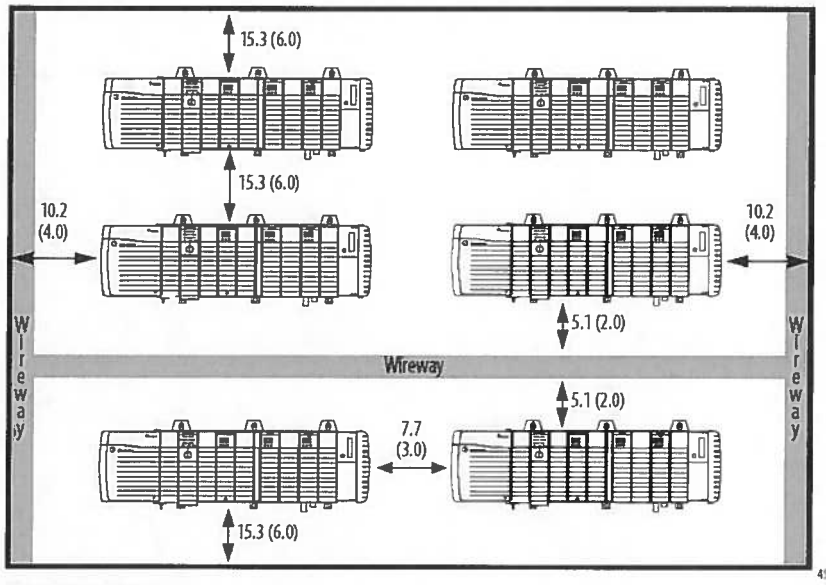
Table 6 - Certifications - ControlLogix-XT Chassis

Certification[1]	1756-A4LXT, 1756-A5XT, 1756-A7LXT	1756-A7XT
c-UL-us	UL Listed Industrial Control Equipment, certified for US and Canada. See UL File E65584. UL Listed for Class I, Division 2 Group A,B,C,D Hazardous Locations, certified for U.S. and Canada. See UL File E194810.	
CE	European Union 2004/108/EC EMC Directive, compliant with: • EN 61326-1; Meas./Control/Lab., Industrial Requirements • EN 61000-6-2; Industrial Immunity • EN 61000-6-4; Industrial Emissions • EN 61131-2; Programmable Controllers (Clause 8, Zone A & B)	
C-Tick	Australian Radiocommunications Act, compliant with: AS/NZS CISPR 11; Industrial Emissions	
Ex	European Union 94/9/EC ATEX Directive, compliant with: • EN 60079-15; Potentially Explosive Atmospheres, Protection "n" • EN 60079-0; General Requirements • II 3 G Ex nA IIC T5 X	European Union 94/9/EC ATEX Directive, compliant with: • EN 60079-15; Potentially Explosive Atmospheres, Protection "n" • EN 60079-0; General Requirements • II 3 G Ex nA IIC T4 X
KC	Korean Registration of Broadcasting and Communications Equipment, compliant with: Article 58-2 of Radio Waves Act, Clause 3	

(1) When marked. See the Product Certification link at http://www.ab.com for Declarations of Conformity, Certificates, and other certification details.

Spacing Requirements

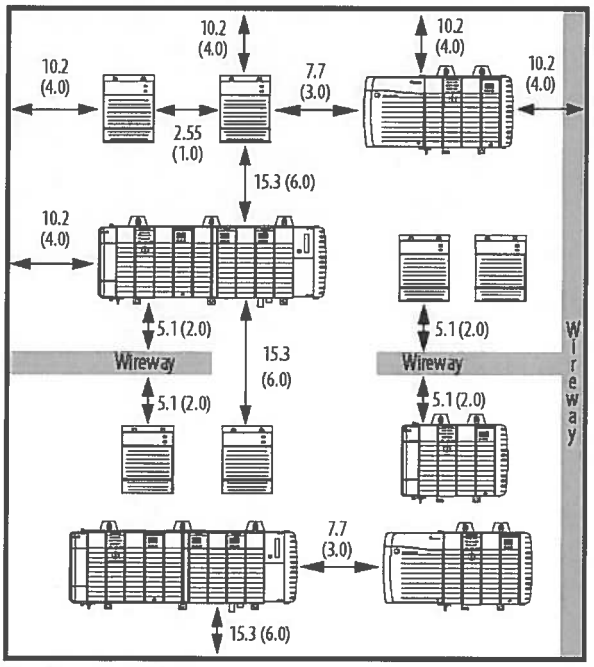
When you mount a ControlLogix chassis with a standard power supply in an enclosure, follow these spacing requirements.



The 10.2 (4.0) measurement to the side of the enclosure can include the wireway.

Dimensions are in cm (in.).

When you mount a ControlLogix chassis with a redundant power supply and a chassis adapter module in an enclosure, follow these spacing requirements.



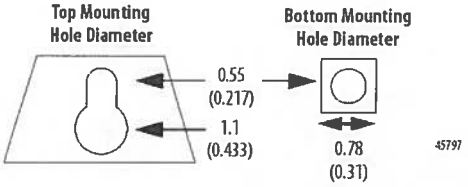
The 10.2 (4.0) measurement to the side of the enclosure can include the wireway only on the right side of the chassis.

Dimensions are in cm (in.).

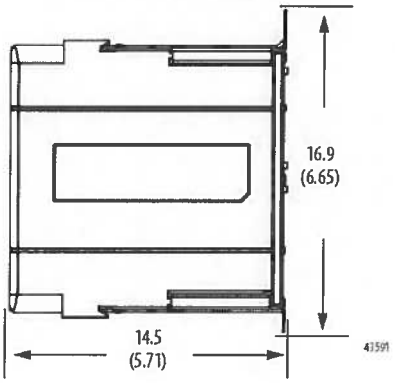
ControlLogix Chassis with Standard Power Supplies Mounting Dimensions

Dimensions are in cm (in.).

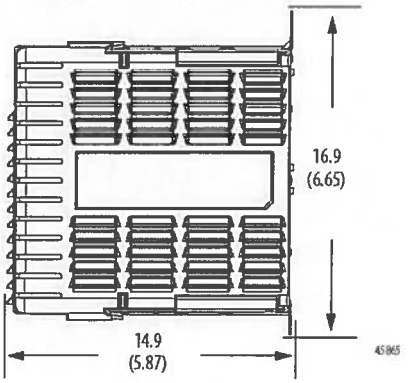
Chassis Common Dimensions



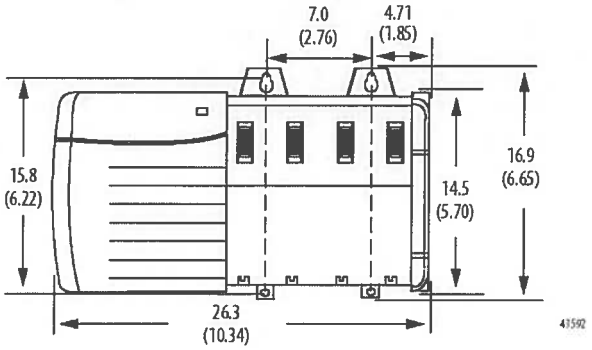
Right-side View of All Standard Chassis



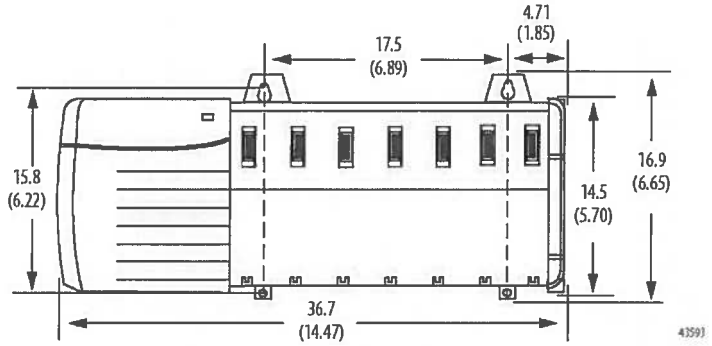
Right-side View of All ControlLogix-XT Chassis



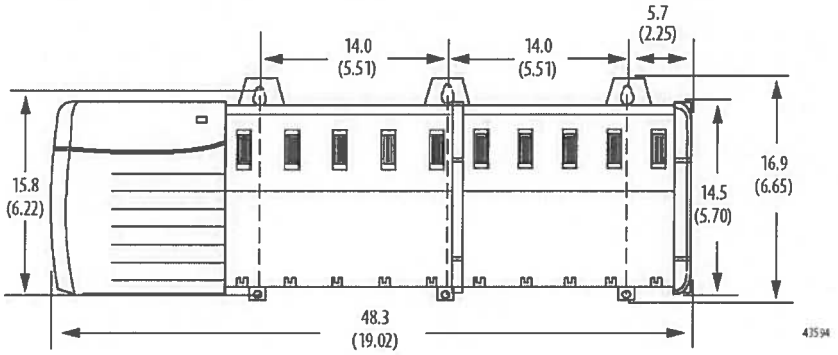
1756-A4 Chassis and Power Supply



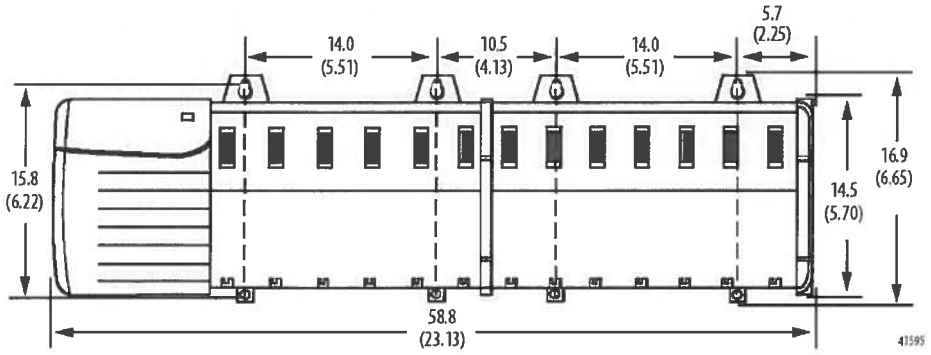
1756-A7 Chassis and Power Supply



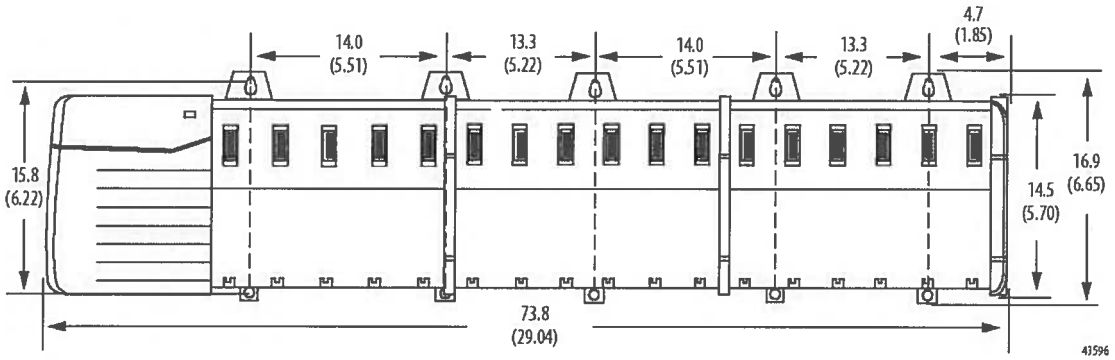
1756-A10 Chassis and Power Supply



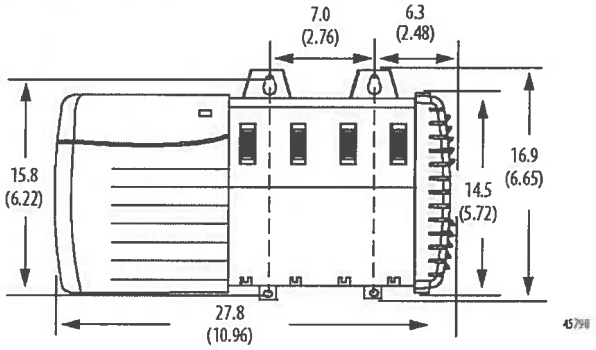
1756-A13 Chassis and Power Supply



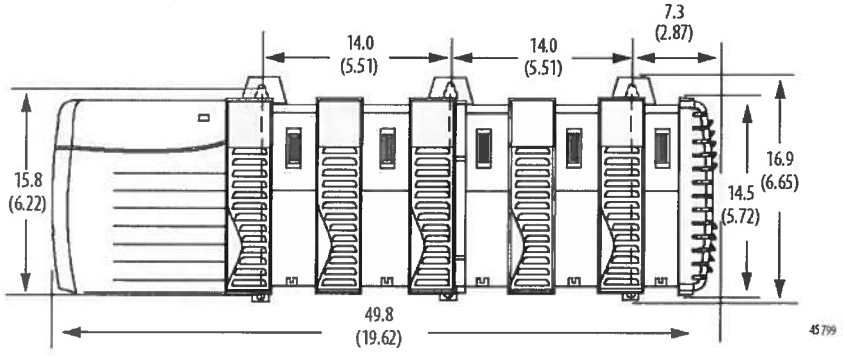
1756-A17 Chassis and Power Supply



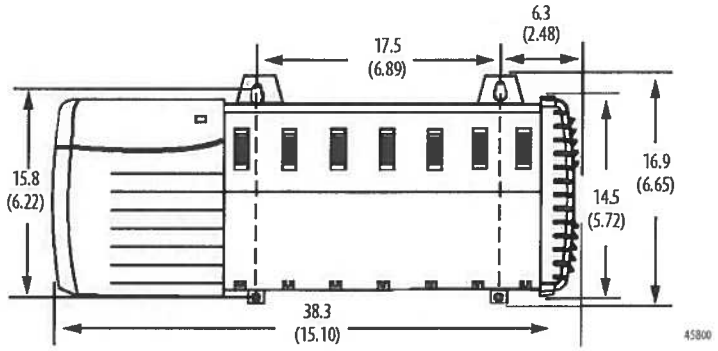
1756-A4LXT Chassis and Power Supply



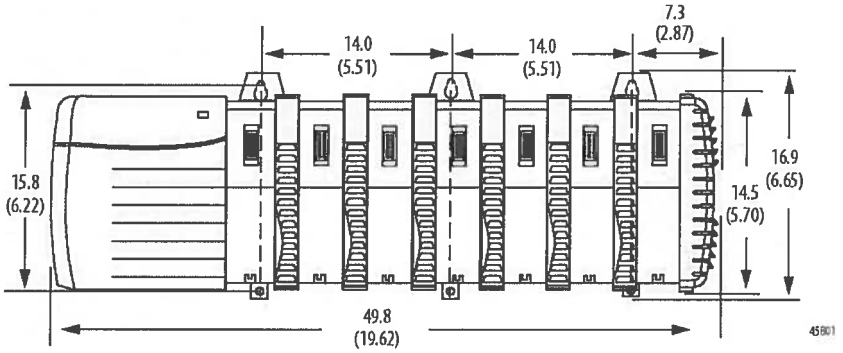
1756-A5XT Chassis and Power Supply



1756-A7LXT Chassis and Power Supply



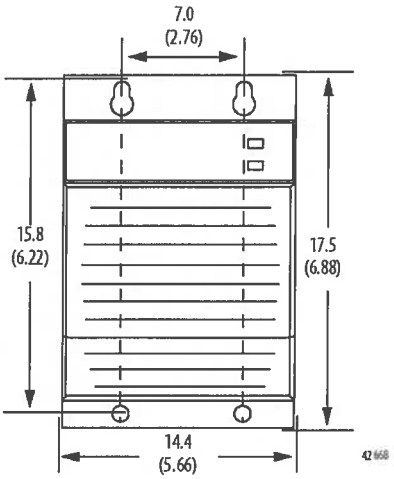
1756-A7XT Chassis and Power Supply

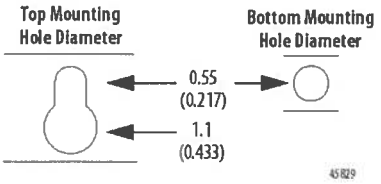


ControlLogix Chassis with Redundant Power Supplies Mounting Dimensions

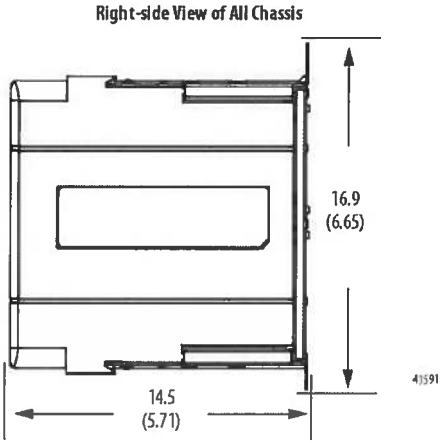
Dimensions are in cm (in.).

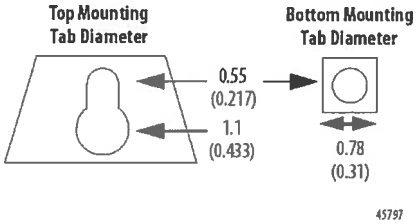
Redundant Power Supplies



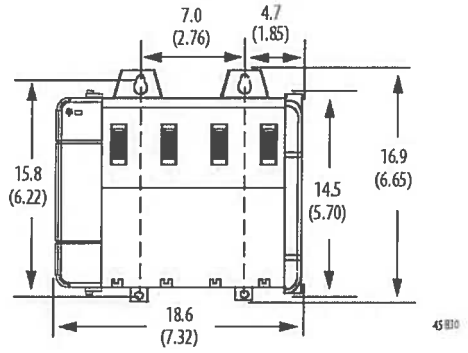


Chassis Common Dimensions

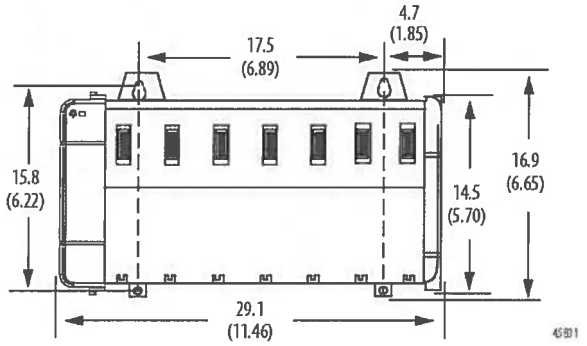




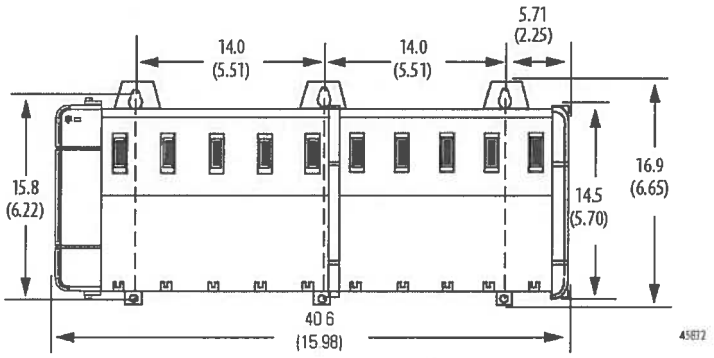
1756-A4 Chassis and Chassis Adapter Module



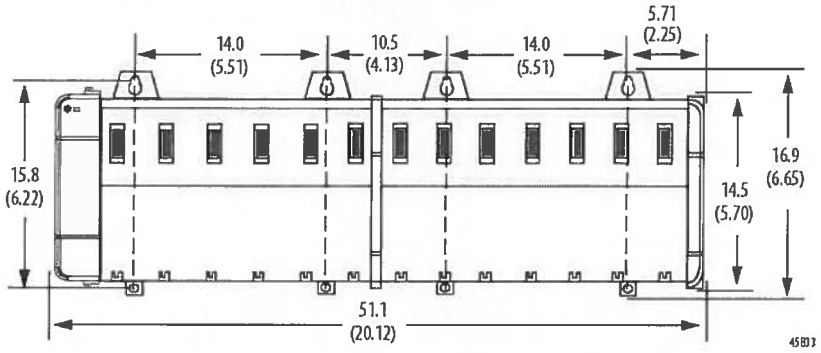
1756-A7 Chassis and Chassis Adapter Module



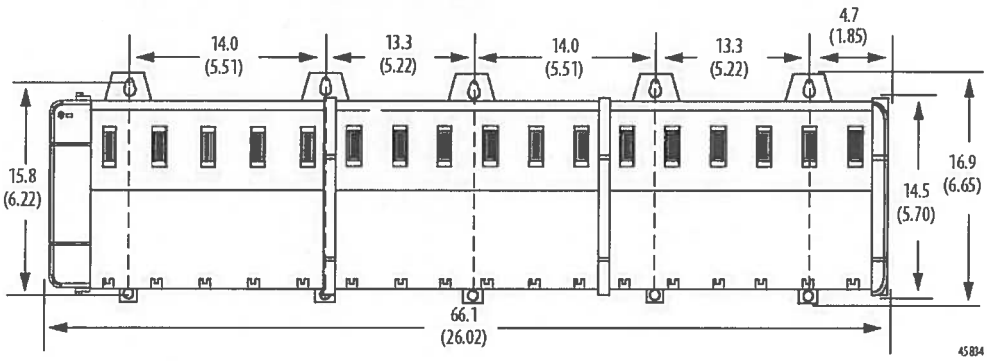
1756-A10 Chassis and Chassis Adapter Module



1756-A13 Chassis and Chassis Adapter Module



1756-A17 Chassis and Chassis Adapter Module



ControlLogix Chassis Accessories

Use a slot filler module to fill empty slots.

Cat. No.	Description
1756-N2	Slot filler module for empty slots in standard ControlLogix chassis
1756-N2XT	Slot filler module for empty slots in ControlLogix-XT chassis

Additional Resources

These documents contain additional information concerning related products from Rockwell Automation.

Resource	Description
ControlLogix Selection Guide, publication 1756-SG001	Provides overview of the ControlLogix system and its products.
ControlLogix Power Supplies Specifications Technical Data, publication 1756-TD005	Provides technical specifications for ControlLogix power supplies.
ControlLogix System User Manual, publication 1756-UM001	Provides information on how to install, configure, program, and use ControlLogix controllers.
Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1	Provides general guidelines for installing a Rockwell Automation® industrial system.
Product Certifications website, http://www.ab.com	Provides declarations of conformity, certificates, and other certification details.

You can view or download publications at http://www.rockwellautomation.com/literature/. To order paper copies of technical documentation, contact your local Allen-Bradley® distributor or Rockwell Automation sales representative.

Important User Information

Solid-state equipment has operational characteristics differing from those of electromechanical equipment. Safety Guidelines for the Application, Installation and Maintenance of Solid State Controls (publication SGI-1.1 available from your local Rockwell Automation sales office or online at http://www.rockwellautomation.com/literature/) describes some important differences between solid-state equipment and hard-wired electromechanical devices. Because of this difference, and also because of the wide variety of uses for solid-state equipment, all persons responsible for applying this equipment must satisfy themselves that each intended application of this equipment is acceptable.

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Publication 1756-TD006C-EN-E - January 2012
Supersedes Publication 1756-TD006B-EN-E - June 2010

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ControlLogix Controller Data Sheet

Technical Data

1756 ControlLogix Controllers Specifications

ControlLogix Controller Catalog Numbers
1756-L61, 1756-L62, 1756-L63, 1756-L64, 1756-L65, 1756-L72, 1756-L73, 1756-L74, 1756-L75

GuardLogix Controller Catalog Numbers
1756-L61S, 1756-L62S, 1756-L63S, 1756-LSP

ControlLogix-XT Controller Catalog Number
1756-L63XT

ControlLogix Redundancy Catalog Numbers
1756-RM, 1756-RMXT

Memory Card Catalog Numbers
1784-CF64, 1784-CF128, 1784-SD1, 1784-SD2

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