

SECTION 231113 – FUEL OIL SYSTEM AND ACCESSORIES

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(Engineer shall edit specifications and blue text in header to meet project requirements. This includes but is not limited to updating Equipment and/or Material Model Numbers indicated in the specifications and adding any additional specifications that may be required by the project. Also turn off all “Underlines”.)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section and all other sections of Division 23.

1.2 SUMMARY

- A. This section includes the requirements for the fuel oil system and accessories for the emergency generator as follows: <Edit for particular project>

1. Single wall pipe and fittings.
2. Double wall pipe and fittings.
3. Piping specialties.
4. Joining materials.
5. Storage tank and accessories.
6. Tank monitoring system.
7. Tank fill station.
8. Leak detection and monitoring system.
9. Fuel oil spill kit.
10. Fuel oil pumps and controls.
11. Labels and identification.

1.3 ACTION SUBMITTALS

- A. Product Data: For each specified product:
 1. Include for pump, include certified performance curves and rated capacities, operating characteristics, furnished specialties, final impeller dimensions, and accessories, controls and electrical requirements.
 2. Include construction details, material descriptions, and dimensions of individual components and profiles.
 3. Include furnished specialties and accessories.
 4. For tanks, include material type, pressure rating, and capacity and installation details.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans and details, drawn to scale, on which fuel oil piping is shown and coordinated with other installations, using input from installers of the items involved.
- B. Site Survey: Plans, drawn to scale, on which fuel oil piping and tanks are shown and coordinated with other services and utilities. <Delete if not required>
- C. Welding certificates.
- D. Field quality control reports.
- E. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: Include a copy of each approved submittal along with any applicable maintenance data in the project operation and maintenance manual.
- B. Maintenance Material Submittals:
 - 1. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1.6 SYSTEM DESCRIPTION

- A. 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.
- B. Comply with ASME B31.9, "Building Services Piping," for fuel oil piping materials, installation, testing, and inspecting.
- C. Fuel Oil Valves: Comply with UL 842 and have service mark initials "WOG" permanently marked on valve body.
- D. Comply with requirements of the EPA and of state and local authorities having jurisdiction. Include recording of fuel oil piping.

1.7 PERFORMANCE REQUIREMENTS

- A. Fuel system vendor shall have single source responsibility for detailed design, equipment, controls, installation, wiring, integration, programming, startup and training.
- B. System is designed for storage and distribution of ASTM D 975 Ultra Low Sulfur No. 2 Diesel Fuel.

- C. Coordinate with Division 26 for Generator interface requirements.
- D. Minimum pressure and temperature rating of fuel piping system (complete system of pipe, fittings, joints, etc.) shall be as follows. Where more stringent pressure and temperature ratings are specified under individual product specifications, the more stringent ratings shall be provided.
 - 1. Fuel Oil: 150 psig at 100°F
- E. Maximum Operating Pressure Ratings: 3 psig fuel oil supply pressure at oil fired appliances. <Edit required for project>
- F. Delegated Design: Engage a qualified professional engineer, as defined in Architectural Specification Section "Quality Requirements," to design restraints and anchors and multiple pipe supports and hangers for fuel oil piping.

1.8 QUALITY ASSURANCE

- A. Steel Support Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Lift and support fuel oil storage tanks only at designated lifting or supporting points, as shown on Shop Drawings. Do not move or lift tanks unless empty.
- B. Deliver pipes and tubes with factory applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- C. Store pipes and tubes with protective PE coating to avoid damaging the coating and to protect from direct sunlight.

1.10 WARRANTY/GUARANTEE

- A. See Division 23 Specification Section "Basic Mechanical Requirements – HVAC" for warranty and guarantee requirements in addition to the special warranty indicated below.
- B. Special Warranty: Manufacturer agrees to repair or replace components of flexible, double containment piping and related equipment that fail in materials or workmanship within specified warranty period.

1. Failures due to defective materials or workmanship for materials including piping, dispenser sumps, water tight sump entry boots, terminations, and other end fittings.
2. Warranty Period: Ten (10) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL PRODUCT REQUIREMENTS

- A. Equipment Design and Selection: Fuel oil piping, equipment and specialties shall be designed and selected in accordance with the scheduled capacities on the drawings and the requirements of this specification.
- B. Basis of Design: The basis of design for fuel oil piping, equipment and specialties shall be as follows: <Edit required for project>
 1. Fuel Oil Pipe and Fittings, Single Wall – Wheatland Tube Company
 2. Fuel Oil Pipe and Fittings, Double Wall – Perma Pipe
 3. Relief Vents – OPW Engineered Systems
 4. Fuel Oil Storage Tank – Highland Tank Inc.
 5. Tank Monitoring System – Veeder Root Co.
 6. Fuel Oil Fill Station – Simplex
 7. Leak Detection – Perma Pipe
 8. Fuel Oil Pumps and Controls – Tothill Pump Group LE
 9. Flexible Connections – Metra Flex
 10. Fuel Oil Spill Kit – Fuel Oil Systems
- C. Other Acceptable Manufacturers: Subject to compliance with requirements, provide heating and cooling and/or heating terminal units by one (1) of the following: <Edit required for project>
 1. Fuel Oil Pipe and Fittings, single wall – US Steel Corp., Paragon Industries
 2. Fuel Oil Pipe and Fittings, double wall – Insul-Tek, Smith Fiberglass, Tricon
 3. Relief Vents – Morrison Brothers Company
 4. Fuel Oil Storage Tank – Buffalo Tank Corp., Steel Tank & Fabricating Company
 5. Tank Monitoring System – Franklin Fueling Systems, Preferred Utilities
 6. Fuel Oil Fill Station – Pryco, Earthsafe
 7. Leak Detection – Veedor Root Co., Containment Solutions, Tyco Thermal Control
 8. Fuel Oil Pumps and Controls – Viking Pumps, Worthington Pumps
 9. Flexible Connections – Flexing Inc., Tru Flex Metal Hose Inc.
 10. Fuel Oil Spill Kit – Chemtrec

- D. Motors: Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Division 23 Specification Section "Motor Requirements for HVAC Equipment."

2.2 HVAC PIPE MATERIAL APPLICATION

- A. General Application: All pipe, fittings and joint methods shall be as specified in the application schedule.

- B. Fuel Oil Pipe Material Application Schedule:

Pipe System	Pipe Material	Fitting Material	Joint Material
Single Wall Pipe and Fittings Above Ground in Building	Steel Pipe: ASTM A53, Grade B, Schedule 40, black steel	2" and Smaller: Malleable Iron Threaded: ANSI B 16.3, Class 150. Threads per ANSI b.1.20.1 and thread-o-lets.	2" and Smaller: Threaded: American Standard for Pipe Threads ANSI B2.1
		2-1/2" and Larger: Steel; ASTM A234, butt welded, long radius ells, and weld o lets. Flanges: ANSI B 16.5, weld neck, raised faced with gaskets.	2-1/2" and Larger: Welded: Latest revision of Section IX, ASME Boiler Pressure Vessel Code, Filler material per AWS D10.12.
Double Wall Pipe and Fittings Above Ground In Building	Service Pipe - Steel Pipe: ASTM A53, Grade B, Schedule 40, black steel	2" and Smaller: Wrought Steel Welding Fittings: ASTM A234 / A234M, Class 150.	2" and Smaller: Socket Weld
	Containment Casing: Schedule 10 or 10 gauge steel casing	2-1/2" and Larger: Steel; ASTM A234 / A234M, butt welded, long radius ells, and weld o lets. Flanges: ANSI B 16.5, weld neck, raised faced with gaskets.	2-1/2" and Larger: Welded: Latest revision of Section IX, ASME Boiler Pressure Vessel Code, Filler material per AWS D10.12.
Vent and Gauge Pipe and Fittings Above Ground in Building	Service Pipe - Steel Pipe: ASTM A53, Grade B, Schedule 40, black steel	2" and Smaller: Malleable Iron Threaded: ANSI B 16.3, Class 150. Threads per ANSI b.1.20.1 and thread-o-lets.	2" and Smaller: Threaded: American Standard for Pipe Threads ANSI B2.1

2.3 SINGLE WALL PIPE FITTINGS

A. Unions and Flanges: Unions and flanges for steel pipe shall be as follows:

1. Unions: ASME B16.39, Class 150, malleable iron with brass to iron seat, ground joint, and threaded ends.
2. Forged Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
 - a. Material Group: 1.1.
 - b. End Connections: Threaded or butt welding to match pipe.
 - c. Lapped Face: Not permitted underground.
 - d. Gasket Materials: Asbestos free, ASME B16.20 metallic, or ASME B16.21 nonmetallic, gaskets compatible with fuel oil.
 - e. Bolts and Nuts: ASME B18.2.1, cadmium plated steel.

2.4 DOUBLE CONTAINMENT PIPE AND FITTINGS <Delete if double wall is not required>

1. Rigid, Double Containment Piping: Comply with UL 971.
2. Leak Detection System: Include design and fabrication of double containment pipe and fitting assemblies with provision for field installation of cable leak-detection system in annular space between carrier and containment piping.

2.5 PIPING SPECIALTIES

A. Metallic Flexible Connectors:

1. Listed and labeled for aboveground applications by an NRTL acceptable to authorities having jurisdiction.
2. Stainless steel bellows with woven, flexible, bronze or stainless steel, wire reinforcing protective jacket.
3. Minimum Operating Pressure: 150 psig.
4. End Connections: Socket, flanged, or threaded end to match connected piping.
5. Maximum Length: Thirty (30) inches
6. Swivel end, 50 psig maximum operating pressure.
7. Factory furnished anode for connection to cathodic protection.

B. Y Pattern Strainers:

1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.

2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
3. Strainer Screen: Sixty (60) mesh startup strainer and perforated stainless steel basket with 50% free area.
4. CWP Rating: 125 psig.

C. Basket Strainers:

1. Body: ASTM A 126, Class B, high tensile cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
3. Strainer Screen: Sixty (60) mesh startup strainer and perforated stainless steel basket with 50% free area.
4. CWP Rating: 125 psig.

D. T-Pattern Strainers:

1. Body: Ductile or malleable iron with removable access coupling and end cap for strainer maintenance.
2. End Connections: Grooved ends.
3. Strainer Screen: Sixty (60) mesh startup strainer and perforated stainless steel basket with 57% free area.
4. CWP Rating: 750 psig.

E. Manual Air Vents:

1. Body: Bronze.
2. Internal Parts: Nonferrous.
3. Operator: Screwdriver or thumbscrew.
4. Inlet Connection: NPS 1/2.
5. Discharge Connection: NPS 1/8.
6. CWP Rating: 150 psig.
7. Maximum Operating Temperature: 225°F.

F. Emergency Pressure Relief Vents:

1. Morrison Bros. Co. 244 Series, OPW 201 or equal
2. Vents shall be aluminum or cast iron construction with Teflon seats. Vents shall be self-closing after over pressure has been dissipated. Restraining cable shall connect head and flange and also serve as grounding cable. Vents shall be sized to meet codes and installed by tank manufacturer.

2.6 JOINING MATERIALS

- A. Joint Compound and Tape for Threaded Joints: Suitable for fuel oil.
- B. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- C. Bonding Adhesive for RTRP and RTRF: As recommended by piping and fitting manufacturer.

2.7 STORAGE TANK AND ACCESSORIES

- A. Storage Tank: Storage tank shall be cylindrical double wall steel fire rated aboveground storage tank and have nominal capacity and dimensions as scheduled on the drawings.
- B. Tank support Cradles and Finish: Tanks shall come complete with factory installed steel support cradles. Tanks and support cradles shall be sandblasted and factory applied with two (2) coats of suitable paint primer and two (2) coats of white epoxy finish.
- C. Tank Openings: Tank shall be reinforced bushings and openings as follows:
 - 1. One (1) four (4) inch, top-mounted fill line with fill and cap internal fill pipe to six (6) inches of bottom of tank and braced at tank bottom. Provide strike plate.
 - 2. One (1) four (4) inch top-mounted vent with UL Listed internal ball check valve, two (2) feet extension, and code approved vent and cap.
 - 3. One (1) four (4) inch top-mounted fuel oil return bushed to two (2) inches with internal pipe to six (6) inches of bottom of tank.
 - 4. One (1) four (4) inch top mounted fuel oil suction bushed to two (2) inches with internal pipe to six (6) inches of bottom of tank with foot valve.
 - 5. One (1) four (4) inch top-mounted outlet equipped with cap and lock for manual gauging of tank level.
 - 6. Furnish sectionalized dip stick accurately marked in gallons.
 - 7. One (1) four (4) inch top-mounted gauge with coupling bushed to required size.
 - 8. Two (2) four (4) inch, top-mounted level transmitter openings with couplings bushed to required size.
 - 9. One (1) twenty four (24) inch, top-mounted diameter UL Listed manhole with bolted gaskets and cover.
- D. Pressure Relief Device: Provide code approved pressure relief device to prevent accumulation of explosive vapors in event of fire. Devices shall be sized as per Code requirements.
- E. Tank Drain: Provide three quarter (3/4) inch or one (1) inch bottom mounted code approved non-freeze drain valve with internal stop to drain water or sludge accumulation without spillage due to breakage.

- F. Lifting Lugs: Furnish tank with required lifting lugs.
- G. Stick Gauge: Provide a wooden stick gauge. Gauge length shall allow measurement of entire level of fuel in the tank. Gauges shall be compatible with the fuel to be measured (no swelling or damage from fuel contact). Provide gauge with non-sparking caps on each end. Mark gauges in feet and inches. The smallest unit of measure on the gauge shall be one sixteenth (1/16) inch.
- H. Main Fuel Receiving Port: Fuel receiving port shall be designed for receiving fuel supply from the delivery trucks and filling main fuel oil storage tank in a controlled manner via direct piped connection to the main tank fill port. Receiving port assembly shall be factory fabricated in a fully enclosed NEMA 12 enclosure suitable for recessed mounting on building exterior wall. The enclosure shall be of welded stainless steel construction with lockable hinged doors and include spill containment with leak sensor and ground stud. Provide required valves and accessories including three (3) inch main inlet quick disconnect coupling, main inlet ball valve, check valve, manual pump, fusible link fire valve on outlet and outlet shutoff valve. Controller shall include tank level transmitter, tank full visual alarm, tank high fuel alarm, audible alarm, control power switch and control power indicator. Unit shall be suitable for operation with 120V, 60 Hz, single phase.

2.8 TANK MONITORING SYSTEM

- A. Veeder-Root Model TLS-350 Plus or equal, digital tank level and monitoring system, meeting EPA requirements of 0.1 GPH volumetric tank tightness testing and continuous statistical leak detection. Provide unit with internal clock with battery backup, data keypad, large LED readout, function keys, audible alarm, and alarm silence switch. Unit shall be programmed to read level in inches or gallons. Provide tank management software to track fuel usage, remaining inventory, generator activity and inventory before and after generator operation.
- B. Provide interface for connection to Level and Leak Detection and Monitoring System and Building Automation System (BAS). Interface shall provide information on actual fuel level for each tank, level alarms for each tank, inventory management and product order notification. Coordinate monitoring and controls with Main Fuel Receiving Port controls and Level and Leak Detection and Monitoring System.
- C. Provide level, temperature, and water detection sensor for each tank.
- D. Provide gauge system complete with tank transmitter that utilizes positive action of leverage float and arm arrangement that is unaffected by change in gravity of tank liquid.
- E. System shall be suitable for operation with 120 V, 60 cycle, 1-phase

2.9 FUEL OIL FILL STATION

- A. Fuel receiving port shall be designed for receiving fuel supply from the delivery trucks and filling main fuel oil storage tank in a controlled manner via direct piped connection to the main tank fill port. Receiving port assembly shall be factory fabricated in a fully enclosed NEMA 3R enclosure suitable for recessed mounting on building exterior wall. The enclosure shall be of welded stainless steel construction with lockable hinged doors and include spill containment with leak sensor and ground stud. Provide required valves and accessories including three (3) inch main inlet quick disconnect coupling, main inlet ball valve, check valve, manual pump, fusible link fire valve on outlet and outlet shut off valve. Controller shall include tank level transmitter, tank full visual alarm, tank high fuel alarm, audible alarm, control power switch and control power indicator. Unit shall be suitable for operation with 120V, 60 Hz, single phase.

2.10 LEAK DETECTION AND MONITORING SYSTEM

- A. Cable and Sensor System: Comply with UL 1238.
- B. Monitoring Points: Provide fuel oil spill/leak detection system to monitor the following points:
 - 1. Annular (interstitial) space in storage tank
 - 2. Secondary containment in day tank
 - 3. Main fuel receiving port
 - 4. Transfer pump assembly containment pan
 - 5. Containment piping
- C. Tank annular space leak detection system shall be of dry type or hydrostatic monitoring type.
- D. Detection system shall continuously monitor the status of each monitoring point. System shall detect presence of, or absence of, hydrocarbons and other non-polar liquids. System shall recognize three ambient media of dry, water, and hydrocarbon. System shall function in ambient temperature range from -40°C to 50°C. System response time for detection of hydrocarbon shall be programmable from 0 to 5 seconds after sensors are covered.
- E. System shall be FM approved and UL Labeled. System shall be intrinsically safe for Class 1, Division 1, Group D hazardous locations.
- F. Control Unit: Microprocessor based, with RS-232 data output port, serial/parallel data output and seventy two (72) hour power-down memory backup. Liquid Crystal Displays (LCD) shall display probe number and probe status. Alarm conditions and relay closure shall be programmable with keypad entries.

- G. Double Wall Tank Interstitial Probes: Complete with sensors, detector head cap with visual status indicators, flexible cable, and stainless steel guide cable. Detector head cap shall provide visual display status for dry, water, and hydrocarbon states.
- H. Building Automation System (BAS) Interface: Provide BACnet IP or BACnet MS/TP interface for communicating all operating and alarm information to site BAS. Provide all hardware, gateways, network controllers, transducers, software and devices as required for this interface. Provide listing of all input/output points including point description and associated engineering units for each point. Manufacturer shall be responsible for coordination of all communication requirements with BAS Contractor, translation of network protocols, testing of communications between systems, and joint commissioning of systems.

2.11 FUEL OIL SPILL KIT

- A. Manufacturers: Fuel Oil Systems and Chemtrec
- B. General: Provide a spill kit contained in two (2) barrels in fuel storage room as follows:
 - 1. Barrel One (1): Barrel one (1) of the spill kit shall contain a twenty (20) pound bag of particulate absorbent, two (2) packages of absorbent "socks" twelve (12) feet long and one hundred (100) absorbent pads.
 - 2. Barrel Two (2): Barrel two (2) of the spill kit shall contain a twelve (12) gallon wet/dry shop vacuum, one hundred (100) foot extension cord, two (2) tarpaulins, one (1) dust pan and broom, one (1) dozen disposal bags and ties, one (1) box contractor towels, one (1) of box of rubber gloves, and four (4) pair protective glasses.
 - 3. Each Barrel: Each barrel shall have a chain fastened crescent wrench.

2.12 DUPLEX FUEL OIL TRANSFER PUMP SETS AND CONTROLS

- A. Description: Comply with HI 3.1-3.5.
 - 1. Type: Positive displacement, rotary type.
 - 2. Impeller: Steel gear with crescent.
 - 3. Housing: Cast iron foot mounted.
 - 4. Bearings: Bronze, self lubricating.
 - 5. Shaft: Polished steel.
 - 6. Seals: Mechanical.
 - 7. Base: Common steel base for pump and motor.
 - 8. Pressure Relief: Built in.
 - 9. Discharge Check Valve.
- B. Drive: Direct close coupled.

- C. Pump and Motor Connection: Pumps shall be flexible connected to motors with flexible coupling bushings keyed to shafts.
- D. Master Control Panel:
1. Provide a master control panel for main fuel storage tanks, pumps and delivery system. Panel shall be UL listed and in a lockable NEMA 4 enclosure. Controls shall be PLC based. Provide duplex (primary and standby) transfer pumps. Panel shall consist of a separate full voltage combination motor starter and line side disconnect for each pump along with a separate control power transformer for each pump. Should a pump power feed be out of service for any reason all remaining pumps and controls shall continue to function without manual intervention.
 2. Provide alternating controls for duplex pumps. If primary pump fails, a failure alarm shall be initiated and backup pump shall be enabled automatically. The pumps shall be switched automatically between primary and stand-by based on run time. The device with the lowest run time shall become the primary device when both devices are stopped. If the primary device runs continuously for 720 hours (FA), the stand-by device shall be started and the primary device shall stop. The stand-by device shall become the primary.
 3. When a pump is commanded to start, controller shall be provided with a feedback signal verifying proof of pump operation via current sensor or flow sensor.
 4. Panel shall also have a manual override switch for each pump to allow for the activation or deactivation of each pump. Provide run indicator lights for each pump.
 5. Master control panel shall receive automatic inputs from emergency generator day tank controls (indicating a demand for fuel to generators). Lead transfer pump shall be enabled when master control panel receives start signal from day tank. When master control panel receives signal that day tank is full, transfer pump shall be off.
 6. Pump and tank control shall be integrated with the tank level monitoring system such that when the tank fuel level drops to low level, pump shall be stopped and a "Low Fuel" alarm generated.
 7. Provide display to indicate tank levels, tank operating status, pump operating status, audible and visual alarms and alarm silence button.
 8. Building Automation System (BAS) Interface: Provide BACnet IP or BACnet MS/TP interface for communicating all operating information to and receive control commands from Emergency Generator Day Tank Controllers and site BAS. Provide all hardware, gateways, network controllers, transducers, software and devices as required for this interface. Provide listing of all input/output points including point description and associated engineering units for each point. Panel manufacturer shall be responsible for coordination of all communication requirements with Emergency Generator Day Tank Provider and BAS Contractor, translation of network protocols, testing of communications between systems, and joint commissioning of systems.

- E. Piping Furnished with Pumps: Steel with ferrous fittings and threaded or welded joints.
- F. Strainers Furnished with Pumps: Duplex, basket type with corrosion resistant metal screen baskets.

2.13 LABELS AND IDENTIFICATION

- A. Provide equipment labels, tags, and pipe markers for all components. See Division 23 Specification Section “Identification for HVAC Piping and Equipment” for labeling and identifying requirements.

2.14 SHUT OFF AND SPECIALTY VALVES

- A. Provide all required valves. See Division 23 Specification Section “Valves for HVAC Piping Systems” for valve requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas for compliance with requirements for installation tolerances and other conditions affecting performance of fuel oil piping.
- B. Examine installation of fuel burning equipment and fuel handling and storage equipment to verify actual locations of piping connections before installing fuel oil piping.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Close equipment shutoff valves before turning off fuel oil to premises or piping section.
- B. Comply with NFPA 30 and NFPA 31 requirements for prevention of accidental ignition.

3.3 INDOOR PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction to allow for mechanical installations.

- C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- D. 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.
- E. Install piping above accessible ceilings at a height that allows sufficient space for ceiling panel removal.
- F. Install piping free of sags and bends.
- G. Install fittings for changes in direction and branch connections.
- H. Install single wall and/or double containment, fuel oil pipe at a minimum slope of 1% downward toward fuel oil storage tank sump.
- I. Install vent pipe at a minimum slope of 2% downward toward fuel oil storage tank sump.
- J. Install system components with pressure rating equal to or greater than system operating pressure.
- K. Comply with requirements for equipment specifications for roughing in requirements.
- L. Conceal pipe installations in walls, pipe spaces, or utility spaces; above ceilings; below grade or floors; and in floor channels unless indicated to be exposed to view.
- M. Prohibited Locations:
 - 1. Do not install fuel oil piping in or through HVAC ducts and plenums, clothes or trash chutes, chimneys or gas vents (flues), ventilating ducts, or dumbwaiter or elevator shafts.
 - 2. Do not install fuel oil piping in solid walls or partitions.
 - 3. Do not install piping over electrical panel boards, switchgear, switchboards or motor control centers.
- N. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.
- O. Connect branch piping from top or side of horizontal piping.
- P. Install unions in pipes NPS 2 and smaller at final connection to each piece of equipment and elsewhere as indicated. Unions are not required on flanged devices.
- Q. Do not use fuel oil piping as grounding electrode.

- R. Install sleeves and sleeve seals for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 23 Specification Section "Sleeves, Seals and Escutcheons for HVAC Piping."
- S. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 23 Specification Section "Sleeves, Seals and Escutcheons for HVAC Piping."

3.4 PIPING JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- D. Welded Joints: Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators according to "Quality Assurance" Article.
 - 1. Inspect pipe and pipe fittings for roundness before they are fit-up or set in place.
 - 2. Properly clean and prepare pipe base material before fit-up. Verify joint land and bevel.
 - 3. Preheat pipe base material as required by welding procedure specification. Temperature of pipe material must be a minimum of 32°F before welding.
 - 4. Properly align and adjust joint as required by welding procedure and thickness of material. Verify tolerances after tacking sequence.
 - 5. Use weld material diameter as procedurally required for type and thickness of work being done.
 - 6. Use sufficient argon pre-purge and argon post-purge for GTAW processes. Post purge should be until weld is no longer glowing plus five (5) seconds. Maintain purge for at least two (2) layers of weld material.
 - 7. Properly store welding materials.
 - 8. Clean tacks before welding out. Remove slag after each pass by grinding to avoid slag inclusion.

9. Brush each weld free of rust and paint with rust resistant product that matches piping surface color.
10. Conduct radiographic test for sections or joints that cannot be tested by other test methods (such as joints cut into existing piping systems) by qualified radiographic testing firm.
11. Patch factory applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.

- E. Flanged Joints: Install gasket material, size, type, and thickness for service application. Install gasket concentrically positioned.
- F. Flared Joints: Comply with SAE J513. Tighten finger tight then use wrench according to fitting manufacturer's written instructions. Do not over tighten.

3.5 HANGER AND SUPPORT INSTALLATION

- A. Pipe hanger and support and equipment support materials and installation requirements are specified in Division 23 Specification Section "Hangers and Supports for HVAC Piping Systems."

3.6 LEAK DETECTION AND MONITORING SYSTEM INSTALLATION

- A. Install leak detection and monitoring system. Install alarm panel inside building where indicated.
- B. Double Containment, Fuel Oil Piping: Install leak detection sensor probes at low points in piping.

3.7 FUEL OIL STORAGE TANK

- A. Install tank system including accessories in strict accordance with manufacturer's recommendations and applicable fire and environmental codes. State and local permits shall be obtained prior to installation.
- B. Install tanks on reinforced concrete base slab designed to support fully loaded tank. A one quarter (1/4) inch of non-shrink grout shall be placed between footings and concrete slab to provide uniform bearing and insure integrity of structure.
- C. Tanks shall be marked on all sides with warning signs: "FLAMMABLE" or "COMBUSTIBLE", "NO SMOKING", product identification, and other signs as required by the applicable Codes.
- D. Electrical work shall be in accordance with applicable codes and shall be rated for hazardous area as required. Tanks shall be electrically grounded in accordance with NFPA 78.

- E. System installation shall be inspected and approved by system supplier or it's certified Contractor. System supplier shall submit comprehensive checklist of quality and safety items critical to system and verify that installation has been in accordance with these Standards and applicable Fire and Environmental Codes.
- F. This Contractor shall provide SPCC (Spill Prevention, Control, and Countermeasure) Plan as mandated by EPA for tanks over one thousand three hundred twenty (1,320) gal per site. Plan shall be stamped by Professional Engineer.

3.8 TANK MONITORING AND LEAK DETECTION SYSTEMS

- A. Install electronic tank monitoring and level leak detection systems in strict accordance with manufacturer's instructions.
- B. Install monitoring well probe guide cable plumb so that float is free to move up and down without binding in detection well casing.
- C. Wire sensors back from various leak detection and level monitoring points.
- D. Program system and set up fuel leak alarms, level alarms for each tank, inventory management, product order notification and interface with BAS.

3.9 FUEL OIL PUMP INSTALLATION

- A. Transfer Pumps:
 - 1. Install pumps with access space for periodic maintenance including removal of motors, impellers, and accessories.
 - 2. Set pumps on and anchor to concrete base.
 - 3. Pump Mounting:
 - a. Install base mounted pumps on cast in place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in Architectural Specification Section "Cast in Place Concrete."
 - b. Comply with requirements for vibration isolation devices specified in Division 23 Specification Section "Vibration and Seismic Controls for HVAC Systems."
- B. Install two (2) piece, full port ball valves at suction and discharge of pumps. Comply with requirements in Division 23 Specification Section "Valves for HVAC Piping Systems."
- C. Install mechanical leak detector valves at pump discharge.
- D. Install Y pattern strainer on inlet side of duplex fuel oil pumps.

- E. Install check valve on discharge of duplex fuel oil pumps.
- F. Install suction piping with minimum fittings and change of direction.
- G. Install vacuum and pressure gauge, upstream and downstream, respectively, at each pump to measure the differential pressure across the pump. Pressure gauges are specified in Division 23 Specification Section "Meters and Gauges for HVAC Piping."

3.10 CONNECTIONS

- A. Where installing piping adjacent to equipment, allow space for service and maintenance.
- B. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment having threaded pipe connection.
- C. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment having flanged pipe connection.
- D. Connect piping to equipment with shutoff valve and union. Install union between valve and equipment.
- E. Install flexible piping connectors at final connection to burners or oil fired appliances.

3.11 FUEL OIL RECEIVING STATION

- A. Install strict accordance with manufacturer's instructions.
- B. Install permanent local signs for operator instructions, warning signs and alarms.

3.12 FUEL OIL ACCESSORIES

- A. Install duplex strainer in fuel oil pump suction.
- B. Install foot valve with extractor assembly on fuel oil suction line in storage tank.
- C. Install vent caps on oil tank vents to atmosphere.
- D. Install fill boxes on oil tank fill lines.

3.13 LABELS AND IDENTIFICATION

- A. Nameplates, pipe identification, valve tags, and signs are specified in Division 23 Specification Section "Identification for HVAC Systems and Equipment."

- B. Equipment Nameplates and Signs: Install engraved plastic laminate equipment nameplates and signs on or near each service regulator, service meter, and earthquake valve.
 - 1. Text: In addition to identifying unit, distinguish between multiple units; inform operator of operational requirements; indicate safety and emergency precautions; and warn of hazards and improper operations.

3.14 FIELD QUALITY CONTROL

- A. Pressure Test Piping: Minimum hydrostatic or pneumatic test pressures measured at highest point in system: as specified in Division 23 Specification Section “Valves for HVAC Piping Systems”.
- B. Inspect and test fuel oil piping according to NFPA 31, "Tests of Piping" Paragraph; and according to requirements of authorities having jurisdiction.
- C. Test leak detection and monitoring system for accuracy by manually operating sensors and checking against alarm panel indication.
- D. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- E. Bleed air from fuel oil piping using manual air vents.
- F. Fuel oil piping and equipment will be considered defective if it does not pass tests and inspections.
- G. Prepare test and inspection reports.
- H. Manufacturer's Field Service: Engage a factory authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- I. Perform the following tests and inspections with the assistance of a factory authorized service representative:
 - 1. Start fuel oil transfer pumps to verify for proper operation of pump, and check for leaks.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- J. Fuel oil pumps will be considered defective if they do not pass tests and inspections.

3.15 DEMONSTRATION

- A. Engage a factory authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fuel oil pumps.

END OF SECTION 231113