SECTION 23 10 00
FACILITY FUEL SYSTEMS

PART 1 – GENERAL:

SPEC WRITER NOTES:
1. Delete between //___// if not applicable to project and delete any other item or paragraph not applicable in the section and renumber the paragraphs.
2. Revise as necessary to conform to local and state regulations.
3. References to pressure are gage pressure unless otherwise noted.
4. This spec does not cover heated burner fuel storage.
5. VA National CAD Standard for underground oil storage tanks, 30,000 litres (8000 gallons) and above: 15606-1.DWG

1.1 DESCRIPTION:

SPEC WRITER NOTE: Verify that the contract drawings show complete info on the tank locations, capacities, piping arrangement.

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. Underground steam and condensate piping for tank heaters: Section 33 63 00, STEAM ENERGY DISTRIBUTION.

B. Excavation and backfill for underground tanks and piping: Section 31 20 00, EARTH MOVING and Section 31 20 11, EARTH MOVING (SHORT FORM).

C. Concrete ballast foundations and concrete pads: Section 03 30 00, CAST-IN-PLACE CONCRETE.

D. Sidewalk doors for underground tank manway enclosures: Section 05 50 00, METAL FABRICATIONS.

E. Platforms, stairs, ladders and railings for aboveground tanks: Section 05 50 00, METAL FABRICATIONS.

F. Sealing of pipe penetrations: Section 07 92 00, JOINT SEALANTS.

G. Primer and finish painting: Section 09 91 00, PAINTING.
H. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.
I. Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION.
J. Field insulation of heated oil piping and aboveground tanks and aboveground oil piping: Section 23 07 11, HVAC, PLUMBING, AND BOILER PLANT INSULATION.
K. Steam and condensate carrier piping within tanks and access manholes: Section 23 21 11, BOILER PLANT PIPING SYSTEMS.
L. Fuel oil pumps for boiler plant: Section 23 50 11, BOILER PLANT MECHANICAL EQUIPMENT.
M. Fuel oil pumps for engine generators: Section 26 32 13, ENGINE GENERATORS.
N. Underground conduit systems for tank fluid level monitors and tank and piping leak detectors: Section 26 05 41, UNDERGROUND ELECTRICAL CONSTRUCTION.

//O. Where soil resistivity is less than 4000 ohm-cm: Section 26 42 00, CATHODIC PROTECTION). //

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 Resident Engineer (RE)/Contracting Officers Technical Representative (COTR) for
resolution. Provide copies of installation instructions to the RE/COTR 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.


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 RE/COTR.

I. Where specified codes or standards conflict, consult the RE/COTR.

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. Underground Tanks:

1. Drawings of tanks, anchoring devices, heating coils (if required), tank manholes, tank manhole enclosures, access doors for the tank manhole enclosures and all accessories. Include overall dimensions
2. Manufacturer's installation instructions describing recommended foundation, bedding and backfill material, support and anchoring devices, and method of installation.

3. Weight of entire tank assemblies, empty and flooded.


5. Certification that steel tank manufacturer participates in the Steel Tank Institute (STI) Quality Assurance Program.

6. Data certifying that tanks are designed for surcharge loads of backfill, traffic and other construction.

7. Design and construction of tanks, secondary containment, pipe connections, manholes, anchoring devices, access doors for tank manhole enclosures.

8. Application and performance data on tank coating (steel tanks) from manufacturer of coating.

9. Design of cathodic protection system (when specified) for steel tanks.

C. 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.


SPEC WRITER NOTE: Delete the following subparagraph in non-seismic projects.
10. Seismic Data: Refer to Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.

D. Fuel Piping:
   1. ASTM and UL compliance.
   2. Grade, class or type, schedule number.
   3. Manufacturer.

E. Pipe Fittings, Unions, Flanges:
   1. ASTM and UL compliance.
   2. ASTM standards number.
   3. Catalog cuts.
   4. Pressure and temperature rating.

F. 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.
   5. Accessories.

G. 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).

H. 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.

I. 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.

J. Tank and Piping Accessories: Design, construction, and dimensions of vent caps, fill boxes, fill caps, spill containers and other accessories.
K. Fuel Quality Maintenance System:
   1. Drawings and description of all components and arrangement of system.
   2. Design and performance of pumps, filters.
   3. Catalog data and operation of control system.
   4. 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 RE/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.):
   A-A-60005 .............. Frames, Covers, Grating, Steps, Sump and Catch Basin, Manhole

C. ASTM International (ASTM):
   A36/A36M-08 ............ Carbon Structural Steel
   A53/A53M-10 ............ Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
   A106/A106M-10 .......... Seamless Carbon Steel Pipe for High Temperature Service
   A234/A234M-10 .......... Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service
   B62-09 .................. Composition Bronze or Ounce Metal Castings
   D2996-01(2007) ......... Filament-Wound "Fiberglass" (Glass-Fiber-Reinforced-Thermosetting-Resin) Pipe

D. American Society of Mechanical Engineers (ASME):
   B16.5-09 ............... Pipe Flanges and Flanged Fittings (NPS ¼-24).
   B16.11-09 ............. Forged Fittings, Socket-Welding and Threaded
   B31.1-10 ............... Code for Pressure Piping, Power Piping with Current Amendments

E. National Electrical Manufacturers Association (NEMA):
   250-08 .................. Enclosures for Electrical Equipment (1000 Volts Maximum)

F. National Fire Protection Association (NFPA):
   30-12 .................. Flammable and Combustible Liquids Code
   31-11 .................. Installation of Oil Burning Equipment
   70-11 .................. National Electrical Code

G. 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

H. 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
P3 ....................... STI-P3 Specification and Manual for External Corrosion Protection of Underground Steel Storage Tanks
R891 ..................... Recommended Practice for Hold Down Strap Isolation

I. 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

J. American Petroleum Institute (API):
1631-01 ............... Interior Lining and Periodic Inspection of Underground Storage Tanks

1.7 PERMITS:
Contractor shall obtain and complete all tank permit and registration forms required by governmental authorities.

SPEC WRITER NOTE: Make material requirements agree with applicable requirements specified in the referenced Applicable Publications. Update and specify only that which applies to the project.
PART - 2 PRODUCTS:

2.1 UNDERGROUND STEEL TANKS:

A. Factory fabricated all welded double-wall steel, horizontal cylindrical configuration, atmospheric pressure, internal and external corrosion protection as specified. 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, UL 58 double-wall, 360-degree secondary containment.
2. Conform to NFPA 30 or 31 as applicable.
3. The bottom 60 degrees of all lap or offset circumferential interior seams shall be seal welded 30 degrees each way from bottom centerline to retard corrosion.
4. Design for surcharge loads such as backfill and paving as shown. In addition, in paved areas, design for H-20 (14,500 kg) (32,000 pound) axle loading.
5. Leaks and abrasions are not permitted. Maximum out-of-roundness is one percent of the diameter.
6. Outer wall shall provide leak tight secondary containment that covers 100 percent of tank volume and shall permit migration of any inner tank leakage to the lowest part of the tank where leak detectors are located. Make provisions for leak detectors to be furnished at lowest part of interstitial space between tank walls.

C. Factory Cleaning: Clean interior and exterior. Remove all mill scale, dirt, rust, oil, welding debris, loose coatings and coatings and material incompatible with fuel stored or protective coating to be furnished. Sandblast exterior in accordance with NACE 3 and STI corrosion protection system requirements.

SPEC WRITER NOTE:
Select the Steel Tank Institute (STI) corrosion protection system in Par. D that is required for the project.
Reference: www.steeltank.com

D. Factory Applied Exterior Corrosion Protection System: Steel Tank Institute (STI) //ACT-100 steel/FRP composite (STI F894)//ACT-100-U urethane coating (STI F961)//STI-P3 coating/cathodic protection (STI F841, P3)//technology. Tank shall be labeled to indicate compliance. Provide signed holiday test results. Provide STI standard limited 30 year warranty against internal and external corrosion penetrating the tank.
E. Factory Applied Interior Coating: API 1631 coating from bottom of tank to 1 m (3 feet) from bottom.

SPEC WRITER NOTE:
ACT-100 and 100-U: Par. F and G are optional.
STI-P3: Include Par. F and G. Where soil resistivity is less than 4000 ohm-cm, delete Par. F and G and specify complete cathodic protection system under Section 26 42 00, CATHODIC PROTECTION.

//F. Cathodic Protection: Conform to UL 1746 and STI-P3, consisting of galvanic anodes, wire conductors welded to the tank and connected to test stations and anodes, insulating devices to electrically isolate the tank from piping, test stations properly connected to permit required tests.

G. Cathodic Protection System Test Stations:
1. STI PP2 system for tanks.
2. Weatherproof high-impact-resistant plastic housing. Provide means to securely anchor housing. Locking cover for terminal board. Yellow color. Identification "CP TEST STATION" molded in cover or otherwise permanently marked.
3. High-impact-resistant plastic terminal board, cadmium-plated or zinc-plated hardware, accessible from front and rear, sufficient terminals for all required connections. //

SPEC WRITER NOTE: Verify that drawings are coordinated with following paragraph. Revise as necessary if concrete enclosure is to be provided.

H. Tank Manhole Enclosures:
1. Rectangular or cylindrical enclosures, sized as shown, designed to contain fuel spills from leaking piping. Locate all tank manholes and tank piping connections within the enclosure. Watertight pipe penetrations.
2. Steel, fiberglass or polyethylene. Reinforce to prevent deflection. Leak-tight attachment to tank. Clean and coat interior and exterior of steel enclosure as specified for exterior of tank.
3. In traffic areas, enclosure must be designed to withstand traffic loads (H-20 wheel loading, 14 500 kg, (32,000 lb)) and must have flexible isolation system to prevent wheel loads being transmitted to tank.
4. For steel enclosures, provide cathodic protection system and test station as specified for the tanks.


I. Pipe Connections to Tanks:
   1. Conform to UL 58.
   2. Pipe sizes 100 mm (4 inches) and smaller, threaded. Pipe sizes 150 mm (6 inches) and larger, raised faced slip-on flanges, 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 fluid level gage unit; leak detector sensor; sounding rod; vent, fill, supply and return pipes; and other pipes as shown.
   5. Dielectric insulation on all connections to steel piping.
   6. All tank piping connections, except vent, shall be within the tank manhole enclosure.


K. Internal Ladder: Provide as shown and shall have 50 mm x 6 mm (2 inch x 0.25 inch) sides, 20 mm (0.75 inch) diameter rungs on 300 mm (12 inch) centers. Provide slide supports to allow for tank movement.

L. Wear (Striker) Plates: Provide 300 mm (12 inch) square, 6 mm (0.25 inch) thick steel plates rolled and seal-welded to bottom of tank directly under all openings.

M. Lifting Lugs: Provide for rigging tanks.

N. Hold Down Straps: Provide quantity and design of EPDM-type rubber encased steel straps as recommended by tank manufacturer to anchor tank to concrete ballast slab. Hold down strap electrical isolation shall conform to STI R891. Straps shall have tension load capability equal to hold-down capability of ballast slab, with a minimum safety factor of two. Provide complete anchorage devices, including turnbuckles, for adjusting tension.

2.2 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.

   SPEC WRITER NOTE: For description of STI design features refer to www.steeltank.com.
   Insulated tank may not require dike. Contact local authorities for requirements.

//3. Double-wall, un-insulated, conforming to STI F001 “Flameshield” construction. Provide label of conformance. //

//4. Double-wall, insulation between walls, conforming to STI F941 "Fireguard" construction, and to UL 2085. Provide label of conformance. //

//5. Single-wall. No STI standards apply.//

//6. Steel dike walls and floors conforming to STI F911. Provide minimum containment of 110 percent of primary tank contents. // Provide steel rain shields which cover the open areas between the tank and the dike wall. //

7. Design for surcharge load produced by tank-mounted platforms and platform loadings shown. Design tanks for saddle supports furnished by tank manufacturer.

8. Leaks and abrasions are not permitted. Maximum permissible out-of-roundness of cylindrical shells is one percent of the diameter.


10. 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.

SPEC WRITER NOTE: Delete following subparagraph in non-seismic project.

N. Seismic Design: Refer to Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.
2.3 ABOVEGROUND CONCRETE-INSULATED STEEL VAULT TANKS:

A. Type: All-welded steel tank, horizontal cylindrical or rectangular configuration, atmospheric pressure, concrete insulation, double-containment, for aboveground installation as shown. Entire unit factory-fabricated, including steel tank and concrete insulation. Provide tank supports that can be anchored to a concrete foundation.

B. Construction:
1. Comply with UL-2085 for protected tanks, vehicle impact resistant and projectile resistant with secondary containment. Provide label of conformance.
2. Inner tank ASTM A36 steel constructed in conformance with UL-142. Provide label of conformance. Steel tanks shall be supported as recommended by steel tank manufacturer. Top of secondary tank shall be sloped to shed rainwater. Test tanks for leaks with test pressure of 20 - 34 kPa (3 - 5 psi) gage. Furnish certificate that inner and outer tanks have been tested and are leak-free and pressure-tight.
3. Concrete Insulation:
   a. Shall consist of 25 MPa (3000 psi) minimum concrete.
   b. Shall be structurally designed to support the filled tank and a top live load of 4.8 kPa (100 lb./sq. ft.).
   c. Monolithic pour with no cold joints, heat sinks. As an alternate, there may be one continuous shiplap joint located at horizontal center of vault sealed with fire and fuel resistant gaskets.
   d. Construct in accordance with ACI and AASHTO standards including concrete placement, vibration, and quality assurance.
4. Conform to NFPA 30 or 31 fire safety standards as applicable. Design for two-hour fire exposure. Provide fittings for grounding per NFPA 70.
5. The tank assembly shall have capability of physical monitoring for leaks between primary and secondary containment.
6. Provide overfill containment (spill container) with internal drain and positive seal.

C. Factory Cleaning: Clean interior and exterior. Remove mill scale, dirt, rust, oil, welding debris, loose coatings and coatings incompatible with fuel stored or protective coating.

D. Factory Coatings: Provide coating of rust resistant red oxide primer on non-fuel side of steel tanks. For tanks with interior access, coat interior of primary tank from bottom to 1 m (3 feet) above bottom in
conformance with API RP 1631. Provide two coats of fuel resistant epoxy coating on exposed surfaces of the external concrete tank.

E. Platforms, Ladders, Stairs, Handrails: Provide as shown. Shall be welded steel assemblies conforming to OSHA requirements. Paint in accordance with Section 09 91 00, PAINTING. Galvanizing is an acceptable alternative.

F. Pipe Connections to Tanks:
   1. Pipe shall terminate 75 mm (3 inches) minimum from top of unit.
   2. Conform to UL 142.
   3. Pipe sizes 50 mm (2 inches) and smaller, threaded. Pipe sizes 65 mm (2 1/2 inches) and larger, 1025 kPa (150 pound) ASME flanged.
   4. Welded joints required on steel piping located inside tanks.
   5. Provide and coordinate tank connection quantities, sizes and types with requirements of tank level gage unit; leak detector sensor; sounding rod; vent, fill, supply and return pipes; and other pipes as shown.
   6. Provide valved drain on interstitial space.

G. Tank Manholes: Provide quantity and size shown. Bolted cover type, gasketed.

H. Emergency Relief Vents for Fire Exposure: Venting capacity shall conform to NFPA 30 or 31 as applicable. Provide separate vents for primary and secondary tanks. Standard product of a manufacturer, designed to automatically open at tank pressure of 17 kPa (2.5 psi). Aluminum or cast iron construction, with Teflon-coated seating surface.

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.

   SPEC WRITER NOTE: Delete the following subparagraph in a non-seismic project.

L. Seismic Design: Refer to Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.
2.4 UNDERGROUND FIBERGLASS REINFORCED PLASTIC TANKS:

A. Type: Factory-fabricated, double-wall, fiberglass reinforced polyester (FRP), horizontal cylindrical configuration, atmospheric pressure, for underground installation as shown.

B. Construction:
1. UL 1316. Provide label of conformance.
2. Conform to NFPA 30 or 31 as applicable.
3. Design for surcharge loads due to backfill and paving as shown. In addition, in paved areas, design for H-20 (14,500 kg) (32,000 pound) axle loading.
4. Leaks and abrasions are not permitted. Maximum out-of-roundness is one percent of the diameter.
5. Outer wall shall provide leak-tight secondary containment that covers entire tank. Provide annular space between the walls arranged with flow channels to allow tank leakage at any point to flow to a leak detector at the bottom of the annular space. Provide connection point to outer wall and plastic pipe from tank connection to grade designed to accommodate leak detection device.

C. Factory Cleaning: Clean interior and exterior. Remove all dirt, debris, and coatings and material incompatible with fuel being stored.

D. Fiberglass Manhole Enclosures:
1. Cylindrical enclosures sized as shown, designed to contain fuel spills from tank piping. Locate all tank manholes and all tank piping connections within the enclosures.
2. Same material type and thickness as tank. Reinforce to prevent deflection. Provide leak-tight connection to tank designed to allow removal of tank manway cover without disturbing connection between enclosure and tank. Coat all exposed steel surfaces, such as bolting, with two coats of urethane.
3. In traffic areas, enclosures and tank must have flexible isolation system to prevent wheel loads from being transmitted to the tank.
4. For burner fuel tanks, design enclosure to permit installation and removal from above grade of present or future heating coil as an assembled unit.
metal doors as shown and as specified under Section 05 50 00, METAL FABRICATIONS. //

E. Pipe Connections to Tanks:
1. Conform to UL 1316.
2. Pipe sizes 100 mm (4 inches) and smaller, threaded. Pipe sizes 125 mm (5 inches) and larger, 1025 kPa (150 pound) ASME flanged.
3. Welded joints required on steel piping located inside tanks.
4. Provide and coordinate tank connection quantities, sizes and types with requirements of level gage unit; tank leak detector; sounding rod; vent, fill, supply and return pipes; and other pipes as shown.
5. All tank piping connections shall be within the tank manhole enclosures and sump/risers.

F. Tank Manholes: Provide quantity shown. Bolted cover type, gasketed, zinc-plated bolts, nuts and washers.

G. 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 support to allow tank movement.

H. Wear (Striker) Plates: Provide 300 mm (12 inch) square, 6 mm (0.25 inch) thick steel plates attached to bottom of tank directly under the sounding opening, the fuel return discharge, and the fill discharge.

I. Lifting Lugs: Provide for rigging tanks.

J. Hold-Down Straps: Provide quantity and design of FRP straps as recommended by tank manufacturer to anchor tank to concrete ballast slab. Straps shall have tension load capability equal to hold-down capability of ballast slab, with a minimum safety factor of two. Provide complete anchorage devices, including turnbuckles, for adjusting tension.

2.5 SOIL SEPARATOR MAT:
A. Material: Porous, non-woven polypropylene geotextile, Weight: 135 g per sq. meter (4 ounces per square yard), resistant to all alkalies and weak acids.

2.6 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. Watertight assembly, cylindrical body, quick-opening corrosion-resistant watertight sealable cover, polyethylene spill containment compartment with minimum 5//10//15//25// 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.

5. Protect spill container from traffic by ramped, drain-slotted cast iron body ring and cover. Design shall prevent transmission of traffic loads to the underground tank. Spill-container type not required at locations designated only for sounding tanks.

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. Furnish sounding rod for each tank size. Mark rods in increments representing five percent of tank capacity. Provide length of rod suitable for tank burial depth (if applicable). Rods shall be graduated in liters//gallons//.

H. Fill Point Identification:

1. Fill Boxes at Grade Level: Aluminum, brass or bronze plate, anchored to concrete fill box pad with stamped or engraved letters 18 mm (0.75 inch) high.

2. Fill Caps above Grade: Aluminum, brass or bronze plate, clamped to fill pipe, with stamped or engraved letters 18 mm (0.75 inch) high.
3. Legend: "BURNER FUEL OIL FILL" "DIESEL FUEL FILL" or "SOUNDING" as appropriate.

2.7 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.

4. Unions: Malleable iron, 2050 kPa (300 psi) class.


   SPEC WRITER NOTE: Delete the following paragraph if pipeline will be traced or if fuel temperature will exceed 66 degrees C (150 degrees F), or if fuel pressure can exceed 345 kPa (50 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. 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. 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. 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.

2.8 SECONDARY CONTAINMENT FOR UNDERGROUND FUEL PIPING SYSTEMS:

A. Enclose the fuel supply, return and fill pipes in factory-engineered and fabricated secondary containment conduit systems. The systems shall be complete with end seals, with 25 mm (1.0 inches) minimum continuous annular space, 37 mm (1.5 inches) between carrier pipes, which shall contain all leakage and which has provisions for leak detection system as specified.

SPEC WRITER NOTE: Where soil resistivity is less than 4000 ohm-cm, delete cathodic protection requirements below and specify complete cathodic protection system under Section 26 42 00, CATHODIC PROTECTION. Paragraphs B, C, D below can be contractor’s options or all but one of
the paragraphs can be deleted to suit the 
project.

B. Steel Conduit with Fusion-Bonded Epoxy Coating and Cathodic Protection:
1. Galvanized carbon steel pipe, ASTM A53, Grade B, Schedule 40 for 
diameters through 125 mm (5 inches), 3.4 mm (0.134 inch) thick for 
diameters greater than 125 mm (5 inches) up through 650 mm (26 

inches). All welded construction.
2. Sand blast exterior per NACE 3.
3. Coat exterior with 0.5 mm (20 mils) thick fusion-bonded epoxy.
4. Provide cathodic protection designed by corrosion specialist and 
consisting of galvanic anodes, test stations, interconnecting wiring 
in conformance with UL 1746 and NACE RP-0169. Electrical isolation 
required between all connecting systems in manholes and buildings.

C. Steel Conduit with Fiberglass Reinforced Plastic (FRP) Coating:
1. Carbon steel pipe, ASTM A53, Grade B, Schedule 40 for diameters 
through 125 mm (5 inches), 3.4 mm (0.134 inch) thick for diameters 
greater than 125 mm (5 inches) up thru 650 mm (26 inches). All 
welded construction.
2. Blast clean exterior per NACE 4.
3. Apply fiberglass reinforced polyester (FRP) external cladding at 
least 2.5 mm (0.10 inches) thick with ultra-violet inhibitor. 
Cladding on field joints shall be equivalent to factory-applied 
cladding applied on remainder of system.
4. Test entire system for holidays using a 35,000 volt holiday 
detector.
5. This system not permitted when carrier pipe or tracing system 
contains steam or condensate.

D. Glass Fiber Reinforced Plastic (FRP) Conduit:
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 carrier pipe fuel 
service, 66 °C (150 °F), 1030 kPa (150 psi) pressure, 68 kPa (20 
inches Hg) vacuum.
3. Provide an integral resin-rich liner, minimum thickness 0.25 mm 
(0.010 inch). Outer layer shall include ultra-violet inhibitors.
4. Minimum total wall thickness 1.8 mm (0.07 inch) for diameters below 
200 mm (8 inches), 2.8 mm (0.11 inch) for diameters 200 mm (8 
inches) and 250 mm (10 inches), 5 mm (0.20 inch) for diameters 250
mm (10 inches) through 500 mm (20 inches), and 6 mm (0.25 inch) for diameters above 500 mm (20 inches).

5. This conduit system is not permitted when carrier pipe or tracing system contains steam or condensate.

E. Pipe Supports: Provide supports within conduit for fuel carrier pipes spaced 2100 mm (7 feet) apart except 3000 mm (10 feet) apart for carrier pipe size 50 mm (2 inches) through 100 mm (4 inches). Support design shall permit differential movement of pipes, allow drainage of leakage to sumps, and maintain alignment of carrier pipes.

F. Conduit End Seals: Same material and coating as conduit; leak tight.

G. Leak Detector Sensor Locations: On each piping system, provide sumps at the low points with water-tight openings above grade for access to leak detector sensors. Design sumps to intercept all potential leakage. Maximum spacing between sumps, 3000 mm (100 feet).

2.9 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. System may be combined with tank fluid level monitor and alarm system specified in Article, TANK FLUID LEVEL MONITOR AND ALARM 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// boiler plant computer workstation// 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.

2.10 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. // System may be combined with leak detection system specified in Article, LEAK DETECTION SYSTEMS //.
B. Fluid Level Monitor:
   1. Digital continuous readout, showing tank oil and water levels in liters/gallons, smallest reading one liter / 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.

C. 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.
   4. Low level alarm actuation adjustable 0-25 percent of tank capacity.
      High level alarm actuation adjustable 75-100 percent of tank capacity.

D. Locate all indicators, selector switches, alarms on face of wall-mounted NEMA 250, Type 4 panel.

E. 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".

F. Modbus communication to engineering control system/boiler plant computer workstation to indicate tank fluid level and alarm conditions. Telephone modem communication capability.

G. 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).

H. 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.

I. Underground Wiring and Piping: Enclose in water-tight corrosion-resistant conduit system sized and arranged as recommended by system manufacturer and conforming to Section 26 05 41, UNDERGROUND ELECTRICAL CONSTRUCTION.


2.11 FUEL OIL QUALITY MAINTENANCE SYSTEMS:

SPEC WRITER NOTE:
1. Depending on the size of the tanks, multiple tanks may be served by one system or a separate system may be provided for each tank. One manufacturer recommends at least three turnovers of tank contents to achieve adequate filtration and dewatering.

2. Water collection devices may consist of a removable sealed bowl on the filter (small oil tanks) or an automatic pumping system from the filter to a water storage tank (large oil tanks).

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//pump-out// 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 //11//22// 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.//


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// boiler plant computer workstation// for 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.  

SPEC WRITER NOTE: The following water collection and holding system is applicable for large oil storage tanks.  

//E. Waste Water Holding and Removal System: Automatic system with gear pump and //100//150// gallon holding tank. System shall sense water in the filter enclosure, automatically start the pump to remove water from the water separation/filter system and pump it into the holding tank. If water collected in the filter enclosure exceeds the pumping capacity,
the filtration system shall automatically stop. Provide hand pump with outlet hose connection for emptying water from holding tank. Provide automatic valves that prevent oil flow into the tank or water flow out of the tank back into the oil system when the system is idle. Tank construction shall be centrifugally cast fiberglass reinforce isophthalic polyester resin. Tank shall have high level alarm and interlock to shut down the filtering system when the tank is full.//

SPEC WRITER NOTE: The following drainage system is applicable to small oil storage tanks or to tanks of any size with small water removal requirements.

//F. 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.//

//G. 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.//

H. Piping: Refer to Section 23 21 11, BOILER PLANT PIPING SYSTEMS.

I. Pressure Gages: Refer to Section 23 09 11, INSTRUMENTATION AND CONTROL FOR BOILER PLANT.

2.12 CONCRETE FOUNDATIONS:
Concrete ballast foundations for underground tanks and concrete pads for aboveground tanks are specified under Section 03 30 00, CAST-IN-PLACE CONCRETE. Ballast foundations shall be sized for buoyancy of entire tank when empty. Credit for overburden is allowed.

2.13 BURIED UTILITY WARNING TAPE:
Tape shall be 0.1 mm (0.004 inch) thick, 150 mm (6 inches) wide, yellow polyethylene with a ferrous metallic core, acid and alkali-resistant and shall have a minimum strength of 12,000 kPa (1750 psi) lengthwise and 10 300 kPa (1500 psi) crosswise with an elongation factor of 350 percent. Provide bold black letters on the tape identifying the type of
system. Tape color and lettering shall be unaffected by moisture and other substances contained in the backfill material.

PART 3 - EXECUTION

3.1 INSTALLATION AND TESTING, UNDERGROUND STEEL TANKS:

A. Conform to NFPA 30 or 31 as applicable.

B. Install tanks on 150 mm (6 inch) thick beds of clean, washed, inert sand that is placed on concrete foundation. Secure tank to concrete ballast foundation with specified straps. Slope tank. Completed tank installation shall successfully resist buoyant forces of flooding to top of tank when tank is empty.

C. After tanks are set in place, prior to backfilling, test tanks by applying internal air pressure of 35 kPa to 48 kPa (5 – 7 psi). Also test air space between tank walls at pressure recommended by tank manufacturer. Repair leaks in steel tanks by chipping to bare metal and rewelding. Repair leaks in plastic tank jackets (if furnished) as recommended by tank manufacturer. Retest tanks until all leaks are repaired. Test manhole enclosures by filling with water and proving no leakage for 24 hours. Tests shall be witnessed by Resident Engineer (RE)/Contracting Officers Technical Representative (COTR).

D. Prior to backfilling, repair all damage to tank coating with the same coating material. Coat all metal parts that will be below grade, including tie-down fittings and straps, bolts, rings, pipes, with the tank coating material. Perform 10,000 volt holiday test on all areas of coating which have been repaired.

E. Excavation, trenching and backfilling around the tanks is specified under Section 31 20 00, EARTH MOVING. Backfill material shall be same as bedding material and shall conform to printed instructions of tank manufacturer. In addition, there shall be no stones, ashes, or corrosive materials in contact with the tanks. Unstable and unsuitable soil shall be removed and replaced with suitable material. Provide a soil separation mat to keep soil separate from sand and pea gravel. Minimum depth of cover shall conform to NFPA 30 or 31 as applicable. After completion of backfilling, measure tanks internally for out-of-roundness (deflection).

F. Do not place fluid in the tank until the backfilling and the piping connections to the tanks are complete, and the tanks have been inspected internally by the RE/COTR. Keep the tank excavation dewatered.
3.2 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 RE/COTR.

D. For steel tanks storing heated oil, field-applied insulation requirements are specified under Section 23 07 11, HVAC, PLUMBING, AND BOILER PLANT INSULATION.

E. Surface finish coating for tanks and steel dikes (if furnished) is specified under Section 09 91 00, PAINTING.

F. Provide electrical grounding in accordance with NFPA 70.

3.3 INSTALLATION AND TESTING, UNDERGROUND FIBERGLASS REINFORCED PLASTIC TANKS:

A. Conform to NFPA 30 or 31 as applicable.

B. Place tanks on 300 mm (12 inch) thick beds of pea gravel (naturally rounded aggregate, clean and free flowing, conforming to the written requirements of the tank manufacturer).

C. Place gravel beds for tanks on concrete ballast foundations. Secure tanks to foundations with fiberglass reinforced plastic straps. Slope tanks. Completed tank installation shall successfully resist buoyant forces of flooding to top of tank when tank is empty.

D. After tanks are set in place, test by applying internal air pressure of 35 kPa (5 psi), using soapsuds to locate leaks. On double-wall tanks, test airspace between tank walls. Repair leaks in accordance with the instructions of the manufacturer under the on-site supervision of a representative of the manufacturer. Retest until all leaks are repaired. Tests shall be witnessed by the RE/COTR. Test manhole enclosures by filling with water and proving no leaks for 24 hours.

E. Prior to backfilling, clean and coat all metal parts that will be below grade (including straps, bolts, piping) with protective coats of
urethane, using quantities and methods recommended by the manufacturer of the coating for underground service.

F. Backfill around the tanks as recommended by the tank manufacturer. Backfill material shall be gravel identical to the bed material. If earth is to be placed above gravel, provide soil separator mat on top of gravel. Lap 300 mm (12 inches) at joints. Minimum depth of cover shall be in accordance with recommendations of tank manufacturer. Earth backfilling shall conform to // Section 31 20 00, EARTH MOVING/\Section 31 20 11, EARTH MOVING (SHORT FORM)/. Where soil conditions are unsuitable for tank installation, unsuitable soil shall be removed and replaced with suitable material. After completion of backfilling, measure tanks internally for out-of-roundness.

G. Do not place fluid in tanks until backfilling and piping connections to tanks are complete, and tanks have been inspected internally by COTR or RE. Keep tank excavation dewatered.

3.4 INSTALLATION AND TESTING, UNDERGROUND PIPING SYSTEMS:
A. Leak Detection System: Arrange fuel and tracing media (if required for heated oil) carrier piping, enclosed in secondary containment piping, to accommodate leak detection system. Slope piping down toward tanks and leak detectors at 25 mm in 10 m (1 inch in 40 feet).

B. Steel Fuel and Tracing Media Carrier Piping: All joints butt or socket welding. Threaded piping is not permitted. Piping ends shall be accurately cut, true, and beveled for welding.

C. Glass Fiber Reinforced Plastic (FRP) Fuel Carrier Piping and Secondary Containment Piping: Install in accordance with printed instructions of pipe manufacturer. Installation personnel trained in accordance with Article, QUALITY ASSURANCE. Plastic piping not permitted in same secondary containment system with steam or condensate piping.

D. Secondary Containment Piping:
1. Provide sand bedding and backfill material for steel piping and pea gravel for FRP piping.
2. Top of system 450 mm (18 inches) minimum below grade.
3. Design and locate leak detector sumps to intercept all potential leakage. Maximum spacing along each system, 3000 mm (100 feet).
4. Seal all building and manhole wall penetrations with a modular, watertight flexible penetration seal system. The modular penetration seal shall have a nitrile rubber seal, or if a fire separation is required, a high temperature silicone fire seal.
5. After placing system, prior to backfill, repair all damage, including coatings, as recommended in printed instructions of system manufacturer. Perform 10,000 volt holiday test on coated steel systems.

6. On steel systems that do not have FRP cladding, install cathodic protection system.

E. Anchorage of System: When heated oil system is provided, anchor systems and provide expansion loops and bends as shown and as recommended by manufacturer of system. Pipe stress due to thermal expansion shall not exceed the limits in ASME B31.1.

F. Leak Test: Test carrier pipes with air pressure at 690 kPa (100 psi), and test the containment piping with air pressure at 55 kPa (8 psi). Systems shall hold the pressure for 30 minutes. Repair all leaks and retest.


H. Buried Utility Warning Tape: Install tape 300 mm (12 inches) below grade above the piping system.

3.5 INSTALLATION, FILL BOXES AND ACCESS MANHOLES AT GRADE:

- Provide for tank fill, tank sounding, leak detector sensors, and extractor fittings. Set at grade in concrete pads. Refer to fill box detail. Provide identification plate set into the concrete pad that identifies the purpose of the device and type of fuel in the tank.

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

- Wiring shall conform to NFPA-70.

- 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.

- 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.

3.7 INSTALLATION, TANK FLUID LEVEL INDICATOR AND ALARM SYSTEM:

- Wiring shall conform to NFPA-70.

- 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.

- Locate remote high level alarm on exterior wall or pole in view of tank fill point, 2400 mm (8 feet) above grade.
3.8 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.

3.9 TANK MANHOLE ENCLOSURES:

All pipe penetrations shall be leak tight permitting no groundwater into enclosure.

SPEC WRITER NOTE: Delete the following cathodic protection articles when cathodic protection is specified under Section 26 42 00, CATHODIC PROTECTION.

//3.10 INSTALLATION, CATHODIC PROTECTION TEST STATIONS:

Provide separate station for each tank and each piping system, anchor firmly, locate so that terminal board is 600 mm (2 feet) minimum above grade. Connect wiring from all anodes and protected structures to the test stations.

3.11 TESTING, CATHODIC PROTECTION:

A. Testing performed by NACE-certified corrosion specialist; witnessed by RE/COTR.

B. Test Instruments:
   1. Volt-Ammeter.
   2. Saturated copper-copper sulfate reference electrode.
   3. Other instruments as required.

C. Procedures: Conform to NACE RP-0169.

D. Test Results Required for Acceptance:
   1. Potential of minus 0.85 volt between protected structure and reference electrode.
   2. Minimum shift of minus 300 millivolts upon application of protective current. Voltage measured between protected structure and reference electrode.
   3. Minimum shift of minus 100 millivolts upon interruption of protective current. Voltage measured between protected structure and reference electrode.

E. Test Report: Provide complete report to RE/COTR showing all test measurements, calculations, list of instruments used. //