SECTION 23 10 00
FACILITY FUEL OIL SYSTEMS

PART 1 - GENERAL

SPEC WRITER NOTES:
1. Delete between // // if not applicable to project. Also 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 gauge pressure unless otherwise noted.
4. This spec does not cover heated burner fuel storage.
5. This specification covers all aboveground and underground fuel oil storage tanks, including day tanks.
6. VA National CAD Standard for underground oil storage tanks, 30,000 liters (8,000 gallons) and above. SD231000-01.DWG
7. Provide the year of latest edition to each publication listed in Article 1.3 APPLICABLE PUBLICATIONS.

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).

E. A complete listing of common acronyms and abbreviations are included in //Section 23 05 10, COMMON WORK RESULTS FOR BOILER PLANT AND STEAM GENERATION// //Section 23 05 11, COMMON WORK RESULTS FOR HVAC//.

1.2 RELATED WORK

A. Section 01 00 00, GENERAL REQUIREMENTS.

B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

C. Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS.

D. //Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.//

E. Section 03 30 00, CAST-IN-PLACE CONCRETE.

F. Section 05 50 00, METAL FABRICATIONS.

G. Section 09 91 00, PAINTING.

H. //Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.//

I. //Section 23 05 10, COMMON WORK RESULTS FOR BOILER PLANT AND STEAM GENERATION.//

J. //Section 23 05 11, COMMON WORK RESULTS FOR HVAC.//

K. Section 23 07 11, HVAC AND BOILER PLANT INSULATION.

L. //Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.//

M. Section 23 09 11, INSTRUMENTATION AND CONTROL FOR BOILER PLANT.

N. Section 23 21 11, BOILER PLANT PIPING SYSTEMS.

O. Section 23 50 11, BOILER PLANT MECHANICAL EQUIPMENT.

P. Section 26 05 41, UNDERGROUND ELECTRICAL CONSTRUCTION.

Q. Section 26 42 00, CATHODIC PROTECTION.

R. Section 31 20 00, EARTHWORK.

1.3 APPLICABLE PUBLICATIONS

SPEC WRITER NOTE:
1.Make material requirements agree with requirements specified in the referenced Applicable Publications. Verify and update the publication list to that which applies to the project, unless the reference applies to all mechanical systems. Publications that apply to all mechanical systems may not be specifically referenced in the body of the specification, but, shall form a part of this specification.

2.Insert the year of approved latest edition of the publications between the brackets //----// and delete the brackets if applicable to this project.

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only. Where conflicts occur these specifications and the VHA standard will govern.

B. American Petroleum Institute (API):

RP 1631-//2001//.....Interior Lining and Periodic Inspection of Underground Storage Tanks

C. American Society of Mechanical Engineers (ASME):

B16.5-//2017//.....Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard.

B16.9-//2018//.....Factory Made Wrought Buttwelding Fittings
B16.11-//2016//.....Forged Fittings, Socket-Welding and Threaded
B31.1-//2018//.....Power Piping

D. American Society for Testing and Materials (ASTM):
A36/A36M-//2017//.....Standard Specification for Carbon Structural Steel
A53/A53M-//2018//.....Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
A105/A105M-//2014//.....Standard Specification for Carbon Steel Forgings for Piping Applications
A106/A106M-//2015//.....Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service
A126-//04(R2019)//.....Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
A234/A234M-//2015//.....Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service
B62-//2017//.....Standard Specification for Composition Bronze or Ounce Metal Castings
D2996-//2015//.....Standard Specification for Filament-Wound "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe

E. Federal Specifications (Fed. Spec.):
A-A-60005-//1998//.....Frames, Covers, Grating, Steps, Sump and Catch Basin, Manhole

F. NACE International (NACE):
SP0169-//2013//.....Control of External Corrosion on Underground or Submerged Metallic Piping Systems
3/SSPC-SP6//2013//.....Commercial Blast Cleaning
4/SSPC-SP7//2006//.....Brush-off Blast Cleaning

G. National Electrical Manufacturers Association (NEMA):
250-//2014//.....Enclosures for Electrical Equipment (1000 Volts Maximum)

H. National Fire Protection Association (NFPA):
30-//2018//.....Flammable and Combustible Liquids Code
31-//2019//.....Standard for the Installation of Oil-Burning Equipment

70-//2017//.....National Electrical Code (NEC)

I. Steel Tank Institute (STI):

F001-//2017//.....Flameshield® Standard for Fire Tested Tanks

F841-//2010//.....Standard for Dual Wall Underground Steel Storage Tanks

F894-//2018//.....ACT-100® Specification for External Corrosion Protection of FRP Composite Steel Underground Storage Tanks

F941-//2015//.....Fireguard: Specification for Fireguard Protected Aboveground Storage Tanks

F961-//2017//.....ACT-100U Specification for External Corrosion Protection of Composite Steel Underground Storage Tanks

P3-//2015//.....Specification and Manual for External Corrosion Protection of Underground Steel Storage Tanks

R891-//2006//.....Recommended Practice for Hold Down Strap Isolation

J. Underwriters Laboratories Inc. (UL):

58-//2018//.....Standard for Steel Underground Tanks for Flammable and Combustible Liquids

142-//2019//.....Standard for Steel Aboveground Tanks for Flammable and Combustible Liquids

971-//2019//.....Standard for Nonmetallic Underground Piping for Flammable Liquids

1316-//2018//.....Glass-Fiber-Reinforced Plastic Underground Storage Tanks for Petroleum Products, Alcohols, and Alcohol-Gasoline Mixtures

1746-//2007(R2014)//....Standard for External Corrosion Protection Systems for Steel Underground Storage Tanks

2085-//2019//.....Standard for Protected Aboveground Tanks for Flammable and Combustible Liquids

1.4 SUBMITTALS

A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Information and material submitted under this section shall be marked “SUBMITTED UNDER SECTION 23 10 00, FACILITY FUEL OIL SYSTEMS”, with applicable paragraph identification.

C. Manufacturer's Literature and Data including: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity.

D. 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 and dimensional locations and sizes of all anchoring devices, pipe connections, and access openings.
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.
4. Certification of compliance with specified standards.
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.

E. 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.

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

10. //Seismic Data: Refer to Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.//

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

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

H. 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.

I. 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).

J. 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.

K. 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.

L. Tank and Piping Accessories: Design, construction, and dimensions of vent caps, fill boxes, fill caps, spill containers and other accessories.

M. 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.

N. Complete operating and maintenance manuals including wiring diagrams, technical data sheets, information for ordering replacement parts, and troubleshooting guide:
   1. Include complete list indicating all components of the systems.
   2. Include complete diagrams of the internal wiring for each item of equipment.
   3. Diagrams shall have their terminals identified to facilitate installation, operation and maintenance.

O. //Completed System Readiness Checklist provided by the Commissioning Agent and completed by the contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.//

P. //Submit training plans and instructor qualifications in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.//

1.5 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, and 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 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 manufacturer's representatives shall provide onsite 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.

1.6 AS-BUILT DOCUMENTATION

SPEC WRITER NOTE: Coordinate O&M Manual requirements with Section 01 00 00, GENERAL REQUIREMENTS. O&M manuals shall be submitted for content review as part of the close-out documents.

A. Submit manufacturer's literature and data updated to include submittal review comments and any equipment substitutions.

B. Submit operation and maintenance data updated to include submittal review comments, VA approved substitutions and construction revisions shall be //in electronic version on CD or DVD// inserted into a three-ring binder. All aspects of system operation and maintenance procedures, including applicable piping isometrics, wiring diagrams of all circuits, a written description of system design, control logic, and sequence of operation shall be included in the operation and maintenance manual. The operations and maintenance manual shall include troubleshooting techniques and procedures for emergency situations. Notes on all special systems or devices shall be included. A List of recommended spare parts (manufacturer, model number, and quantity) shall be furnished. Information explaining any special knowledge or tools the owner will be required to employ shall be inserted into the As-Built documentation.

SPEC WRITER NOTE: Select and edit one of the bracketed options after the paragraph below to indicate the format in which the contractor must provide record drawing files. Select the hand-marked option only when the designer has been separately contracted to provide the record drawings from the contractor's mark-ups. Select the BIM option only when a BIM model will be generated, which is typically only performed by the designer on some Design-Bid-Build projects or by the contractor on some Design-Build projects.

C. The installing contractor shall maintain as-built drawings of each completed phase for verification; and, shall provide the complete set at the time of final systems certification testing. Should the installing contractor engage the testing company to provide as-built or any portion thereof, it shall not be deemed a conflict of interest or breach of the 'third party testing company' requirement. Provide record drawings as follows:
   1. //Red-lined, hand-marked drawings are to be provided, with one paper copy and a scanned PDF version of the hand-marked drawings provided on CD or DVD.//
   2. //As-built drawings are to be provided, with a copy of them on AutoCAD version // // provided on CD or DVD. The CAD drawings shall use multiple line layers with a separate individual layer for each system.//
   3. //As-built drawings are to be provided, with a copy of them in three-dimensional Building Information Modeling (BIM) software version // // provided on CD or DVD.//

D. The as-built drawings shall indicate the location and type of all lockout/tagout points for all energy sources for all equipment and pumps to include breaker location and numbers, valve tag numbers, etc. Coordinate lockout/tagout procedures and practices with local VA requirements.

E. Certification documentation shall be provided to COR 21 working days prior to submitting the request for final inspection. The documentation shall include all test results, the names of individuals performing work for the testing agency on this project, detailed procedures followed for all tests, and provide documentation/certification that all results of tests were within limits specified. Test results shall contain written sequence of test procedure with written test results annotated at each step along with the expected outcome or setpoint. The results shall include all readings, including but not limited to data on device (make, model and performance characteristics), normal pressures, switch ranges, trip points, amp readings, and calibration data to include equipment serial numbers or individual identifications, etc.

1.7 PERMITS

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

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/A36M steel, UL 58 double-wall, 360-degree secondary containment.
2. Conform to NFPA 30 or NFPA 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 AASHTO H-20 14,515 kg (32,000 pound) axle loading.
5. Leaks and abrasions are prohibited. 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/SSPC-SP6 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// 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 RP 1631 coating from bottom of tank to 1 m (3 feet) from bottom.

SPEC WRITER NOTES:
1. ACT-100 and 100-U: paragraphs F and G are optional.
2. STI P3: Include paragraphs F and G. Where soil resistivity is less than 4000 ohm-cm, delete paragraphs 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 and NACE SP0169 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 P3 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 the 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 (AASHTO H-20 wheel loading, 14,515 kg, (32,000 pound)) 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.
5. Access to Manhole Enclosure: //Cast iron manhole frames and covers, rated for traffic, minimum opening as shown. Comply with Fed. Spec. A-A-60005.// //Sidewalk type metal doors as shown and as specified under Section 05 50 00, METAL FABRICATIONS.//

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, 1034 kPa (150 psig) 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 gauge 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.

J. Tank Manholes: Provide quantity shown. Bolted cover type, gasketed. Zinc plated bolts, nuts, washers.

K. Internal Ladder: Provide as shown and shall have 50 mm x 6 mm (2 inch x 1/4 inch) sides, 20 mm (3/4 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 (1/4 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/A36M 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 NFPA 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 standards. 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 prohibited. Maximum permissible out-of-roundness of cylindrical shells is one percent of the diameter.
9. Provide lifting lugs for rigging tanks.
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 RP 1631.

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, 1034 kPa (150 psig) 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 gauge 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 1/4 inch) sides and 20 mm (3/4 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 (1/4 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 NFPA 31 as applicable. Standard product of a manufacturer, designed to automatically open at tank pressure of 17 kPa (2.5 psig) gauge. 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 the following paragraph 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/A36M 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 21 to 34 kPa (3 to 5 psig) gauge. Furnish certificate that inner and outer tanks have been tested and are leak-free and pressure-tight.
3. Concrete Insulation:
   a. Shall consist of 20 MPa (3,000 psig) 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 NFPA 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, 1034 kPa (150 psig) 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 gauge 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 NFPA 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 psig). 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 1/4 inch) sides and 20 mm (3/4 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 (1/4 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 paragraph 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 NFPA 31 as applicable.
3. Design for surcharge loads due to backfill and paving as shown. In addition, in paved areas, design for AASHTO H-20 14,515 kg (32,000 pound) axle loading.
4. Leaks and abrasions are prohibited. 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.
5. Access to Manhole Enclosure: //Fed. Spec. A-A-60005 cast iron manhole frames and covers rated for AASHTO H-20 14,515 kg (32,000 pound) axle loading minimum with opening size as shown.// //Sidewalk

type 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, 1034 kPa (150 psig) 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 gauge 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 1/4 inch) sides and 20 mm (3/4 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 (1/4 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 20 mm (3/4 inch) high.

2. Fill Caps above Grade: Aluminum, brass or bronze plate, clamped to fill pipe, with stamped or engraved letters 20 mm (3/4 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, and pump out.

B. Steel Pipe and Fittings:

1. Piping: Steel, seamless or electric resistance welded (ERW), ASTM A53/A53M Grade B or ASTM A106/A106M Grade B, Schedule 40. Aboveground piping shall be painted. Refer to Section 09 91 00, PAINTING.
2. Joints: Socket or butt-welded. Threaded joints are prohibited except at valves, unions and tank connections.
3. Fittings:
   a. Butt-welded joints: Steel, ASTM A234/A234M, Grade B, ASME B16.9, same schedule as adjoining pipe.
   b. Socket-welded joints: Forged steel, ASME B16.11, 13,790 kPa (2000 psig) class.
4. Unions: Malleable iron, 2070 kPa (300 psig) class.
5. Companion flanges: Flanges and bolting, ASME B16.5.
6. Welding flanges: Weld neck, ASME B16.5, forged steel ASTM A105/A105M, 1034 kPa (150 psig).

SPEC WRITER NOTE: Delete the following paragraph if pipeline will be traced or if fuel temperature will exceed 65 degrees C (150 degrees F), or if fuel pressure can exceed 345 kPa (50 psig).

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, 65 degrees C (150 degrees F), 1034 kPa (150 psig) 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 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 psig) 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 1380 kPa (200 psig) water-oil-gas, swing-type, 861 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 0.3 L/s (5 gpm) 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 inches) minimum continuous annular space, 40 mm (1-1/2 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/A53M, 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 660 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 SP0169. 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/A53M, 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 660 mm (26 inches). All welded construction.
   2. Blast clean exterior per NACE 4/SSPC-SP7.
   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.

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, 65 degrees C (150 degrees F), 1034 kPa (150 psig) 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 (3/16 inch) for diameters 250 mm (10 inches) through 508 mm (20 inches), and 6 mm (1/4 inch) for diameters above 508 mm (20 inches).

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 (10 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 paragraph, 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 3.2 mm (1/8 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 paragraph, 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.
   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.

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 (0.10 inch) of fluid height in inventory mode and 0.25 mm (0.01 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 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 4.6 L/s (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.

J. Code Conformance: NFPA 70.

2.11 FUEL OIL QUALITY MAINTENANCE SYSTEMS

SPEC WRITER NOTES:
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 percent 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. 861 kPa (125 psig) 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 percent 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 shutdown.
10) //"High Water Level" in water storage tank.//

e. Filter and strainer differential pressure gauges, 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 4, 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 Type 4 enclosure, 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 percent 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 Gauges: Refer to Section 23 09 11, INSTRUMENTATION AND CONTROL FOR BOILER PLANT.

2.12 CONCRETE FOUNDATIONS

A. 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 TRACING TAPE

A. Tape shall be 0.1 mm (0.004 inch) thick, 150 mm (6 inches) wide, yellow polyethylene with a metallic core, acid and alkali-resistant and shall have a minimum strength of 12,000 kPa (1740 psig) lengthwise and 10,342 kPa (1500 psig) crosswise with an elongation factor of 350 percent. Provide bold black letters on the tape identifying the type of system. Insulating and labeling shall be unaffected by moisture and other substances contained in the backfill material.

PART 3 - EXECUTION

3.1 GENERAL

A. If an installation is unsatisfactory to the COR, the Contractor shall correct the installation at no additional cost or time to the Government.

3.2 INSTALLATION AND TESTING, UNDERGROUND STEEL TANKS

A. Conform to NFPA 30 or NFPA 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 34 kPa to 48 kPa (5 to 7 psig). 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 COR.

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, EARTHWORK. 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 NFPA 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 COR. Keep the tank excavation dewatered.

3.3 INSTALLATION AND TESTING, ABOVEGROUND TANKS

A. Conform to NFPA 30 or NFPA 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 21 kPa to 34 kPa (3 to 5 psig), 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. For steel tanks storing heated oil, field-applied insulation requirements are specified under Section 23 07 11, HVAC 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.

3.4 INSTALLATION AND TESTING, UNDERGROUND FIBERGLASS REINFORCED PLASTIC TANKS

A. Conform to NFPA 30 or NFPA 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 34 kPa (5 psig), 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 onsite supervision of a representative of the manufacturer. Retest until all leaks are repaired. Tests shall be witnessed by the COR. 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, EARTHWORK. 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 COR. Keep tank excavation dewatered.

3.5 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 12 m (1 inch in 40 feet).

B. Steel Fuel and Tracing Media Carrier Piping: All joints butt or socket welding. Threaded piping is prohibited. 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 paragraph, QUALITY ASSURANCE. Plastic piping is prohibited in the 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 (10 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. Fuel oil piping is prohibited in the same secondary containment system as steam or condensate piping.
7. 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 psig), and test the containment piping with air pressure at 55 kPa (8 psig). Systems shall hold the pressure for 30 minutes. Repair all leaks and retest.

G. Coatings for Steel Piping not in Secondary Containment System: Provide urethane coating and cathodic protection.

3.6 INSTALLATION, FILL BOXES AND ACCESS MANHOLES AT GRADE

A. 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.

3.7 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.

3.8 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.

3.9 INSTALLATION, BURIED UTILITY WARNING TRACING TAPE

A. Install tracer wire in the trench approximately 457 mm (18 inches) above the non-metallic pipe. The tracer wire shall be taped approximately every 3 m (10 feet) to the pipe, where practical. The tracer wire shall be installed so that electrical continuity is maintained throughout the pipe system. As few connections as possible shall be made in the tracer wire. The wire shall be contiguous except at test stations, valve boxes, and where splicing is required. All splices shall be encased. Connections will be made by stripping the insulation back one inch and joining the two ends using an approved mechanical connector and a split bolt connector. Twisting of copper wire is prohibited. To complete this connection, wrap all exposed wire thoroughly with electrical tape. A minimum 1.5 m (5 foot) of additional tracer wire will be coiled, buried and terminate aboveground at the ends of the pipeline.

3.10 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 gauges at suction and discharge piping connections. Refer to Section 23 09 11, INSTRUMENTATION AND CONTROL FOR BOILER PLANT for gauge requirements.

3.11 TANK MANHOLE ENCLOSURES

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

3.12 STARTUP AND TESTING

A. Perform tests as recommended by product manufacturer and listed standards and under actual or simulated operating conditions and prove full compliance with design and specified requirements. Tests of the various items of equipment shall be performed simultaneously with the system of which each item is an integral part.

B. When any defects are detected, correct defects and repeat test at no additional cost or time to the Government.

C. //The Commissioning Agent will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with COR and Commissioning Agent. Provide a minimum notice of 10 working days prior to startup and testing.//

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

3.13 //INSTALLATION, CATHODIC PROTECTION TEST STATIONS

A. 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.//

3.14 //TESTING, CATHODIC PROTECTION

A. Testing performed by NACE-certified corrosion specialist; witnessed by COR.

B. Test Instruments:

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

C. Procedures: Conform to NACE SP0169.

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 COR showing all test measurements, calculations, list of instruments used.//

3.15 //COMMISSIONING

A. Provide commissioning documentation in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

B. Components provided under this section of the specification will be tested as part of a larger system.//

3.16 DEMONSTRATION AND TRAINING

A. Provide services of manufacturer’s technical representative for //4// // // hour//s// to instruct each VA personnel responsible in operation and maintenance of the system.

B. //Submit training plans and instructor qualifications in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.//

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