

SECTION 15104
TECHNICAL EQUIPMENT COOLING WATER PIPING,
EQUIPMENT AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this Section.

1.2 SUMMARY

- A. This Section includes a variety of "secondary" cooling water-loops that assist in removing process heat rejected through the technical equipment "primary" cooling side of the heat exchanging process. For primary cooling systems description, see Section 15130, "Stainless Steel Piping Systems-Activated Cooling Water".

Secondary closed-loop cooling systems include piping, pump, filters, sterilizers, valves, heat exchangers, hydronic specialties, such as: air separator, expansion tank, and control accessories as required. Secondary cooling water systems are as follows:

1. De-ionized (DI) cooling water services to various primary-loop cooling systems. Such DI water systems are dedicated, "closed-loop" circuits designed to circulate low conductivity de-ionized cooling water between primary and secondary systems.
 2. Glycol solution cooling water service to each 402.5 MHz Klystron. The addition of "glycol solution" to the "closed-loop" cooling water system is designed to protect against temperature extremes, treat to prevent corrosion and lubricate all moving parts such as pumps. The assembly to administer glycol to the system shall be part of each closed-loop cooling system that may include but not limited to: piping, valves, injection tank and all essential support elements to facilitate the addition of glycol.
- B. Related Sections include the following:
1. Division 15, Section 15050, "Piping Systems".
 2. Division 15, Section 15072, "Cleaning".
 3. Division 15, Section 15073, "Pressure/Leak Testing".
 4. Division 15, Section 15074, "Identification and Labeling".
 5. Division 15, Section 15075, "Disinfection".
 6. Division 15, Section 15100, "Valves".
 7. Division 15, Section 15130, "Stainless Steel Piping Systems-Activated Cooling Water".
 8. Division 15, Section 15185, "Hydronic Pumps".
 9. Division 15, Section 15250, "Mechanical Insulation".
 10. Division 18, Section 18100, "General Welding Requirements".

1.3 REFERENCES

- A. AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)
1. ASME, Section VIII, Division I (1998) ASME Construction Requirements for Pressure Vessels.
- B. NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)
1. NFPA 70 (1999) National Electrical Code (NEC).
- C. OCCUPATIONAL SAFETY and HAZARDS ASSOCIATION (OSHA)
1. OSHA Regulation 1910.7.

1.4 SUBMITTALS

- A. Product Data (For each component indicated): Include rated capacities of equipment and accessories; shipping, installed and operating weights; furnished specialties; and accessories. Indicate dimensions, required clearances, methods of assembly of components, and piping and wiring connections.
- B. Submit six (6) of the following to the Construction Manager:
 - 1. Design Data: Indicate in sufficient detail to verify that products meet or exceed specified requirements.
 - 2. Certificates: Certify that products meet or exceed specified requirements.
 - 3. Manufacturer's Instructions: Indicate installation and support requirements.
 - 4. Shop drawings: Provide large-scale (Scale of $\frac{1}{4}$ " = 1'-0" minimum) layout drawings, indicating all relevant equipment and routing of piping. Shop drawings shall be "spool" type that includes all connection joints, fittings, hangers, supports and details.
 - 5. Coordination Drawings: Include relationship to other services that serve same work areas.
 - 6. Certificates of Shop Inspection and Data Report: As required by ASME Boiler and Pressure Vessel Code.
 - 7. Operation and Maintenance Data: For all skid mounted assemblies of equipments, such as Pump Skid assemblies and Water Filter/Polish Skid assemblies to include in the Operating and Maintenance (O&M) manuals as specified in General and Supplementary Conditions.

1.5 QUALITY ASSURANCE

- A. Product Options: Drawings indicate size, profiles, and dimensional requirements of equipment and accessories and are based on specific types and models indicated. Other products with equal performance characteristics, made by specified manufacturers, may be considered.
- B. Provide listing/approval stamp, label, or other marking on equipment made to specified standards.
- C. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing laboratory," as defined in OSHA Regulation 1910.7.
- D. Comply with ASME Section VIII, Division 1 Code Requirements for Unfired Pressure Vessels, for 125 PSI (860 kPa) working pressure.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store equipment and large accessories on factory-installed shipping skids with protective wrapping over all components, and small accessories in factory-fabricated fiberboard containers.

1.7 DI WATER PRODUCTION PROCESS EQUIPMENTS

- A. Pump-Skid assembly: Size and capacity as shown on drawings. Assembly connections and all interfaces shall be complete for installation and include but not limited to the following:
 - 1. Supply and return piping and fittings.
 - 2. Suitable isolation valves and trim.
 - 3. Circulating Pump(s).
 - 4. Pump Vibration Isolation.
 - 5. Expansion Tank.

6. Air Separator.
 7. Heat Exchanger.
 8. High-Point Air Vents and Low-Point Drains.
 9. Sampling Ports.
 10. Hangers & Supports.
 11. Accessories.
 12. Glycol-Injection Tank (where applicable).
- B. Water Filter / Polish Skid Assembly: Deionized (DI) water Filter / Polish assembly: Size and capacity as shown on drawings. Assembly connections and all interfaces shall be complete for installation and include but not limited to the following:
1. Supply and return piping and fittings.
 2. Suitable isolation valves and trim.
 3. Mixed Bed Deionizer canisters (Removable).
 4. Inline monitors.
 5. Filters with suitable Filter housings (Exchangeable).
 6. Ultraviolet (Sterilizer) water treatment assemblies
 7. High-Point Air Vents and Low-Point Drains.
 8. Sampling Ports (for Resistivity & Temperature).
 9. Hangers & Supports.
 10. Accessories.
- C. DI Distribution Piping System: See Section 1.2A, Paragraph 1 & 2 for definition of specific systems for the facility.
1. Piping systems.
 2. Fittings.
 3. Valves.
 4. Hangers & Supports.
 5. Accessories and Trim.
 6. High-Point Air Vents and Low-Point Drains.
 7. Glycol injection tank.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Equipment Performance Criteria: Information regarding the requirements of products.
- B. Equipment Construction Criteria: Information regarding the materials of construction of products.
- C. Miscellaneous Criteria: Any other requirement of the products listed, including code references and other supplemental information.
- D. Manufacturers Criteria: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following listed in this Specification.
- E. Product specifications are included for all components utilized throughout the various project tasks. Many skid assemblies have variations. Refer to flow diagrams for specific equipment to be supplied with each skid.

2.2 DI PUMP SKID(S)

- A. Supplier is to coordinate access to the area in which a specific skid mounted equipment is to be installed. Skid assembly design shall allow easy disassembly and re-assembly as required to allow access through available size of doors, hatches, elevators or area-ways to the building in which the equipment are to be installed
- B. Pumps:
1. Performance:
 - a. For pump performance see Equipment Pump Schedules on drawings and specifications as defined in Division 15, Section 15185 "Hydronic Pumps".
 2. Construction:
 - a. Materials for all "wetted-parts" for the DI water system shall be 304L or 316L Stainless Steel construction.
 - b. Provide vibration isolators as required for the specific size of pumps within the skid assembly. Pump assembly of less than three(3) horsepower may utilize suitable Neoprene pads. No pump assemblies of more than three (3) horsepower size to be attached to the pump-skid structure without suitable spring type vibration isolation.
 - c. Pumps provided shall be of an ANSI Standard Dimensional Pump.
- C. Plate/Frame Heat Exchanger:
1. Design: Plate type heat exchanger shall be designed and constructed in accordance with ASME Section VIII, Division 1, requirements for pressure and temperature.
 2. ASME Code certification label shall be provided.
 3. Construction:
 - a. Plates and gaskets: Plates shall be fabricated of Type 304 stainless steel conforming to ASTM A 240 and pressed into one piece with a port punched in each corner for inlet and outlet connections. A boundary gasket fabricated of Buna or natural rubber shall be fitted in a track around the periphery of the plate. The ports shall also be fitted with gaskets. Metal plates shall be corrugated to improve heat transfer and eliminate stagnant areas.
 - b. Plate carrying members and compression bolts and nuts: Carrying members shall be designed to hold the plates in proper alignment and maintain even gasket compression to ensure uniform flow across the heat transfer surface. Frame and compression bolts shall be designed to accommodate the number of plates required under the design conditions plus 25 percent more. All guide bars shall be stainless steel clad with carbon steel bolts.
 - c. End Covers: Fixed and movable end covers shall be provided containing flanges welded to covers for inlet and outlet fluid connections. Drains and vents shall be provided. Fixed and movable covers shall be provided with a lifting eye. Movable cover shall be provided with a pulling eye. Inlet and outlet nozzles shall be Type 304 stainless steel with 150 lb. ANSI rated flanges (B16.5). All nozzles shall be installed to the fixed cover to allow maintenance of heat exchanger without disconnecting pipe. Inlet and outlet nozzles shall be sized for 125 percent of the design conditions.
 4. Tests: The following shop tests shall be performed on the heat exchanger prior to shipment to the job site. The Owner's Representative may elect to witness any or all of these tests. At least 7 days advance notice of all tests shall be given to the Owner's Representative. Each heat exchanger shall be hydrostatically tested with water to 1-1/2 times the maximum allowable working pressure. Minimum period under test at full pressure shall be 2 hours. Pump Skids shall be hydrostatically tested at the factory after final assembly and shipped to the job site fully assembled.
 5. Painting: Painting will not be required for parts of equipment manufactured of or coated with corrosion-resistant materials, that are machine finished and normally left unpainted, or that are subject to abrasion. All other parts of equipment and ferrous

surfaces shall be painted with an epoxy base paint applied over thoroughly prepared and primed surface. Machine finished parts not painted or not manufactured of corrosion-resistant materials shall be coated with a rust inhibiting compound that can be removed easily at installation by hand wiping.

- D. Expansion Tanks
 - 1. Performance:
 - a. Pressurized, Diaphragm type, capacity as scheduled.
 - 2. Construction:
 - a. Body: 304L Stainless Steel.
 - b. Internal: EPDM Diaphragm.
 - c. Domed Bottom with Leg Stands.
 - 3. Miscellaneous:
 - a. Expansion Tank shall be designed and constructed in accordance with ASME Section VIII, Division 1, requirements for pressure and temperature and bear the appropriate code label. Expansion tank shall be rated for 125 PSIG pressure and shall be complete with pressure gauge, pressure-relief valve, and automatic drain.
 - b. Accessories: Include with Automatic Air Vent.
- E. Air Separators.
 - 1. Performance:
 - a. Remove air from system.
 - b. Maximum pressure drop through units of 3 psig.
 - 2. Construction:
 - a. Conical-shaped, centrifugal airline separators.
 - b. Body & Internal Materials: 304L Stainless Steel.
 - 3. Miscellaneous:
 - a. Equip with water-removal tap and drain.
- F. Accessories and trim:
 - 1. General: Include accessories with working-pressure rating not less than system pressure at location where used, and compatible with equipment and piping system used.
 - 2. Refer to Section 2.4 and system flow diagrams as indicated on drawings. .
 - 3. For Pump Skid assemblies PS-KL-05 and PS-RF-02, provide a Glycol Injection Tank as specified in section 2.4F, and as shown on respective Flow Diagrams.

2.3 DI WATER FILTER / POLISH SKID(S)

- A. Supplier is to coordinate access to the area in which a specific skid mounted equipment is to be installed. Skid assembly design shall allow easy disassembly and re-assembly as required to allow access through available size of doors, hatches, elevators or area-ways to the building in which the equipment are to be installed.
- B. Mixed Beds Deionizers.
 - 1. Performance:
 - a. Resin type, 5-gpm capacities per bottle.
 - 2. Construction.
 - a. Industrial grade resin, unless otherwise shown.
 - b. Fiberglass casing with hose connections on top.
 - 3. Miscellaneous:
 - a. Group mixed bed resin bottle packs in parallel based on flow requirements.
- C. Pre-Filters.
 - 1. Performance:

- a. 10 micron filtration capacity
 2. Construction:
 - a. Mechanical-separation type filters in sizes and ratings indicated.
 - b. Equip with deflector plates.
 - c. Resin-impregnated-ribbon-type filters with edge filtration.
 - d. Cartridge-type.
 - e. Housing:
 - 1) 304L Stainless Steel, Brushed Finish.
 - 2) Leg Stands.
 3. Miscellaneous:
 - a. Provide drain cock for drain-down.
 - b. Install filters in parallel based on equal-flow requirements.
 - c. Filters shall be tested in accordance with ASME B&PV Code Section VIII, Division I requirements.
- D. Final Filters.
1. Performance:
 - a. 1-micron filtration capacity.
 2. Construction:
 - a. Mechanical-separation type filters in sizes and ratings indicated.
 - b. Equip with deflector plates.
 - c. Resin-impregnated-ribbon-type filters with edge filtration.
 - d. Cartridge-type.
 - e. Housing:
 - 1) 304L Stainless Steel, Bushed Finish.
 - 2) Leg Stands.
 3. Miscellaneous:
 - a. Provide drain cock for drain-down.
 - b. Install in parallel based on flow requirements.
 - c. As per ASME B&PV Code Section VIII, Division I.
- E. Resin Traps.
1. Performance:
 - a. 5-micron capacity.
 - b. Remove potential down-stream shedding of resin from mixed beds.
 2. Construction:
 - a. Mechanical-separation type filters in sizes and ratings indicated.
 - b. Equip with deflector plates.
 - c. Resin-impregnated-ribbon-type filters with edge filtration.
 - d. Cartridge-type.
 - e. Housing:
 - 1) 304L Stainless Steel, Brushed Finish.
 - 2) Leg Stands.
 3. Miscellaneous:
 - a. Provide drain cock for drain-down.
 - b. Install in parallel based on flow requirements.
 - c. As per ASME B&PV Code Section VIII, Division I.
- F. Ultraviolet Treatment:
1. Performance: Provide bacteria destruction.
 2. Construction:
 - a. Material: 316L Stainless Steel for all wetted parts.
 - b. Output: 254 nm
 - c. Electrical: 120 VAC
 - d. Accessories: LED display, intensity meter, running time hour meter in a 304 Stainless Steel NEMA 4 enclosure

- e. Protection: Over-temperature thermistor.
- f. Capacity suited to flow rates shown on the flow diagrams indicated on drawings.

G. Accessories & Trim:

- 1. General: Include accessories with working-pressure rating not less than system pressure at location where used, and compatible with equipment and piping system used.
- 2. Refer to Section 2.4 and dedicated system flow diagrams as indicated on drawings.

2.4 DI DISTRIBUTION PRODUCTS

A. Piping Systems: As defined in Section 1.2 A.

- 1. All DI water piping systems assembled as a "skid-package" unit shall be constructed of all 304L Stainless Steel, with all welded or grooved components. Skid-assembly interface connections with facility piping systems shall be flanged.
- 2. All DI water piping systems installed within the Target Building shall be all 304L Stainless Steel with all welded components. Skid-assembly connections with facility piping systems shall be flanged.
- 3. Distribution products installed anywhere else in the various buildings throughout the facility where this specification is enforced:
 - a. For sizes 2" and smaller, ASTM B88, Type L, Drawn-Temper copper tubing may be used instead of 304L Stainless Steel.
 - b. For sizes 2" and smaller, .049 wall, Schedule 5, 304L Stainless Steel with "press-fit" joints may be substituted as an option
- 4. Distribution products installed anywhere else in the various buildings throughout the facility where this specification is enforced:
 - a. For sizes 2½" and larger: ASTM 312 or ASTM 358, Schedule 10 Electric Resistance Welded (ERW) 304L Stainless Steel, Class 4 shall be used.

B. Piping Fittings: As defined in Section 1.2A and restricted in Section 2.4 par. A2 for fittings to be installed in the Target Building.

- 1. Copper pressure fittings: ASME 16.18, cast copper-alloy solder-joint type or wrought copper solder-joint type conforming to ASME/ANSI B16.22.
- 2. Solder joints: Use ASTM B813, water-flushable, lead-free flux; and ASTM B 32, lead-free alloy-solder, unless otherwise indicated.
- 3. Welded or Grooved Stainless steel fittings: ASTM A403, Grade WP-S304L or WP-W304L, Elbows: Standard 1.5x radius.
- 4. Grooved Couplings and Flanges: Ductile iron conforming to ASTM A-536, galvanized.
- 5. Flexible Connectors: Braided Stainless Steel with Threaded or Flanged End Connections.
- 6. Dielectric flange connections: Water impervious insulation barrier capable of limiting galvanic current to one percent of short circuit current in a corresponding bimetallic joint. Insulation barrier shall be able to withstand a 600-volt breakdown test when dry. Provide at all connections of dissimilar metals.
- 7. Reducer: Concentric-type.

C. Valves: Under the definitions established for piping above, classifications remain for valves.

<u>Shutoff</u>	<u>Size</u>	<u>Number</u>	<u>End type</u>
Ball (Bronze)	½" to 2"	V-6469	Soldered
Ball (SS)	½" to 3"	V-1181&-1181A	Flanged
Ball (SS)	½" to 2"	V-6177	Vic-Press 304
Butterfly (SS)	4" & larger	V-6489&-6489A	Wafer / Flanged
Butterfly (SS)	2½" & 12"	V-6477	Grooved

<u>Check</u>	<u>Size</u>	<u>Number</u>	<u>End type</u>
Swing (Bronze)	½" to 2"	V-1163	Soldered
Swing (SS)	2½" & larger	V-6115	Socket Weld
<u>Control/Balance</u>	<u>Size</u>	<u>Number</u>	<u>End type</u>
Ball (Bronze)	½" to 2"	V-6469	Soldered
Ball (SS)	½" to 3"	V-1181	Flanged
Globe (SS)	2½" & larger	V-1118	Flanged
<u>Press.Relief</u>	<u>Size</u>	<u>Number</u>	<u>End type</u>
Globe (SS)	1½" & 3"	V-512	Screwed
Globe (DI or Brz)	4" & larger	V-512	Flanged

- D. Hangers & Supports:
1. Piping 10" and Larger: Mounted on rollers.
- E. Accessories & Trim:
1. Pete's Plugs:
 - a. Stainless Steel with Neoprene Valve Core.
 - b. ¼" or ½" NPT End Connections.
 2. Basket Strainers:
 - a. Body: Stainless Steel.
 - b. Seals: EPDM.
 - c. Screen: Stainless Steel, 30 mesh.
 - d. End Connections: 2" and Under Union, 3" and Larger Flanged.
 3. Automatic Air Vent:
 - a. Body: Stainless Steel.
 - b. Internal: Teflon.
 - c. Set Point: 10" WC and minus 3" WC.
 - d. Connections: Flanged, welded or screwed.
 4. Vibration and Temperature compensating devices:
 - a. Flexible connections to vibrating equipments.
 - b. Engineered Expansion loops or pre-fabricated expansion pipe joints.
- F. Glycol Injection Tank:
1. Capacity: 5 gallon:
 - a. Body: 304L Stainless Steel.
 - b. Wide mouth threaded cap.
 - c. 1" diameter inlet (low) and outlet (high) connections with isolation valve.
 - d. ¾" diameter drain valve with hose connection.
 - e. ½" diameter manual air vent.
- G. Back-pressure / Relief Regulator:
1. As the basis of design, BPRR valve shall be as manufactured by "CASHO", Model 8311HP with double seat design or approved equal. Diaphragm shall be suitable for up to 200psig relief, and shall be isolated from fluid velocity effects. Valve size shall "line-size" or as indicated on drawings. End connections for:
 - a. 2" and smaller: shall be threaded.
 - b. 2½" and larger: shall be flanged (150 lbs RF).
 - c. Valve body and spring chamber, outlet diaphragm (composition S40 trim, consult manufacturer) materials shall be suitable for low conductivity deionized water (DI) service. Valve seat leakage shall meet ANSI B16.104, Class II. Inlet water temperature may range from -20°F to +180°F.

2.5 MISC. SKID ASSEMBLY & INSTRUMENTATION PRODUCTS

- A. Pressure Regulating Valve Assemblies.
 - 1. Performance.
 - a. To adjust fill pressure of pump skid.
 - 2. Construction:
 - a. Copper or Stainless Steel, diaphragm operated, direct acting, spring loaded, manual pressure-setting adjustment.
 - b. Rated for 125-psig-inlet pressure, except where otherwise indicated.

- B. Resistivity/Conductivity Controls/Indication:
 - 1. Performance.
 - a. To read resistivity of the DI water within the main piping loop and polish loop.
 - b. Unit shall have local read-out as well as analog output signals.
 - c. Unit shall be complete with analyzer/transmitter, smart sensors for resistivity/conductivity and minimum 50 foot patch cords.
 - 2. Construction.
 - a. Wall mounted panel constructed of ABS-PC alloy and 20 character by 4 line backlit LCD display with 20 tactile feedback keys. Unit shall operate on 120 VAC, 20 watts maximum. On power loss all stored values shall be retained in a non-volatile memory without batteries.
 - b. Accuracy shall be a minimum of $\pm 0.5\%$ of reading for resistivity. Two sensors for reading resistivity between 0 and 5 Mega Ohm – cm shall be provided with each panel. Fifty foot (50') patch cords shall be provided to connect sensors to panel. Sensors shall be provided with a retractable mounting such that sensor removal with fluid shut-off is achievable. Sensor mounting shall connect to 1" NPT, stainless steel thread-o-lets.
 - c. Panel outputs shall be a minimum of four, 4-20 MA analog output signals to report resistivity values to the building central control system. Panel shall have 16 set points/alarms.
 - d. Panel shall be Thornton 770 Max, multi-parameter analyzer/transmitter, or equal.

- C. Temperature Indication Wells:
 - 1. Performance:
 - a. To accept thermowells by others.
 - 2. Construction:
 - a. Wetted Parts: 316L Stainless Steel.
 - b. Connection: 3/4-inch NPT thread-o-let.

- D. Pressure Indication Tap Points:
 - 1. Performance:
 - a. To accept pressure gauges by others.
 - 2. Construction:
 - a. Wetted Parts: 316L Stainless Steel.
 - b. Connection: 1/2" NPT thread-o-let.

- E. Flow Controls/Indication (For "Polish-Skid" only!)
 - 1. Performance:
 - a. Range: As indicated on drawings.
 - 2. Construction:
 - a. Type: Variable Area, Visi-Float flow meter.
 - b. Body: Machined Acrylic plastic, or 316 Stainless Steel.

- c. Float & Guide rod: 316 Stainless Steel.
 - d. "O" rings: Viton.
 - e. Connections: VFC-1" NPT.
 - f. Flow-meter shall be by Dwyer, Model VFC-123-5" scale or equal.
- F. Sampling Ports:
- 1. Performance:
 - a. Sample portions of the flow stream as indicated.
 - 2. Construction:
 - a. Body & Trim: 304L or 316L Stainless Steel.
 - b. End Connections: Threaded, NPT.
 - c. Body: In-Line Needle Valve.
 - d. Size: ½" Diameter.

PART 3 - EXECUTION

3.1 STEEL BASES

- A. Provide steel bases of dimensions required for pump skids, filter skids and accessories.

3.2 EQUIPMENT INSTALLATION

- A. Installation of Equipment: Comply with ASME B19.1 or ASME B19.3 as appropriate.
- B. Pump Skids and Filter/Polish Skids shall be installed plumb, level, and firmly anchored to housekeeping pads. Coordinate and maintain skid manufacturers' recommended orientation in relation to other equipment, controls, and devices requiring access for service.
- C. Install additional specialty accessories and instrumentation such as valves, flow-meters, thermo-wells, pressure gages taps, etc. outside of skid assembly as indicated on Flow diagrams. Coordinate instrument locations with other trades and equipment to allow access for service.

3.3 CONNECTIONS

- A. Install piping next to equipment to allow adequate space for service and maintenance. Connect piping to equipment and accessories with flanges. Install pressure gage taps on piping where indicated.
- B. Install accessories and instrumentation as indicated on drawings.

3.4 FIELD QUALITY CONTROL

- A. Installer is to install the equipment as shown on the design drawings. Installer is to provide final alignment of the rotating equipment and shall provide pressure testing with the cooling loop system to assure that leaks were not caused by shipping or installation.

3.5 CLEANING

- A. Clean Technical Equipment Cooling Water piping system in accordance with Section 15072, "Cleaning".

3.6 COMMISSIONING

- A. Perform the following final checks before startup.

1. Verify that specified tests of piping systems are completed.
 2. Check for piping connection leaks.
 3. Check that piping and equipment connections are clear.
 4. Check for equipment vibration-control supports and flexible pipe connectors and the equipment is properly attached to base.
 5. Ensure relief settings are greater than discharge pressure, but not greater than rating of system components.
 6. Test operation of equipment safety controls and devices.
- B. Starting Procedures:
1. Energize circuits.
 2. Start and run equipment through complete sequence of operations.
 3. Check for excessive vibration and noise. Correct problems.
 4. Check pressures.
5. Manually operate control valves.
- C. Operate and adjust safety controls. Replace damaged and malfunctioning controls and equipment discovered by service representative.

3.7 DEMONSTRATION

- A. Engage the provider of the Skid assembly to train CM designated operating and maintenance personnel to adjust, operate, and maintain Pump Skids and Water Filter/Polish Skid assemblies as specified below:
1. Train operating and maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining the above described skid mounted equipments..
 2. Review data in Operation and Maintenance (O&M) manuals. . Refer to General and Supplementary Conditions "Contract Closeout".
 3. Schedule training with Construction Manager with at least seven days' advance notice.

3.8 TESTING

- A. Leak Testing:
1. System shall be tested for a continuous period of 24 hours at normal operating pressure.

3.9 SYSTEM PERFORMANCE

- A. Refer to the project drawings for system pressure, temperature, flow, and analytical performance requirements.

3.10 ADJUSTING & BALANCING

- A. Performed by Contractor.

END OF SECTION 15104