

SECTION 23 10 00 FACILITY FUEL SYSTEMS

PART 1 – GENERAL:

1.1 DESCRIPTION:

- A. Diesel fuel oil and unheated burner fuel oil tanks, piping, and accessories located outside, underground or aboveground as shown on contract drawings. Refer to contract drawings for type of fuel and for tank capacities.
- B. Tank fluid level monitoring and alarm systems.
- C. Leak detection system for tanks and underground piping.
- D. Fuel oil quality maintenance system (water and particulate removal).

1.2 RELATED WORK:

- A. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
- B. Section 03 30 00, CAST-IN-PLACE CONCRETE.
- C. Section 09 91 00, PAINTING.
- D. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.
- E. Section 23 34 00, HVAC Fans.
- F. Section 26 99 11, Motor Controller.
- G. Section 26 32 13, Engine Generators.

1.3 QUALITY ASSURANCE:

- A. Approval by Contracting Officer is required of products or services of proposed manufacturers, suppliers and installers, and will be based on Contractor's certification that:
 - 1. Manufacturers regularly and currently manufacture tanks, tank and piping accessories, tank fluid level monitoring and leak detection systems, fuel quality management systems.
 - 2. Manufacturers of steel tanks participate in the Quality Assurance Program of the Steel Tank Institute (STI).
 - 3. The design and size of each item of equipment provided for this project is of current production and has been in satisfactory operation on at least three installations for approximately three years. Current models of fluid level and leak detection systems with less than three years service experience are acceptable if similar previous models from the same manufacturer have at least three years service experience.

- B. Apply and install materials, equipment and specialties in accordance with manufacturer's written instructions. Conflicts between the manufacturer's instructions and the contract drawings and specifications shall be referred to the COR Contracting Officers Representative (COR) for resolution. Provide copies of installation instructions to the COR two weeks prior to commencing installation of any item.
- C. All equipment shall be free from defects that would adversely affect the performance, maintainability and appearance of individual components or overall assembly.
- D. Tanks, Secondary Containment Systems for Piping, Plastic Piping and Containment Systems, Tank Level Monitoring Systems, Leak Detection Systems, Fuel Quality Management Systems, Cathodic Protection Systems: Authorized manufacturers representatives shall provide on-site training of installers and supervision of the installation and testing of the equipment and systems to assure conformance to written instructions of manufacturers.
- E. Tank and piping installation contractor shall be certified as acceptable by local and state pollution control authorities.
- F. Entire installation shall conform to requirements of local and state pollution control authorities.
- G. Pipe Welding: Conform to requirements of ASME B31.1. Welders shall show evidence of qualification. Welders shall utilize a stamp to identify their work. Unqualified personnel will be rejected.
- H. Assembly of Glass Fiber Reinforced Plastic Piping: Installation personnel shall have been trained, tested and certified under a procedure approved by the manufacturer of the piping. Proof of certification, in writing, shall be provided to the COR.
- I. Where specified codes or standards conflict, consult the COR.
- J. Label of Conformance (definition): Labels of accredited testing laboratories showing conformance to the standards specified.
- K. Equipment and materials installed shall be compatible in all respects with other items being furnished and with existing items so that the result will be a safe, complete and fully operational system which conforms to contract requirements and in which no item is subject to conditions beyond its design capabilities.

1.4 SUBMITTALS:

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
- B. Aboveground Steel Tanks, Including Vault-type Tanks:
 - 1. Drawings of tanks, supports, ladders, platforms, heating coils, tank manholes, emergency relief vents and all accessories. Include

- overall dimensions and dimensional locations and sizes of pipe connections, and access openings.
 - 2. Recommended tank support locations.
 - 3. Weight of entire tank assembly, empty and flooded.
 - 4. Design and construction of primary tanks, insulation, secondary containment, supports, pipe connections, platforms.
 - 5. Application and performance data on coatings from manufacturer of coatings.
 - 6. Data certifying tanks are designed for surcharge loads of platforms shown.
 - 7. Certification of compliance with specified standards.
 - 8. Certification that steel tank manufacturer participates in Steel Tank Institute (STI) Quality Assurance Program.
 - 9. Design, construction, performance, dimensions of emergency relief vents.
 - 10. Seismic Data: Refer to Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.
- C. Fuel Piping:
- 1. ASTM and UL compliance.
 - 2. Grade, class or type, schedule number.
 - 3. Manufacturer.
- D. Pipe Fittings, Unions, Flanges:
- 1. ASTM and UL compliance.
 - 2. ASTM standards number.
 - 3. Catalog cuts.
 - 4. Pressure and temperature rating.
- E. Foot Valves, Check Valves, Overfill Prevention Valves:
- 1. Catalog cuts showing design and construction.
 - 2. Pressure and temperature ratings.
 - 3. Pressure loss and flow rate data.
 - 4. Materials of construction.
 - 5. Accessories.
- F. Secondary Containment System for Fuel Piping:
- 1. Sizes, materials, construction of containment system including end seals, sumps, coatings and pipe supports.

2. Layout of system.
 3. Installation instructions.
 4. Design of cathodic protection system (steel casing).
- G. Leak Detection System:
1. Drawings, description and performance data on sensors, control units.
 2. Description of operation.
 3. Layout of system.
 4. Installation and operating instructions.
 5. Data on interconnecting wiring systems to be furnished.
- H. Tank Fluid Level Monitoring Instrumentation System:
1. Drawings showing instruments and in-tank sensing units, with dimensions.
 2. Design and construction of all elements of system.
 3. Installation instructions.
- I. Tank and Piping Accessories: Design, construction, and dimensions of vent caps, fill boxes, fill caps, spill containers and other accessories.
- J. Fuel Quality Maintenance System:
- a. Drawings and description of all components and arrangement of system.
 - b. Design and performance of pumps, filters.
 - c. Catalog data and operation of control system.
 - d. Installation instructions.

1.5 DELIVERY, STORAGE AND HANDLING:

- A. Protection of Equipment:
1. Equipment and material placed on the job site shall remain in the custody of the Contractor until phased acceptance, whether or not the Government has reimbursed the Contractor for the equipment and material. The Contractor is solely responsible for the protection of such equipment and material against any damage.
 2. Place damaged equipment in first class, new operating condition; or, replace same as determined and directed by the COR/COTR. Such repair or replacement shall be at no additional cost to the Government.

3. Protect new equipment and piping systems against entry of foreign matter on the inside. Clean both inside and outside before painting or placing equipment in operation.
 4. Existing equipment and piping being worked on by the Contractor shall be under the custody and responsibility of the Contractor and shall be protected as required for new work.
 5. Protect plastic piping and tanks from ultraviolet light (sunlight).
- B. Cleanliness of Equipment and Piping:
1. Exercise care in storage and handling of equipment and piping material to be incorporated in the work. Remove debris arising from cutting, threading and welding of piping.
 2. Piping systems shall be flushed, blown or pigged as necessary to provide clean systems.
 3. Clean interior of all tanks prior to delivery for beneficial use by the Government.
 4. Contractor shall be fully responsible for all costs, damages and delay arising from failure to provide clean systems and equipment.

1.6 APPLICABLE PUBLICATIONS:

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by basic designation only.
- B. Federal Specifications (Fed. Spec.):
- C. A-A-60005.....Frames, Covers, Grating, Steps, Sump and Catch Basin, Manhole
- D. ASTM International (ASTM):
- E. A36/A36M-08.....Carbon Structural Steel
- F. A53/A53M-10.....Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
- G. A106/A106M-10.....Seamless Carbon Steel Pipe for High Temperature Service
- H. A126-04(R2009)Gray Iron Castings for Valves, Flanges and Pipe Fittings
- I. A234/A234M-10.....Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service
- J. B62-09Composition Bronze or Ounce Metal Castings
- K. D2996-01(2007).....Filament-Wound "Fiberglass" (Glass-Fiber-Reinforced-Thermosetting-Resin) Pipe

- L. American Society of Mechanical Engineers (ASME):
 - B16.5-09Pipe Flanges and Flanged Fittings (NPS ½-24).
 - B16.11-09Forged Fittings, Socket-Welding and Threaded
 - B31.1-10Code for Pressure Piping, Power Piping with Current Amendments
- M. National Electrical Manufacturers Association (NEMA):
 - 250-08.....Enclosures for Electrical Equipment (1000 Volts Maximum)
- N. National Fire Protection Association (NFPA):
 - 30-12.....Flammable and Combustible Liquids Code
 - 31-11.....Installation of Oil Burning Equipment
 - 70-11.....National Electrical Code
- O. Underwriters Laboratories Inc. (UL):
 - 58-98.....Steel Underground Tanks for Flammable and Combustible Liquids
 - 142-10.....Steel Aboveground Tanks for Flammable and Combustible Liquids
 - 971-06.....Non-Metallic Underground Piping for Flammable Liquids
 - 1316-06.....Glass-Fiber-Reinforced Plastic Underground Storage Tanks for Petroleum Products
 - 1746-07.....External Corrosion Protection System for Steel Underground Storage Tanks
 - 2085-10.....Protected Above-ground Tanks for Flammable and Combustible Liquids
- P. Steel Tank Institute (STI):
 - F001.....Standard for Fire Resistant Tanks
 - F841.....Dual Wall Underground Steel Storage Tanks
 - F894.....ACT-100 Specification for External Corrosion Protection of FRP Composite Steel Underground Storage Tanks
 - F911.....Standard for Diked Aboveground Storage Tank System
 - F941.....Standard for Fireguard Thermally Insulated Aboveground Storage Tanks
 - F961.....ACT-100-U Specification for External Corrosion Protection of Composite Steel Underground Storage Tanks

- P3STI-P3 Specification and Manual for External Corrosion Protection of Underground Steel Storage Tanks
- R891Recommended Practice for Hold Down Strap Isolation
- Q. NACE International (Corrosion Engineers) (NACE):
- SP0169-07.....Control of External Corrosion on Underground or Submerged Metallic Piping Systems
- NACE 3/SSPC-SP6-07 Commercial Blast Cleaning
- NACE 4/SSPC-SP7-07 Brush-off Blast Cleaning
- R. American Petroleum Institute (API):
- 1631-01.....Interior Lining and Periodic Inspection of Underground Storage Tanks

1.7 PERMITS:

- A. Contractor shall obtain and complete all tank permit and registration forms required by governmental authorities.

PART - 2 PRODUCTS:

2.1 ABOVEGROUND STEEL TANKS:

- A. Type: Factory fabricated all welded steel, horizontal cylindrical configuration, atmospheric pressure, internal and external corrosion protection as specified. In addition to specified requirements, tanks shall be fabricated in accordance with Steel Tank Institute (STI) design standards by manufacturer that participates in STI Quality Assurance Program.
- B. Construction:
1. ASTM A36 steel, conform to UL 142. Inner and outer tanks of double wall tanks shall both conform. Provide label of conformance.
 2. Conform to NFPA 30 or 31 as applicable.
 3. Double-wall, un-insulated, conforming to STI F001 "Flameshield" construction. Provide label of conformance.
 4. Design for surcharge load produced by tank-mounted platforms and platform loadings shown. Design tanks for saddle supports furnished by tank manufacturer.
 5. Leaks and abrasions are not permitted. Maximum permissible out-of-roundness of cylindrical shells is one percent of the diameter.
 6. Provide lifting lugs for rigging tanks.
 7. Make provisions for leak detectors to be installed at lowest part of interstitial space between walls of double-wall tanks.

- C. Platforms, Stairs, Ladders and Handrails: Provide welded steel assemblies as shown, conforming to OSHA requirements. Provide welded steel tank attachments designed to support platform framing, stairs, ladders and live and dead loadings. Clean and coat all surfaces as specified for tank and steel dike exterior. Galvanizing is an acceptable alternative.
- D. Factory Cleaning: Clean interior and exterior of tanks and steel dikes (if furnished). Remove mill scale, dirt, rust, oil, welding debris, loose coatings and coatings incompatible with fuel stored or protective coating. Sandblast exterior in accordance with NACE 3.
- E. Factory Coating: Provide tanks and steel dikes (if furnished) with exterior coat of rust resistant metal primer, specified under Section 09 91 00, PAINTING. Coat interior from bottom of tank to 1 m (3 feet) above bottom in compliance with API RP1631.
- F. Field Painting: Clean and coat all surfaces as specified in Section 09 91 00, PAINTING.
- G. Pipe Connections to Tanks:
 - 1. Conform to UL 142.
 - 2. Pipe sizes 50 mm (2 inches) and smaller, threaded. Pipe sizes 65 mm (2 1/2 inches) and larger, flanged, 1025 kPa (150 pound) ASME rating.
 - 3. Welded joints required on steel piping located inside tanks.
 - 4. Provide and coordinate tank connection quantities, sizes and types with requirements of tank level gage unit; sounding rod; vent, fill, supply and return pipes; and other pipes as shown.
 - 5. On double-wall tanks, provide valved drain of interstitial space.
- H. Tank Manholes: Provide quantity shown. Bolted cover type, gasketed.
- I. Internal Ladder: Provide as shown with 50 mm x 6 mm (2 inch x 0.25 inch) sides and 20 mm (0.75 inch) diameter rungs at 300 mm (12 inches) on center. Provide slide supports to allow for tank movement.
- J. Wear (Striker) Plates: Provide 300 mm (12 inch) square, 6 mm (0.25 inch) thick steel plates welded to tank bottom directly under the sounding opening, the fuel return discharge, and the fill discharge.
- K. Lifting Lugs: Provide for rigging tanks.
- L. Emergency Relief Vents for Fire Exposure: Venting capacity shall conform to NFPA 30 or 31 as applicable. Standard product of a manufacturer, designed to automatically open at tank pressure of 17 kPa (2.5 psi) gage. Aluminum or cast iron construction with Teflon seating surface. Provide separate vents for primary and secondary tanks.
- M. Provide fittings for grounding per NFPA 70.

- N. Seismic Design: Refer to Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.

2.2 TANK AND PIPING ACCESSORIES:

- A. Vent Caps: Galvanized cast iron or cast aluminum with brass or bronze screens, arranged to permit full venting and to prevent entry of foreign material into the vent line. Same pipe size as vent pipe.
- B. Fill Boxes:
1. Spill-container type enclosing a fill cap assembly with camlock hose connector with closure coordinated with fittings used by fuel supplier.
 2. Spill containment compartment with minimum 20 gallon capacity. Integral drain valve with discharge to fill pipe.
 3. Fill cap shall be lockable, tight-fill design with provision for padlock on the top of the cap. Fill cap shall screw onto threaded adapter that can be removed without removing fill box. Entire assembly shall seal tight with no leakage during filling and when cap is in place.
 4. Provide special tools necessary for opening fill boxes and fill caps.
- C. Fill caps located above grade without fill boxes shall be lockable, tight-fill design, operated by special wrench that shall be furnished. Entire assembly shall seal tight with no leakage during fill and when cap is in place.
- D. Refer to Section 05 50 00, METAL FABRICATIONS, for access platforms shown for aboveground tanks.
- E. Support horizontal portion of pipes located inside tank every 2100 mm (7 feet) maximum.
- F. Furnish gauging chart, liters versus mm and gallons versus inches depth.
- G. Fill Point Identification:
1. Fill Caps above Grade: Aluminum, brass or bronze plate, clamped to fill pipe, with stamped or engraved letters 18 mm (0.75 inch) high.
 2. Legend: "DIESEL FUEL FILL" as appropriate.

2.3 PIPING, VALVES, FITTINGS:

- A. Fuel supply and return, tank fill, vents, sounding, pump out, steam and condensate.
- B. Steel Pipe and Fittings:
1. Piping: Steel, seamless or electric resistance welded (ERW), ASTM A53 Grade B or ASTM A106 Grade B, Schedule 40. Aboveground piping shall be painted. Refer to Section 09 91 00, PAINTING.

2. Joints: Socket or butt-welded. Threaded joints not permitted except at valves, unions and tank connections.
 3. Fittings:
 - a. Butt-welded joints: Steel, ASTM A234, Grade B, ASME B16.9, same schedule as adjoining pipe.
 - b. Socket-welded joints: Forged steel, ASME B16.11, 13 700 kPa (2000 psi) class.
 4. Unions: Malleable iron, 2050 kPa (300 psi) class.
 5. Companion flanges: Flanges and bolting, ASME B16.5.
 6. Welding flanges: Weld neck, ASME B16.5, forged steel ASTM A105, 1025 kPa (150 psi).
- C. Glass Fiber Reinforced Plastic (FRP) Pipe and Fittings:
1. Conform to UL 971 and ASTM D2996 using a filament-winding process and epoxy or vinyl ester resins.
 2. Design pipe, fittings and joining system for required fuel service, 66 °C (150 °F), 1030 kPa (150 psi) pressure, 68 kPa (20 inches HG) vacuum.
 3. Provide an integral resin-rich liner, 0.5 mm (0.020 inches) minimum thickness to enhance the corrosion resistance. Outer layer shall include ultra-violet inhibitors. Joining adhesive shall be designed for the pipe furnished and shall be supplied by the pipe manufacturer.
 4. Plastic pipe and fittings are not permitted on steam or condensate service. Plastic piping allowed in underground use only.
- D. Check Valves - Fuel Pump Suction.
1. Pipe Sizes 50 mm (2 inches) and under: Rated for 1375 kPa (200 psi) water-oil-gas, swing-type, threaded ends, ASTM B62 bronze body. Provide union adjacent to valve.
 2. Pipe Sizes 65 mm (2 1/2 inches) and above: Rated for 1375 kPa (200 psi) water-oil-gas, swing-type, 850 kPa (125 pounds) ASME flanged ends, ASTM A126 class B cast iron body.
- E. E. Foot Valves - Fuel Pump Suction: Double poppet, lapped-in metal-to-metal seats, double-guided stems, 20 mesh inlet screen, same size as fuel suction piping. Foot valve shall be removable to above grade through the tank manhole enclosure or through extractor fitting.
- F. F. Extractor Fittings: Arranged to permit removal of foot valves, overfill prevention valves, and other devices that are located below grade. Access point shall be through a cast iron fill box-type manhole located at grade. Provide extractor wrench.

- G. G. Overfill Prevention Valve: Aluminum automatic valve designed for underground or aboveground tanks, as applicable. Removable through the extractor fitting on underground tanks. Locate valve near the top of the tank in the fill pipe. On underground tanks with gravity fill, provide two stage automatic float-operated valve. First stage operation at 92 percent tank capacity shall reduce flow to 19 L per minute (5 gallons per minute) or less. Second stage operation shall stop flow completely when tank is no more than 95 percent full. On aboveground tanks, or tanks pressure-filled, provide single stage valve, rated for fill flow and pressure, which stops flow completely at 95 percent of tank capacity. Valve shall include method for draining oil trapped above the valve into the tank.

2.4 LEAK DETECTION SYSTEMS:

- A. Automatic digital continuous monitoring systems responsive to the presence of water and hydrocarbons in the interstitial space of the double-wall tanks, in the tank manhole access enclosures, and in the secondary containment of fuel piping systems. System shall distinguish between hydrocarbon and water and identify location of leak as to individual tank and piping system.
- B. Functions and Arrangement:
1. Single control station to monitor all sensing probes.
 2. Visual indicator to monitor and identify leaks as water or hydrocarbon and location.
 3. Indicators showing system status including faults and alarms.
 4. On board printer that provides complete reports of all system functions upon command.
 5. Panel circuit test button.
 6. 95 dB audible alarm with silencing control to sound when leak is detected.
 7. Eight hour memory backup system with battery.
 8. NEMA 250 Type 4 cabinet.
 9. UL or other accredited testing laboratory listing.
 10. RS232 Modbus communications with engineering control system to indicate system in service and alarm conditions.
- C. Sensors:
1. Designed for required locations including: Insertion between walls of double-wall tanks, in sumps in double-wall piping systems and in tank manhole enclosures. Sensing points shall be at lowest point of each tank or sump. Intrinsically safe design.
 2. Sensing units shall detect presence of water and a minimum 3 mm (0.125 inch) thick layer of hydrocarbon on surface of water and

minimum 50 mm (2 inch) thickness of hydrocarbon in area that has no water present.

3. Sensors shall be arranged to allow replacement of individual sensors without disturbing other portions of leak detection system or fuel storage and piping system. Underground sensors shall be accessed through caps as grade.
4. Materials of construction shall be non-corroding.
5. Transmit status signal to control unit.

D. Components:

1. Provide manholes at grade for each sensor cap similar in construction to fill boxes. Manholes shall be cast iron, quick-opening cover, watertight, minimum size necessary to accommodate sensor caps. Provide identification plates, similar to those specified for fill points, labeled "MONITORING/OBSERVATION WELL-DO NOT FILL". Provide special tools if necessary for opening covers.
2. Sensor housings from tank and piping to grade shall be Schedule 40 PVC, or stainless steel.
3. Underground wiring between probes and control unit: Place in water-tight corrosion-resistant conduit system conforming to Section 26 05 41, UNDERGROUND ELECTRICAL CONSTRUCTION.

2.5 FUEL TRANSFER PUMPS

- A. Primary and Secondary fuel transfer pumps from main fuel storage tank and engine-generator day tank shall be vertical single stage turbine type as indicated on the drawings.
- B. Emergency fuel transfer electrical pump shall be gear type.
- C. Day tank fuel oil return pump shall be gear type self priming horizontal.

2.6 FUEL PUMP CONTROLS AND DAY TANK MONITORING AND ALAMS

- A. Each day tank shall be furnished with the following instruments and alarms.
 1. Fuel high level alarm.
 2. Fuel high level normal.
 3. Fuel low level normal.
 4. Fuel low level alarm.
 5. Fuel temperature transmitter.
 6. High fuel temperature alarm.

7. Fuel filter high differential pressure alarm.

B. The fuel pumps motor controllers shall perform the following operations.

1. On fuel high level alarm, close fuel oil supply solenoid valve, open fuel oil return solenoid valve and start fuel oil return pump.

2. On fuel oil high temperature open fuel oil supply and fuel oil return solenoid valves and start fuel oil return pump.

3. When fuel oil drops below normal high level, open fuel oil supply solenoid valve and start primary fuel oil transfer.

4. When fuel oil drops to or below fuel low level normal start the second stage fuel transfer pumps and turn-off the fuel oil return pump.

5. When the fuel level high is restored turn-off all pumps, unless the generator is running then maintain operation of first stage supply oil pump.

6. The fuel pumps shall alternate lead/lag functions to maintain equal wear on the pumps.

2.7 LEAK DETECTION SYSTEMS:

A. Automatic digital continuous monitoring systems responsive to the presence of water and hydrocarbons in the interstitial space of the double-wall tanks, in the tank manhole access enclosures, and in the secondary containment of fuel piping systems. System shall distinguish between hydrocarbon and water and identify location of leak as to individual tank and piping system.

B. Functions and Arrangement:

1. Single control station to monitor all sensing probes.

2. Visual indicator to monitor and identify leaks as water or hydrocarbon and location.

3. Indicators showing system status including faults and alarms.

4. On board printer that provides complete reports of all system functions upon command.

5. Panel circuit test button.

6. 95 dB audible alarm with silencing control to sound when leak is detected.

7. Eight hour memory backup system with battery.

8. NEMA 250 Type 4 cabinet.
 9. UL or other accredited testing laboratory listing.
 10. RS232 Modbus communications with engineering control system to indicate system in service and alarm conditions.
- C. Sensors:
1. Designed for required locations including: Insertion between walls of double-wall tanks, in sumps in double-wall piping systems and in tank manhole enclosures. Sensing points shall be at lowest point of each tank or sump. Intrinsically safe design.
 2. Sensing units shall detect presence of water and a minimum 3 mm (0.125 inch) thick layer of hydrocarbon on surface of water and minimum 50 mm (2 inch) thickness of hydrocarbon in area that has no water present.
 3. Sensors shall be arranged to allow replacement of individual sensors without disturbing other portions of leak detection system or fuel storage and piping system. Underground sensors shall be accessed through caps as grade.
 4. Materials of construction shall be non-corroding.
 5. Transmit status signal to control unit.
- D. Components:
1. Provide manholes at grade for each sensor cap similar in construction to fill boxes. Manholes shall be cast iron, quick-opening cover, watertight, minimum size necessary to accommodate sensor caps. Provide identification plates, similar to those specified for fill points, labeled "MONITORING/OBSERVATION WELL-DO NOT FILL". Provide special tools if necessary for opening covers.
 2. Sensor housings from tank and piping to grade shall be Schedule 40 PVC, or stainless steel.
 3. Underground wiring between probes and control unit: Place in water-tight corrosion-resistant conduit system conforming to Section 26 05 41, UNDERGROUND ELECTRICAL CONSTRUCTION.

2.8 TANK FLUID LEVEL MONITOR AND ALARM SYSTEMS:

- A. Digital systems for central monitoring of fuel and water levels in all fuel oil storage tanks in the project. High and low level visual and audible alarms. Volumetric tank-tightness testing. Complete with all transducing, transmitting, and receiving devices. On board printer to provide complete report of all system functions upon command. Fluid Level Monitor:

1. Digital continuous readout, showing tank oil and water levels in gallons, smallest reading one gallon. Provide identification of product measured, measuring units, and the tank number.
 2. Tank and fuel characteristics contained in preprogrammed non-volatile field-replaceable databases. Protected power supply.
- B. High and Low Fluid Level Alarm System:
1. Automatic continuous on-line monitoring of all tanks.
 2. Visual and audible indicators combined with fluid level monitor. Identify the tank that is in alarm condition.
 3. Manual alarm test and silencing controls.
 4. Low level alarm actuation adjustable 0-25 percent of tank capacity. High level alarm actuation adjustable 75-100 percent of tank capacity.
- C. Locate all indicators, selector switches, alarms on face of wall-mounted NEMA 250, Type 4 panel.
- D. Remote Alarm Annunciator:
1. Visual and audible high level alarms adjacent to tank fill box locations. Locate in NEMA 250 Type 4X weatherproof exterior wall or pole-mounted panels.
 2. Alarm shall include flashing red light with 180 degree visibility for each tank and 95 dB horn or 100 mm (4 inch) diameter bell. Provide alarm silence control.
 3. Provide identification sign: "WHEN ALARM SOUNDS - FUEL TANK FILLED TO CAPACITY - DO NOT OVERFILL".
- E. Modbus communication to engineering control to indicate tank fluid level and alarm conditions. Telephone modem communication capability.
- F. System Performance: Accuracy plus or minus 2.5 mm (0.01 inch) of fluid height in inventory mode and 0.25 mm (0.001 inch) in leak detection mode. Automatic compensation for fluid temperature changes. Volumetric tank tightness sensitivity of 0.4 lph (0.1 gph).
- G. Sensors:
1. Provide sensor types such as magnetostrictive, capacitance, float, hydrostatic and other types as necessary for the applications.
 2. Apply in accordance with manufacturer's instructions with provisions for easy future replacement without need for excavation.
 3. Provide for each hydrostatic sensor a constant flow differential pressure regulator and pneumatic transmitter protected from fuel contamination. Air supply shall include filter and over-pressure protection. Provide desiccant-type dryer on air supply designed for

removal of water vapor. Dryer rating, minimum 280 cubic liters per minute (10 scfm). Provide moisture indicator. Dryer may be deleted if air supply source has a refrigerated dryer.

4. Float-type units shall be designed for installation and removal through a 100 mm (4 inch) diameter vertical pipe mounted in the top of the tank.

H. Code Conformance: NFPA-70.

2.9 FUEL OIL QUALITY MAINTENANCE SYSTEMS:

- A. Complete factory-assembled automatic particulate filtration and dewatering and fuel additive injection system to maintain the purity of No. 2 fuel oil in storage. The system shall circulate the oil from the storage tank, through the system, and back to the storage tank. Provide quantity and capacity of systems to serve tanks as shown, connected to the tank suction and return pipes. Drawings may show multiple tanks served by one system. Smaller systems without large water storage tanks and without fuel additive injection shall be wall-mounted. Units with water storage tanks and/or additive injection shall be floor-mounted on steel skids on concrete foundations. Digital controls.
- B. Performance: Design for nearly 100% water removal. Provide 2 micron particulate filtration. Each system shall have capacity to turn over the largest connected full tank one time within 1122 hours maximum. System shall be designed to allow continuous operation with brief interruptions to manually change filters and clean strainers.
- C. Components:
 1. Strainer: 100 mesh perforated stainless steel basket. Clamped covers. 860 kPa (125 psi) design pressure.
 2. Water Separation Unit: Two stage, designed to reduce water content of fuel to less than 10 ppm. Centrifugal separator for removal of large droplets and renewable resin-impregnated cellulose water coalescing elements. Water removed shall flow to water holding sump in the unit. Water sensing probe to alert the operator when water level in bowl has reached capacity. Automatic pumped drain to holding tank actuated by electronic water level sensing devices in the separation unit.
 3. Filter: 2 micron filtration with 96% removal efficiency, valved manual drain. Replaceable elements.
 4. Filtration Pump: Positive displacement base-mounted pump with cast iron or bronze housing, for circulating the oil from the storage tank, through the water separation and filter units and back to the storage tank. Pump shall have carbon bushings, stainless steel shaft and Teflon mechanical seal, ODP motor.

5. Controls:
- a. Digital PLC electronic controls for all system control and alarm functions. Relay logic not acceptable.
 - b. Control panel with selector for modes of operation, indicators to show system status, and visual and audible alarms to signal the need for operator intervention. Operator interface shall be 2 x 20 LCD and keypad.
 - c. Controls shall include:
 - 1) Control power "on-off".
 - 2) "Cycle Start".
 - 3) "Cycle Cancel".
 - 4) "Hand-off-Auto" for filtration pump.
 - 5) Pump cycle timer set function.
 - 6) Cycle duration selector.
 - 7) "Auto-Off" switch for water transfer pump.
 - 8) "Auto-Off" for chemical additive pump.
 - d. Indications shall include:
 - 1) "Control Power On".
 - 2) "Pump Run".
 - 3) "Pump Failure".
 - 4) "Excess Water in Fuel".
 - 5) "Filter Water Level High".
 - 6) "Rupture Basin Leak" alarm.
 - 7) "High Pressure Drop in Strainer" alarm.
 - 8) "High Pressure Drop in Filters" alarm.
 - 9) "High Pressure" alarm and automatic shut down.
 - 10) "High Water Level" in water storage tank.
 - e. Filter and strainer differential pressure gages, differential pressure switches and control. Provide indication when filters should be changed.
 - f. Over pressure switch and control to shut down pump if filter inlet pressure exceeds limits.
 - g. All primary wiring exiting the enclosure shall be encased in conduit.
 - h. Magnetic motor starters with overload protection.

- i. Circuit breakers.
 - j. Control enclosure shall be NEMA 12, fully gasketed doors with 3 point lockable latching. Interior shall have white gloss finish; exterior shall be chemical-resistant gray enamel. All controls and indicating devices shall be mounted on front of enclosure and labeled with black Phenolic labels with white lettering.
 - k. Modbus communication to engineering control system or alarms and system status.
- D. Enclosure – Wall Mounted Units: 14 gauge steel, NEMA 12/13 standards, continuously welded, framed cabinet. Provide doors for complete access to all equipment. Doors shall have a turned edge, piano hinges, three-point locking mechanisms. Corrosion-resistant prime and finish coatings on all interior and exterior surfaces.
- E. Water Drainage System: Sealed bowl (bottle) with high level alarm system. Water collected in filters shall drain to a sealed bowl that can be easily removed and emptied.
- F. Chemical Additive System: Provide welded steel chemical storage tank and chemical pump that shall automatically add chemical to the fuel being circulated. Tank shall be sized to hold five years supply of additive as recommended by additive supplier. Pump shall be positive displacement metering type with totally enclosed 250 watt (1/3 hp) motor, cast iron pump body, stainless steel trim and Teflon diaphragm. Output of pump shall be adjustable for 0 to 100% of capacity. Control system shall automatically operate the pump for an adjustable time period during each filtration cycle.

2.10 CONCRETE FOUNDATIONS:

- A. Concrete pads for aboveground tanks are specified under Section 03 30 00, CAST-IN-PLACE CONCRETE.

PART 3 - EXECUTION

3.1 INSTALLATION AND TESTING, ABOVEGROUND TANKS:

- A. Conform to NFPA 30 or 31 as applicable.
- B. Support tanks on steel saddles welded to the tanks. Anchor to concrete foundations. Provide molded neoprene isolation pads between the steel supports and the concrete foundation.
- C. After tanks are installed, test steel tanks with air pressure of 20 kPa to 35 kPa (3 - 5 psi), using soapsuds to locate leaks. Repair leaks by chipping to bare metal and rewelding. Retest until all leaks are repaired. Repair all damaged areas of prime coat on tanks and steel dikes (if furnished). Test interstitial area between steel tank walls with air at pressure

recommended by tank manufacturer. Tests shall be witnessed by the COR.

- D. Surface finish coating for tanks and steel dikes (if furnished) is specified under Section 09 91 00, PAINTING.
- E. Provide electrical grounding in accordance with NFPA 70.

3.2 INSTALLATION AND TESTING OF DAY TANKS AND PUMPS

- A. Install day tank on equipment pad provide.
- B. Ensure that all piping connections indicated on the drawings are completed including pipes to and from main storage tank and normal and emergency vents through the roof.
- C. Ensure that all instrumentation pumps and controllers are installed and tested.
- D. Test secondary containment switch.
- E. Test operation of fuel transfer pumps.
- F. Test operation of electrical emergency transfer pump using a temporary generator and cable.
- G. Test all the functions of the fuel pumps controls and alarms specified in paragraph 2.6.
- H. Test and monitor day tank operation during generator start-up and tests indicated on Section 26 32 13, Engine Generators.

3.3 INSTALLATION AND TESTING, LEAK DETECTOR SYSTEMS FOR TANKS AND PIPING:

- A. Wiring shall conform to NFPA-70.
- B. Locate control monitor panels 1500 mm (5 feet) above the floor on inside wall of boiler room, generator room or garage, depending on type of fuel tank served, unless shown otherwise.
- C. Test operation of each probe, and monitoring system with fuel and water. If type of probe utilized is damaged by exposure to fuel, provide temporary probe for testing monitoring system.

3.4 INSTALLATION, TANK FLUID LEVEL INDICATOR AND ALARM SYSTEM:

- A. Wiring shall conform to NFPA-70.
- B. Locate level indicator and alarm panel 1500 mm (5 feet) above the floor on inside wall of boiler room, generator room or garage, depending on type of fuel tank served, unless shown otherwise.

- C. Locate remote high level alarm on exterior wall or pole in view of tank fill point, 2400 mm (8 feet) above grade.

3.5 INSTALLATION, FUEL OIL QUALITY MAINTENANCE SYSTEMS:

- A. Locate systems within easy reach of persons standing on floor, with sufficient elevation to allow gravity flow of water from system to water storage tank sitting on the floor.
- B. Connect to tank suction and return piping systems with isolation valves. Provide compound pressure gages at suction and discharge piping connections. Refer to Section 23 09 11, INSTRUMENTATION AND CONTROL FOR BOILER PLANT for gage requirements.

END OF SECTION 23 10 00