

SECTION 22 50 00 - FUEL OIL PIPING SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. The Conditions of the Contract and applicable requirements of Division 1, "General Requirements", and Section 23 00 01, "Mechanical General Provisions", govern this Section.

1.2 DESCRIPTION OF WORK:

- A. Work Included: Provide a complete fuel oil supply system including pumps, piping, fittings, valves, controls and accessories as specified and required for a complete and operating system.
- B. Applications: Applications of piping systems include, but are not limited to, the systems as listed below:

System	Working Pressure	Operating Temperatures
Fuel Oil	150 psig	65°F to 100°F

- C. Basic Materials and Methods: Refer to Section 23 03 00, "Basic Materials and Methods", for additional piping system requirements.
- D. Fuel Oil Storage Tanks: Tanks are specified under Section 22 50 10, "Fuel Oil Storage Tanks".
- E. Make all final supply and return connections to existing equipment and equipment furnished under other Sections of the Specifications, as required.

1.3 REFERENCE STANDARDS:

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.
- C. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:
 - 1. ANSI B31.1 - Power Piping.
 - 2. ANSI B31.4 - Liquid Petroleum Transportation Piping Systems.
 - 3. ANSI B31.9 - Building Service Piping.
 - 4. API 2000 - Venting Atmospheric and Low Pressure Storage Tanks.
 - 5. ASME Section 9 - Welding and Brazing Qualifications.
 - 6. ASME B16.3 - Malleable Iron Threaded Fittings.
 - 7. ASME B36.10 - Welded and Seamless Wrought Steel Pipe.
 - 8. ASTM A53 - Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless.

9. ASTM A234 - Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.
10. NFPA 30 - Flammable and Combustible Liquids Code.
11. NFPA 31 - Installation of Oil Burning Equipment.

1.4 QUALITY ASSURANCE:

- A. Acceptable Manufacturers: Provide products complying with these specifications and produced by one of the following:
 1. Valves:
 - a. Apollo.
 - b. Nibco.
 - c. OPW.
 - d. Preferred Utilities Manufacturing Corporation.
 - e. Stockham Valve and Fittings.
 2. Fuel System Pumps, Day Tanks, Fill Stations, Controls and Monitoring :
 - a. Cougar Fuel Systems/Preferred Utilities Manufacturing Corporation.
 - b. Gilbarco.
 - c. Hersey.
- B. Valves: Manufacturer's name and pressure rating marked on valve body.
- C. Welding: Qualify welding procedures, welders, and operators in accordance with ANSI B31.1, Paragraph 127.5, for shop and job site welding of piping work. Make welded joints on the piping system with continuous welds, without backing rings and with pipe ends beveled before welding. Gas cuts shall be true and free from burned metal. Before welding, surfaces shall be thoroughly cleaned. The piping shall be carefully aligned and no weld metal shall project inside the pipe.
- D. Welders Certification: In accordance with ASME Sec 9.

1.5 SUBMITTALS:

- A. Shop Drawing submittals shall include, but not be limited to, the following:
 1. Cut sheets of pipe and fittings, valves, pumps, pump controllers, fill stations, day tanks, monitoring equipment and other required accessories clearly indicating all features, options, materials and dimensions.
 2. Piping fabrication drawings for all main piping runs including connections to existing piping. Fabrication drawings shall include plan views and suitable elevations and shall include all accessories and equipment.
 3. Submit complete wiring diagrams for system controllers, fill stations, day tanks, pump controllers and monitoring equipment.
 4. Additional information as required in Section 23 00 01 "Mechanical General Provisions".

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING:

- A. Deliver fuel oil system components in factory-fabricated water-resistant wrapping.

- B. Handle fuel oil system components carefully to avoid damage to material component, enclosure and finish.
- C. Store fuel oil system components in a clean, dry space and protect from the weather.

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS:

- A. Fuel Oil Piping Above Ground:
 - 1. Piping: Black steel ASTM A53, Grade B, Schedule 40 seamless.
 - 2. Socket Weld Fittings: ANSI B16.11 forged steel socket-weld fittings matching pipe schedule for all non-threaded joints.
 - 3. Threaded Fittings: Malleable iron, 150 psi class, ANSI B16.3 at valves and unions.
- B. Miscellaneous Piping Materials/Products:
 - 1. Welding Materials: Comply with ASME Boiler and Pressure Vessels Code, Section II, Part C, for welding materials.
 - 2. Gaskets for Flanged Joints: 1/16" thick for all pipe size 10" and smaller and 1/8" thick for all pipe size 12" and larger. Ring-type shall be used between raised face flanges and full face-type between flat face flanges with punched bolt holes and pipe opening. Gaskets shall be Garlock Style 3400 compressed non-asbestos or equal.
 - 3. Insulating (Dielectric) Unions: Provide dielectric unions at all pipe connections between ferrous and nonferrous piping. Unions shall be "Delvin" as made by Pipeline Seal and Insulator Company or "EPCO" as made by Epco Sales, Inc. and shall have nylon insulation, or "Clearflow" waterway by Victaulic.
 - 4. Thread Sealant: Use "Gasolite Soft Set" manufactured by Federal Process Company, Cleveland, Ohio or approved equal thread sealant applied only to male threads to make up threaded joints. Refer to Sections 23 03 00 "Basic Materials and Methods" for additional requirements.

2.2 VALVES AND ACCESSORIES:

- A. Valves for Fuel Oil Isolation/Balancing Service at or Less Than 200 PSIG:
 - 1. Ball Valves:
 - a. Ball valves shall be two piece, full line size (full port) 316 stainless steel balls and stems and reinforced seats and stuffing box rings. All ball valves shall be designed to permit repacking while valve is in line. Valves shall be furnished with blowoutproof stems. Valves used for balancing shall be provided with balancing stops.
 - b. Ball valves 2" and smaller shall be threaded body bronze or brass valves of a full port design. Valves shall be rated for 300 psi WOG and shall conform to Federal Specification WW V 35B. Valves shall be:
 - 1) Apollo No. 70-100 Series.
 - 2) Nibco No. T585 Series.
 - 3) Stockham No. S-216-BR-R-T.

2. Check Valves:

- a. Check valves 2" and smaller shall be Class 125 threaded bronze swing check valves with horizontal swing and replaceable discs. Valves shall be rated for 200 psi WOG and shall conform to MSS SPÄ80 and shall be:
 - 1) Nibco No. T-433.
 - 2) Stockham No. B-321.
- B. Foot Valves: Double poppet with metal-to-metal seat and 8Ämesh screen. Body and poppet shall be bronze; screen shall be brass. Valve rated at 125 psi cold non-shock pressure at 350°F OPWÿ92 or approved equal.
- C. Fusible Link Lever Operated Gate Valves: Threaded, 300 psi WOG, full ported bronze body and disc, lever operated quick closing mechanism with zinc plated malleable iron handle, cadmium plated steel spring, 165° F fusible link. Valves shall be UL listed and tested for fuel oil system use and shall automatically close if the link melts.
- D. Solenoid Valves: Provide ASCO or approved equal bronze body, two-way solenoid valves rated for 400 psi WOG minimum. Valves shall 120 volt rated coils with Class F insulation and shall be of a normally closed (fail closed) design.
- E. Pressure Regulating Valves: Provide A.W. Cash "B" Series or approved equal pressure regulating valves. Valve shall be iron body, Buna-N diaphragms, and brass piston and cylinder. Valves shall be designed to reduce 120 psi to 20 psi in the fuel oil return line and shall be rated for 150 psi WOG.
- F. Strainers: 150 psig working pressure, 2" and smaller, shall be Muessco No. 11 or equal, 400 pounds WOG, iron body with perforated 20 mesh monel screen with cleanout and screwed ends.
- G. Unions: Provide and install in lines assembled with screwed fittings at points of connection to items of equipment and elsewhere as indicated or required to permit proper connections to be made or so that equipment may be removed. Unions shall also be provided in welded lines at the connections to items of equipment, where flanges are not provided.
 1. Unions in steel lines assembled with screwed fittings shall be Class 300 AAR malleable iron screwed pattern unions with iron to brass seats. Dielectric unions shall be used at all junctures of dissimilar metals.

2.3 ENCLOSED FUEL OIL TRANSFER SYSTEM/CONTROLLER:

- A. General: The enclosed fuel oil transfer system/controller shall be a Cougar Fuel Systems EFTS series or approved equal freestanding fuel oil transfer pumping system with an integral fuel oil system controller to transfer fuel oil from the main AST to the genset fuel oil day tank.
- B. Packaged System: The enclosed automatic fuel oil transfer system/controller shall be a factory packaged pre-engineered, pre-wired and pre-plumbed system. The system shall only require external field pipe, power and control wiring connection the system.,
- C. System Operation: The fuel oil transfer system controller shall the fuel oil transfer pumps when the emergency generator is operating to automatically transfer fuel oil from the main AST to fill the fuel oil day. The fuel oil transfer system controller shall automatically stop when generator stops and the fuel oil day tank is full.
- D. System components shall include, but not be limited to:
 1. Fully contained freestanding dead front weatherproof enclosure with the HMI user interface screen located inside the enclosure **and integral containment** basin with leak switch.
 2. Integral positive displacement transfer pumps

3. Inlet strainer and gauges
4. Integral differential pressure switch and flow proving controls.
5. Sight flow indicators for quick operational assessment.
6. API 607 Firesafe isolation valves.
7. Inlet compound pressure gauge and pump discharge pressure gauges with gauge isolation valves.
8. Schedule 40 steel/S.S. pipe system (no rubber hoses) with relief valves, check valves, ball valves and simplex inlet strainers.
9. "Pump On" indicators.
10. Magnetic motor starters with motor circuit breakers, overload protection and HOA switches.
11. Audible alarm with alarm silence/reset pushbutton.
12. Microprocessor based UL 508 Listed Controller and automatic fuel oil system operation including, but not limited to:
 - a. HMI display, alarm/event and operator action log.
 - b. Main AST level monitoring with high level alarm.
 - c. Main AST leak detection.
 - d. Day tank interface.
 - e. Remote fill operations control with power and control for the fuel oil remote fill system and associated interface panel in the remote fuel oil fill station.
 - f. Main tank(s) leak & level monitoring.
 - g. BasNet BCAS communications interface.

E. Fuel Oil Pumps:

1. Capacities: Pumps shall deliver the capacities scheduled or shown on the Drawings.
2. Type: Pumps shall be positive displacement type, bronze fitted, bronze impeller, and stainless steel shaft.
3. Pressure Rating: Pumps, casings, connections, and mechanical seals shall be rated for operation at the system working pressure.

2.4 FUEL OIL DAY TANK/DAY TANK CONTROLLER:

- A. The fuel oil day tank shall be a Cougar Fuel Systems DTS series or approved equal freestanding fuel oil day tank system with integral controller. The day tank system shall include a dual wall containment day tank, a complete fill station assembly, a return pump assembly and UL 508 day tank controller. Day tank and return pump capacity shall be as shown on the drawings.
- B. The day tank fill assembly shall include Schedule 40 steel pipe with 150 lb. fittings, required unions with gaskets, API 607 carbon steel valves, fire safety valve kit, strainer, robust electronic fill valve, level gauge with isolation valve, sight flow indicator, manual spring return by-pass valve and flexible connector.
- C. The day tank return pump assembly shall include a fuel oil transfer pump with TEFC motor, check

valve sight flow indicator and flexible connectors.

- D. The day tank controller shall provide all day tank control functions including, but not limited to, a continuous day tank level display in gallons, day tank leak alarm, return pump control, fire valve status, generator run status. The day tank controller shall be connected and interfaced to the Fuel Oil System Controller located in the Fuel Oil Pumping System enclosure to provide integrated fuel oil system control and monitoring. The day tank controller user interface shall include a graphical display locally to provide day tank/fuel oil system monitoring and control. The day tank controller shall include an on screen non-volatile historical memory of alarm events, trouble shooting screen and graphics depicting system status.

2.5 AST REMOTE FUEL OIL FILL STATION:

- A. The AST fuel oil fill station shall be a Cougar Fuel Systems RFS series or approved equal freestanding Remote Fill Station/Spill Container Fill Box. The fill station shall have a weatherproof stainless steel enclosure, 7 gallon fuel containment area, Schedule 40 carbon steel flanged pipe, API 607 full port isolation valve with locking handle, check valve, dry break coupler and disconnect with dust cap and complete system status with A/V functionality. The integral controls package shall be UL 508 listed.
- B. The fill station shall be supplied with one dry disconnect and dust cover. Coupling devices shall be aluminum body and guide fins with Buna N seals and shall be compatible with the Total TPI fuel oil vendor's fill equipment. Couplings shall be hydrostatically tested to 200 psig. Contractor to provide a redundant safety check valve downstream of the dry disconnect fill connection as shown on the drawings..
- C. The fill station shall have an overfill alarm station inside the enclosure with a green motorized overfill valve open indicator light, a red motorized overfill valve closed indicator light, a red tank overfill indicator light, an explosion proof overfill horn and silence push-button and a digital remote readout of the main fuel oil tank level. If the fill operator does not normally silence the horn, in one minute it will silence automatically. Light and horn which shall be powered from the Fuel Oil System Controller located in the Fuel Oil Pumping System enclosure.
- D. Panel and shall be provided incorporated in the fill box enclosure. The alarm station shall be NEMA 4 construction.
- E. Install a fill alarm sign on the inside of the remote fill station. Sign shall read "CAUTION WHEN ALARM HORN SOUNDS FUEL OIL TANK FILLED TO CAPACITY DO NOT OVERFILL".
- F. Contractor shall provide to the Owner, one fill hose fitting suitable for use with the fuel fill dry disconnect.

2.6 FUEL TANK SENSORS:

- A. Analog Level Sensors: Provide a 4-10 mA analog tank fuel level sensor, suitable for installation in in the new AST to provide a tank fuel oil level input to the Fuel Oil System Controller.
- B. High Level Switch: Provide a high level switch with a SPDT dry contact, suitable for installation in the new AST to provide a high tank fuel oil level alarm to the Fuel Oil System Controller.

2.7 MOTORIZED BALL VALVES:

- A. Provide a UL listed 300 psi rated motorized ball valve listed for fuel oil service. Motorized ball valve shall be installed in the fill line as shown on the drawings or as required and be powered closed by the Fuel Oil System Controller when the generator fuel oil tank is full.

2.8 FUEL OIL SYSTEM ACCESSORIES:

- A. Flexible Pipe Connections: Provide full line size flexible connectors at locations shown on the drawings and as required to eliminate vibration transfer in the fuel oil system. Flexible connectors shall be suitable for use at the pressure and temperature encountered at point of operation. End fitting of connectors shall conform to pipe fitting types specified elsewhere. Threaded connections 2" and smaller shall be Amber/Booth Type SS PM metal hose connections constructed of stainless steel hose and braid with carbon steel NPT threaded end fittings. Minimum lengths shall conform to the following:
 - 1. 1 1/2" diameter (and smaller) x 10" long.
 - 2. 2" x 12" long.
- B. Vent Caps: Provide OPW #63 or approved equal UL listed vent cap fittings with an iron body and 40 mesh brass screen at the fuel oil tank vent line.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION:

- A. General:
 - 1. Industry Practices: Install pipe, tube, and fittings in accordance with recognized industry practices which will achieve permanently leakproof piping systems, capable of performing each indicated service without failure or degradation of service. Install each run with a minimum of joints and couplings, but with adequate and accessible unions or flanged connections to permit disassembly for maintenance/replacement of valves and equipment. Reduce sizes (where indicated) by use of reducing fittings. Align accurately at connections, within 1/16" misalignment tolerance. Coordinate piping locations with other trades to avoid conflict. Give ductwork preference unless directed otherwise by the Engineer.
 - 2. Systems: Install piping parallel or perpendicular to lines of building, true to line and grade, and with sufficient hangers to prevent sags between hangers. Provide fittings at changes in direction. Piping in finished areas shall be concealed, except in mechanical rooms. Where pipes of different sizes join, provide reducing elbows, tees, or couplings. Bushings will not be acceptable.
- B. Steel Pipe: Ream steel pipe after cutting and before threading. Thread with clean-cut taper threads of length to engage all threads in fittings and leave no full-cut threads exposed after make-up. Thread with cleancut taper threads of length to engage all threads in fittings and leave no full-cut threads exposed after make up. Use "Gasoil Soft Set" manufactured by Federal Process Company, Cleveland, Ohio or approved thread sealant applied only to male threads to make up threaded joints. Refer to Sections 23 03 00 "Basic Materials and Methods" for additional requirements.
- C. Final Connections to Equipment Furnished by Owner or Under Other Divisions of These Specifications: Where Drawings show equipment to be furnished under other Divisions of these Specifications or by the Owner, such equipment will be delivered to the site, uncrated, assembled, and set in-place under those other Divisions of these Specifications or under the separate contracts. Any required automatic control valves shall also be provided under those other Divisions of these Specifications or other separate contracts. Make all final connections of chilled water, hot water, and condenser water as shown. Provide valves, unions, strainers, check valves, and traps as required for proper operation of systems and equipment. Equipment not shown or noted on the piping drawings shall not be included in the scope of this requirement.
- D. Pipe, Valves, and Fittings:
 - 1. Install piping, valves and fittings to make fuel systems complete

2. Pipe shall be clean and free of sand and grease at connection ends. Ream steel pipe after cutting and before threading or socket welding. . All couplings and fittings shall be socket weld type except for connection to valves, unions, AST, fill station, fuel oil piping system, fuel oil day tank and genset which may be threaded.
3. Install valves with screwed, flanged or weld ends to match pipe jointing at point of connections.
4. Make change of direction in piping with 90 degree elbows and nipple connections.
5. Pipe shall be clean and free of sand and grease at connection ends.

E. Fuel Oil System Equipment and Accessories:

1. General: Install enclosed fuel oil system/controller, fuel oil day tank/day tank controller, AST remote fuel oil fill station and fuel oil system accessories where shown on the drawings and required, in accordance with manufacturer's written instructions and recognized industry practices, to ensure that the fuel oil system complies with requirements and serve intended purposes. Comply with Codes and NFPA standards and requirements of NEC.
2. Piping: Make piping connections to fuel oil system equipment as shown on the drawings, per the equipment manufacturer's written installation drawings and as required. Provide all valves, unions, flexible connections and accessories as required to make connections.
3. Power Wiring: Coordinate power connection to fuel oil system equipment with Division 26.
4. Control Wiring: Install required control wiring and test the remote fuel oil system components in accordance with the system manufacturer/supplier's written installation instructions. All control wiring shall be installed in RGS conduit where installed outdoors and in EMT conduit where installed indoors. Refer to Division 26 for additional control wiring and raceway requirements.
5. BCAS Monitoring: Coordinate the fuel oil system controller BCAS monitoring connection and interface programming with Division 23.

3.2 STARTUP AND TESTING

- A. Furnish all instruments, equipment, and labor necessary to conduct all tests.
- B. Methods of sampling, inspecting, and testing shall conform to specified standards and codes.
- C. Leak Testing:
 1. Test tanks in accordance with manufacturer's recommendations upon arrival at site and after tank installation to assure tank integrity.
 2. Fuel Oil Piping Leak Testing: Blank tanks during fuel oil piping system testing. Hydrostatically test system fuel oil system piping at a pressure of 150 psig or 1-1/2 times working pressure, whichever is greater, for a period of 24 hours and carefully check for leaks. Repair all leaks and retest until proven watertight. Provide all necessary equipment for testing, including pumps and gauges. Refer to Section 23 05 93 for additional requirements. Flush system thoroughly with diesel fuel until all moisture or debris is removed and diesel is clear. Fill system with clean diesel fuel, close end valves and allow system to remain full. Legally dispose of flush diesel. Refer to Section 23 03 00 for additional pipe flushing and cleaning requirements.
- D. Startup/Operational Performance Testing:
 1. Prior to system startup, visually inspect the entire system for completion of joints, adequate hangers, supports, and inclusion of components, accessories and appurtenances.
 2. Furnish equipment manufacturer's qualified representative to monitor and furnish supervisory instructions to ensure proper equipment installation and operation, system startup, system operational testing, compliance with warranty requirements and Owner operational training.

3. System startup shall include 100% functional and operational testing of all fuel oil system components, controls, monitoring and alarms. Should any item or system fail to perform in acceptable manner, adjust, remodel, or replace system or items as required.
4. Repeat performance test, adjust or repair systems or item as often as necessary to prove system and items of equipment in proper and satisfactory operating condition.
5. Refer to Section 23 05 93 for additional testing requirements.

E. Operational Demonstration:

1. After the fuel oil system is fully installed and tested, the equipment manufacturer's qualified representative shall demonstrate system operation, alarm and BCAS monitoring and alarms to the Owner's Representatives.

F. Certification: Installing contractor shall certify that the complete fuel oil and monitoring systems are installed in accordance with all applicable local, state and federal codes, standards and regulations.

3.3 IDENTIFICATION:

- A. Refer to Section 23 03 00 "Basic Materials and Methods" for applicable painting, nameplates and labeling requirements.

END OF SECTION 22 50 00

E&C Engineers & Consultants Inc.
TX Firm Registration No. F-003068