earth safe
Fuel Systems for Critical Facilities

SECTION 231000

Mission Critical
GENERATOR FUEL SYSTEM

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PART 1 GENERAL

1.01 Provide an integrated emergency power fuel system. The specification requires the detailed system design, equipment, installation inspection, startup, and training to be the responsibility of a single specialized fuel system supplier. The specification section includes responsibility for mechanical, electrical, and control systems. The system shall be in accordance with design standards and shall be designed and built to N+1 redundancy against failure.

1.02 Section Includes:
- A. Fuel Tanks
- B. Fuel Piping
- C. Fuel transfer and control – day tanks.
- D. Fuel transfer and control – duplex pump sets.
- E. Multi-tank selection control.
- F. Tank level and leak monitoring system.
- G. Tank fill system and controls.
- H. Tank power fill and controls.
- I. Fuel filtration system.
- J. Integrated control and monitoring.

1.03 Related Sections:
- A. Section 02200 Excavating, Backfilling and Compacting.
- B. Section 03300 Cast-In-Place Concrete.
- C. Section 13010 Fuel Tanks and Piping
- D. Section 15010 Basic Mechanical Requirements.
- E. Section 16010 Basic Electrical Requirements.

1.04 References:
- A. NFPA 30 - Flammable and Combustible Liquids Code.
- B. NFPA 70 - National Electric Code.
- C. UL 142 - Steel Aboveground Tanks for Flammable and Combustible Liquids.
- D. Uniform Fire Code: Article 52, Article 79 and Appendix II-F.
- E. BOCA Fire Prevention Code

1.05.1 Submittals

- A. Mechanical System Design: Indicate system layout, pipe sizes, location of supports, elevations, and equipment mounting details. For fuel tank, indicate dimensions, vent sizes and location of all accessories including pumps, fill pipe, manways, tank supports, inventory sensor, and leak sensors. Provide a piping and instrument diagram for the system including a complete bill of material/ equipment list.
- B. Electrical System Design: Provide drawings and specifications that include the proposed conduit layout and wiring diagrams for equipment covered in this section that requires electrical connections. Indicate conduit size and material, number and size of wires,

location of wiring in classified areas and location of intrinsically safe circuits and conduits. Provide a one-line power diagram. Provide an electrical equipment list.

C. Control System Design: Provide control system designs including electrical schematics, panel physical, and field wiring diagrams.
D. Calculations: Provide calculations for pump selection and pipe sizing requirements.
E. Equipment Data: Provide manufacturers information for all equipment.
F. Commissioning: Provide a detailed commissioning plan.

1.06 Project Record Documents

A. Record and submit actual location of fuel system equipment, wiring, conduit runs and system components.

1.07 Operation and Maintenance Manuals

A. Operation Data: Include installation instructions and exploded assembly views.
B. Maintenance Data: Include maintenance and inspection data, replacement part numbers and availability, and service depot location and telephone number.

1.08 Quality Assurance

A. Comply with NFPA 30 “Flammable and Combustible Liquids Code” for design and construction, installation, inspection, and testing of fuel system components and accessories.
B. Comply with NFPA 70 “National Electric Code” for equipment, wiring, and conduit installed under this section.
C. Provide equipment and accessories that are listed and labeled.

1.09 Qualifications

A. A single vendor shall be responsible for the detailed system design, equipment, and installation inspection. The company shall be a licensed engineering firm with 5 years of documented experience in the design and construction of emergency power fuel systems. The company shall provide evidence of professional liability and pollution liability insurance.

1.10 Regulatory Requirements

A. Comply with requirements of the EPA and other state and local authorities having jurisdiction. Include permitting and registering of fuel storage tank.

PART 2 PRODUCTS

2.01A Aboveground Fire Rated Fuel Tanks

A. Manufacturers
   1. STI Fireguard
   2. Modern Welding
   3. Engineer Approved Equivalent

B. General
   1. Provide and install an aboveground tank with secondary containment and a minimum 2-hour fire rating. The tank and its enclosure shall be listed as an assembly by

Underwriters Laboratories, Inc. per U.L. 2085. The primary tank shall have a total volume as noted on drawings.

C. Design Criteria

1. Primary Tank: The primary tank shall be minimum 0.18 inch thick carbon steel approved per U.L. Standard 142 and meeting the requirements of N.F.P.A. 30. The tank shall be warranted for 30 years by the manufacturer.
2. Secondary Containment with Leak Monitoring: Integral secondary containment shall provide at minimum 100% containment of the primary storage tank. The interstitial space shall allow liquid to migrate through it to a monitoring point. A leak detection access tube shall be located in the interstitial space between the inner tank and the secondary barrier.
3. Fire Resistance: The tank system shall be designed and tested to provide 2-hour fire protection for the primary tank. No steel members shall penetrate the concrete/thermal insulation layer between the primary tank and the secondary containment barrier to assure isolation from pool fire heat.
4. Venting: Provide properly sized emergency and standard vents to satisfy code requirements. Standard vent shall terminate a minimum of 12’ above the adjacent ground level. Standard vent shall be equipped with a flame arrestor.
5. Exterior Finish: The tank system shall include an epoxy or polyurethane exterior finish. Color of finish to be approved by the architect.

D. Tank Accessory Equipment

1. Standard Vent: The standard 2” vent shall be equipped with an aluminum updraft vent cap with wire screen.
2. Emergency Vents: Emergency vents shall be equipped with aluminum vents sized to open at ½ oz pressure to provide the required capacity.
3. Direct Read Level Gauge: Tank shall be equipped with a direct reading level gauge with an aluminum housing. The level gauge shall be readable from ground level.
4. Inspection Port Adapter Cap: Tank shall be equipped with a 4” adapter and lockable cap for inspection and manual gauging of fuel level. Gauge port shall be accessible from steps or ladder.
5. Overfill Prevention Valve: The tank shall have an overfill prevention valve installed in the fill pipe. The valve shall close automatically at 90% of tank capacity. The valve shall incorporate a drop tube extending to within 6” of the tank bottom. Valve shall be rated for pressurized fuel delivery. An automatically actuated solenoid valve in the fill pipe may be provided as an alternative.
6. Spill Container: The tank shall be equipped with an integral spill container of 7 gallon capacity surrounding the fill pipe. The spill container shall include a valve to drain spilled product into the tank. Where a ground mounted fill system is used the spill container shall be located at the inspection/manual gauging port.
7. Access Steps and Ladders: Tanks shall be equipped with access steps or ladders as indicated on the drawings. Steps and ladders shall be of welded steel construction with prime and finish paint of industrial enamel. Steps and ladders shall be designed to conform with OSHA requirements. Steps shall include non-skid tread surfaces, handrails, platforms, and kickplates as required for OSHA compliance.

2.01B Aboveground Fuel Tanks (Non fire rated)

A. Manufacturers
1. Modern Welding
2. Containment Solutions
3. Engineer Approved Equivalent

B. General
   1. Provide and install an aboveground steel tank with steel secondary containment. The tank and its containment shall be listed as an assembly by Underwriters Laboratories, Inc. per U.L. 142. The primary tank shall have a total volume as noted on drawings.

C. Design Criteria

   1. Primary Tank: The primary tank shall be minimum 0.18 inch thick carbon steel approved per U.L. Standard 142 and meeting the requirements of N.F.P.A. 30. The tank shall be warranted for 30 years by the manufacturer.
   2. Secondary Containment with Leak Monitoring: Integral secondary containment shall provide at minimum 100% containment of the primary storage tank. The interstitial space shall allow liquid to migrate through it to a monitoring point. A leak detection access tube shall be located in the interstitial space between the inner tank and the secondary barrier.
   3. Venting: Provide properly sized emergency and standard vents to satisfy code requirements. Standard vent shall terminate a minimum of 12' above the adjacent ground level. Standard vent shall be equipped with a flame arrestor.
   4. Exterior Finish: The tank system shall include an exterior polyurethane finish.

D. Tank Accessory Equipment

   1. Standard Vent: The standard 2" vent shall be equipped with an aluminum updraft vent cap with wire screen.
   2. Emergency Vents: Emergency vents shall be equipped with aluminum vents sized to open at ½ oz pressure to provide the required capacity.
   3. Direct Read Level Gauge: Tank shall be equipped with a direct reading level gauge with an aluminum housing. The level gauge shall be readable from ground level.
   4. Inspection Port Adapter Cap: Tank shall be equipped with a 4" adapter and lockable cap for inspection and manual gauging of fuel level. Gauge port shall be accessible from steps or ladder.
   5. Overfill Prevention Valve: The tank shall have an overfill prevention valve installed in the fill pipe. The valve shall close automatically at 90% of tank capacity. The valve shall incorporate a drop tube extending to within 6" of the tank bottom. Valve shall be rated for pressurized fuel delivery. An automatically actuated solenoid valve in the fill pipe may be provided as an alternative.
   5. Spill Container: The tank shall be equipped with an integral spill container of 7 gallon capacity surrounding the fill pipe. The spill container shall include a valve to drain spilled product into the tank. Where a ground mounted fill system is used the spill container shall be located at the inspection/manual gauging port.
   6. Access Steps and Ladders: Tanks shall be equipped with access steps or ladders as indicated on the drawings. Steps and ladders shall be of welded steel construction with prime and finish paint of industrial enamel. Steps and ladders shall be designed to conform with OSHA requirements. Steps shall include non-skid tread surfaces, handrails, platforms, and kickplates as required for OSHA compliance.

2.01C Underground Fuel Tanks – Steel / Fiberglass Composite

A. Manufacturers
   1. Modern Welding
   2. STI Permatank
   3. Engineer Approved Equivalent

B. General
   1. Provide and install an underground steel tank with primary steel wall and a fiberglass exterior containment wall. The tank and its containment shall be listed as an assembly by Underwriters Laboratories. The primary tank shall have a total volume as noted on drawings.

C. Design Criteria

   1. Primary Tank: The primary tank shall be minimum 0.18 inch thick carbon steel approved per U.L. Standard 58 and meeting the requirements of N.F.P.A. 30. The tank shall be warranted for 30 years by the manufacturer.
   2. Secondary Containment with Leak Monitoring: The secondary fiberglass containment shall provide at minimum 100% containment of the primary storage tank. The interstitial space shall allow liquid to migrate through it to a monitoring point. A leak detection access tube shall be located in the interstitial space between the inner tank and the secondary barrier.
   3. Corrosion Protection: The exterior of the tank shall be constructed of fiberglass for corrosion protection.
   4. Hold-Down Construction: Tanks shall be designed for stability with a water table at grade. Tank anti-flotation calculations shall be submitted for approval. The anti-flotation devices shall consist of precast concrete deadmen with tank hold down straps. Hold down straps shall be provided by the tank manufacturer and shall be isolated by a non-conductive material from the tank shell.

D. Tank Accessory Equipment

   1. Standard Vent: The standard 2” vent shall be equipped with an aluminum updraft vent cap with wire screen.
   2. Manway with Piping Sump. The tank shall be equipped with a manway which incorporates all fuel piping connections to the tank. The manway sump shall be watertight polyethylene construction. Pipe and conduit penetrations into the sump shall be through a watertight sleeve.
   5. Access Frames and Covers. Manways and other tank risers shall be installed at grade within a traffic rated frame and cover. Covers shall be non-metallic lightweight construction.
   6. Inspection Port Adapter Cap: Tank shall be equipped with a 4” adapter and lockable cap for inspection and manual gauging of fuel level. Gauge port shall be accessible from steps or ladder.
   7. Overfill Prevention Valve: The tank shall have an overfill prevention valve installed in the fill pipe. The valve shall close automatically at 90% of tank capacity. The valve shall incorporate a drop tube extending to within 6” of the tank bottom.
   8. Spill Container: The tank shall be equipped with an integral spill container of 15 gallon capacity surrounding the fill pipe. The spill container shall include a valve to drain spilled product into the tank. The spill container shall be located within a tank sump to provide secondary containment.

2.01D Underground Fuel Tanks – Double Wall Fiberglass

A. Manufacturers
   1. Containment Solutions
   2. Xerxes
   3. Engineer Approved Equivalent

B. General

1. Provide and install an underground steel tank with primary and secondary fiberglass walls. The tank and its containment shall be listed as an assembly by Underwriters Laboratories. The primary tank shall have a total volume as noted on drawings.

C. Design Criteria

1. Tank Construction: The tank shall be approved per U.L. Standard 1316 and meeting the requirements of N.F.P.A. 30. The tank shall be warranted for 30 years by the manufacturer. The tank shall be constructed to withstand a 5 PSI pressure test with 5:1 safety factor.
2. Secondary Containment with Leak Monitoring: The secondary fiberglass containment shall provide at minimum 100% containment of the primary storage tank. The interstitial space shall allow liquid to migrate through it to a monitoring point. A leak detection access tube shall be located in the interstitial space between the inner tank and the secondary barrier. Alternatively the leak detection method may be provided as a brine filled interstice with electronic monitoring.
3. Hold-Down Construction: Tanks shall be designed for stability with a water table at grade. Tank anti-flotation calculations shall be submitted for approval. The anti-flotation devices shall consist of precast concrete deadmen with tank hold down straps. Hold down straps shall be provided by the tank manufacturer and shall be isolated by a non-conductive material from the tank shell.

D. Tank Accessory Equipment

1. Standard Vent: The standard 2” vent shall be equipped with an aluminum updraft vent cap with wire screen.
2. Manway with Piping Sump. The tank shall be equipped with a manway which incorporates all fuel piping connections to the tank. The manway sump shall be watertight polyethylene construction. Pipe and conduit penetrations into the sump shall be through a watertight sleeve.
4. Access Frames and Covers. Manways and other tank risers shall be installed at grade within a traffic rated frame and cover. Covers shall be non-metallic lightweight construction.
5. Inspection Port Adapter Cap: Tank shall be equipped with a 4” adapter and lockable cap for inspection and manual gauging of fuel level. Gauge port shall be accessible from steps or ladder.
6. Overfill Prevention Valve: The tank shall have an overfill prevention valve installed in the fill pipe. The valve shall close automatically at 90% of tank capacity. The valve shall incorporate a drop tube extending to within 6” of the tank bottom.
7. Spill Container: The tank shall be equipped with an integral spill container of 15 gallon capacity surrounding the fill pipe. The spill container shall include a valve to drain spilled product into the tank. The spill container shall be located within a tank sump to provide secondary containment.

2.02A Fuel Distribution Pipe- Aboveground

A. General

1. Provide and install steel piping aboveground as indicated on the drawings. Primary fuel pipe connections shall be welded except where required to be threaded at tanks or specialized valves.

B. Design Criteria

1. Steel Pipe: ASTM A53 or A120, or ASME B36.10, Schedule 40 black.

2. Fittings: ASTM B16.3, 300 lb. threaded malleable iron, or ASTM A234, forged steel welding type.
3. Finish: Prime and finish paint with industrial enamel.

C. Accessory Equipment

1. Unions: 300 lb. malleable iron threaded unions.
2. Ball Valves: Steel construction, two piece body, chrome plated steel ball.
3. Swing Check Valves: Bronze body, bronze swing disc, threaded ends.
4. Swing Check Valves with Integral Pressure Relief Valves: Bronze body, bronze swing disc, teflon seat, steel stem and springs, automatic, direct, pressure actuated at maximum 40 PSI, threaded ends, UL listed for fuel.
5. Anti-Siphon Valves: Bronze body, bronze swing disc, spring loaded, normally closed, threaded ends, size to resist static siphon head.
6. Solenoid Valves: Bronze, “0” PSIG pressure differential, normally closed or normally open per plans, NEMA 7, explosion proof and watertight, threaded ends.
7. Emergency Shut-Off Valves: Provide a fusible link Emergency Shut-Off Valve at exterior wall penetration as indicated.
8. Flexible Connectors: Stainless steel inner hose and braided exterior sleeve, suitable for minimum 200 psi WOG and 250 degrees F.

2.02B Fuel Distribution Pipe, Aboveground Secondary Containment.

A. General

1. Provide and install a steel containment jacket for aboveground steel piping where indicated on drawings.

C. Design Criteria

1. Primary pipe: The Primary pipe shall be ASTMA53 schedule 40 black with welded connections.
2. Secondary containment pipe: The secondary pipe shall be shecdule 10 steel pipe and fittings. The secondary pipe shall be sized to allow liquid flow beneath the bottom of the primary pipe.
3. The primary pipe shall be supported and centralized within the secondary pipe using steel supports.
4. The secondary pipe fittings shall be designed to allow the inspection and testing of primary pipe connections prior to closure of secondary pipe fittings.
5. The secondary pipe shall be tested at 5 PSI.

2.02C Fuel Distribution Pipe, Underground Secondary Containment.

A. Manufacturers

1. Ameron
2. AO Smith
3. Engineer Approved Equivalent

B. General

1. Provide and install a double-wall fiberglass underground piping system, underground where indicated on drawings.

C. Design Criteria

1. Primary and secondary pipe: The fiberglass pipe shall be coaxial construction for secondary containment. The pipe shall be UL listed for underground handling of petroleum products. The secondary pipe shall have a design strength of 40 PSI and a field test pressure of 5 PSI.
2. Pipe Fittings: Pipe fittings shall be compression molded fiberglass reinforced epoxy construction.
4. Product compatibility: All the components of the double-wall piping system shall be compatible with the products to be stored.
5. Structural integrity: The outer secondary containment piping shall be of such design and materials to have sufficient strength to withstand the maximum underground burial loads and tested in accordance with AASHTO M294.

2.03 Generator Day Tank

A. Manufacturers
1. Day Tank: Earthsafe M500
2. Tanks: Modern, Containment Solutions
3. Return Pumps: Viking, Tuthill
4. Controls: Earthsafe Systems C800 or C900

B. General: Provide a packaged design fuel oil day tank. Day tank shall be for use with main tank in order to provide an automatic, self-refilling fuel supply system. Where a duplex or remote pump set is used, the day tank shall be equipped with an inlet solenoid valve and the day tank pump shall be eliminated. Where a generator base tank is used, the day tank is deleted and the control panel only is provided for installation on the base tank.

C. Design Criteria

1. Day Tank: The day tank capacity shall be 50 gallons or as indicated on the drawings. The tank shall be UL 142 listed rectangular steel tank with minimum 110 % containment basin. The day tank shall be finished with prime and finish coats of fuel resistant industrial coating.
2. Dual Inlet Solenoid Valves: The day tank shall be equipped with dual solenoid valves, 100 PSI rated, normally closed, under control of level controller described below. The solenoid valve shall be protected by an upstream strainer. An inlet shutoff valve shall be provided. The inlet valves shall operate as a primary and secondary valves and shall automatically alternate.

3. Day Tank Level Controller: Provide an electronic liquid level controller/indicator with functions to include: pump/valve level control, high / low / critical low level sensors, system alarms and manual operating controls. Level controller shall be based on an industrial grade controller with networking capabilities for system monitoring.

a. Control Functions: The control functions shall include an “Auto-Off-Manual” fill control mode switch, a “press to test” fill control push-button, a pump/valve level control with output contacts for control of on-board solenoid valve and remote delivery valve and remote delivery system described above, and an overflow cutout.
b. Duel Inlet Valve Control: The control panel shall provide for the automatic alternation of the dual inlet solenoid valves. The secondary valve shall open upon a low level condition in the day tank.

c. Indication Functions: The day tank level controller shall be equipped with indicator lights for power on, pump on, high alarm, low alarm, critical low alarm, and tank leak
d. Outputs: The day tank level controller shall be equipped with output relays for fill control, low level alarm, high level alarm, and tank rupture. The controller shall include a network adapter to interface with other control devices and the fuel system Network Interface Module.
e. The level controller shall have an intrinsic overflow cutout backup control which, upon sensing a high level, will open the fill control contacts, close the fill control solenoid valve and stop the fuel delivery system.
f. The level controller shall monitor a leak sensor in the day tank containment space.

D. Accessory Equipment

1. Level Sensor: The level sensor shall be a solid state capacitance type sensor with no moving parts. The sensor shall indicate 4 level positions High Alarm, Fill Stop, Fill Start, and Low Level.

2. Return Fuel Pump. Where required for return flow to a bulk storage tank, the day tank shall be equipped wit a return fuel pump and controls. The pump shall be sized to provide 125% of the fuel supply pump capacity. The pump shall be activated by the pump high level sensor and de-activated by the pump off level sensor. The return fuel pump shall have a local motor starter with disconnect and HOA operator switch.

3. High Level Shutoff Valves: Where indicated on the drawings, the day tank inlet piping shall include dual normally open solenoid valves directly upstream of the fill solenoid valves. The normally open solenoid valves shall be energized upon high level conditions to close and prevent overfilling.

2.04A Duplex Pump Set - Submersible

A. Manufacturers
1. Submersible Pumps: Red Jacket / FE Petro
2. Controls: Earthsafe Systems C800 or C900.

B. General: Provide a packaged duplex submersible pump set to provide fuel to a day tank or a series of day tanks. The duplex pump set shall be integrated with a control panel to provide motor control, system status, and alarm indication.

C. Design Criteria

1. Transfer Pumps: Dual pumps each rated at the design flow as indicated on the drawings. Pump motors shall be 208 VAC Single Phase with minimum 0.75 HP or as noted on the drawings.
2. Pump Motor Starters: Each pump shall be equipped with amn individual motor starter disconnect panel. The panel shall include an HOA switch for operator use. The panel shall include output relays for pump overload trip and Not-In-Auto signals. In auto mode the pump shall be controlled by the duplex pump control module.
3. Control Module: The pump set shall be controlled by a microprocessor based control module. The unit shall receive a pump on signal from a tank level controller to activate and deactivate the pump set. The unit shall monitor a flow switch in the fuel discharge. A “No Flow” condition for 15 seconds after the start of pump 1 shall automatically activate pump 2. The module shall have exterior hand-off-auto mode selector switches for each pump. Indicator lights shall be provided for power on,

pump on, and flow failure alarm. The controller shall provide automatic alternation of pumps.

D. Accessory Equipment

1. Ball Valves: Carbon Steel ball valves at unit outlet and to isolate each pump.
2. Check Valves: Brass swing check valves at the discharge of each pump where indicated on the drawing.
3. Pressure Relief Valve: Pumps shall have internal pressure relief. In addition pressure relief valves shall be installed in sections of piping that can be blocked in by valves. Pressure relief valves shall discharge to the return flow pipe for free flow back to the storage tank.
4. Flow Switch: Flow switch at unit discharge to activate secondary pump.
5. Pressure Gauges: Mount pressure in piping system where it will be visible to the facility operator.

2.04B Duplex Pump Set – PD Pumps

A. Manufacturers
1. Duplex Pump Set: Earthsafe M200
2. Positive Displacement Pumps: Viking / Tuthill
3. Controls: Earthsafe Systems C800 or C900

B. General: Provide a packaged duplex pump set to provide fuel to a day tank or a series of day tanks. The duplex pump set shall be integrated with a control panel to provide motor control, system status, and alarm indication.

C. Design Criteria

1. Transfer Pumps: Dual pumps each rated at the design flow as indicated on the drawings. Pump motors as a minimum shall be 1 VAC single phase, 1/3 HP. Motors shall be TEFC.
2. Containment Base and Frame: Pumps shall be mounted on a welded steel liquir tight containment basin. The base shall include a welded steel support for piping and accessories.
3. Pump Motor Starters: Each pump shall be equipped with amn individual motor starter disconnect panel. The panel shall include an HOA switch for operator use. The panel shall include output relays for pump overload trip and Not-In-Auto signals. In auto mode the pump shall be controlled by the duplex pump control module.
4. Control Module: The pump set shall be controlled by a microprocessor based control module. The unit shall receive a pump on signal from a tank level controller to activate and deactivate the pump set. The unit shall monitor a flow switch in the fuel discharge. A “No Flow” condition for 15 seconds after the start of pump 1 shall automatically activate pump 2. The module shall have exterior hand-off-auto mode selector switches for each pump. Indicator lights shall be provided for power on, pump on, and flow failure alarm. The controller shall provide automatic alternation of pumps.

D. Accessory Equipment

1. Ball Valves: Brass ball valves at unit inlet, outlet and to isolate each pump.
2. Check Valves: Brass swing check valves at the discharge of each pump.
3. Pressure Relief Valve: Brass relief valve set at 100 PSI at pump discharge.
4. Strainers: Brass basket strainers at the inlet for each pump.
5. Flow Switch: Flow switch at unit discharge to activate secondary pump.

6. Pressure Gauges: Mount 2.5 inch liquid filled pressure gauge at unit outlet and vacuum gauge at inlet. Include isolation valves for the gauges,
7. Leak Sensor: Provide liquid sensor for containment basin.
8. Enclosure: Where indicated on the drawings the pump set shall be enclosed within a welded steel weatherproof enclosure.

2.05 Multi-Tank Selection Control

A. Manufacturers
   1. Valves: Apollo, Jamesbury
   2. Controls: Earthsafe Systems C800 or C900

B. General: Provide a multi-tank control system including tank level sensors, control valves, and an electronic control module. The selection system allows a duplex pump set to draw fuel from multiple fuel storage tanks. The tank flow is controlled by actuated inlet and outlet valves. A low level condition on the primary tank automatically switches supply to alternate tanks.

C. Design Criteria

1. Control Module: The tank manifold system shall be controlled by a microprocessor based control module. The module shall have output relays to activate valves at the tank inlet and outlet. The unit shall receive a signal from a tank low level to automatically switch fuel supply and return to a secondary tank or tanks. The module shall have exterior hand-off-auto mode selector switches for each tank. Indicator lights shall be provided for power on, tank standby status, tank active status, and tank low level alarm. The control module shall interface with the pump control module so that valves are activated only when the pump is on.
2. Low Level Sensors: The low level sensors shall be provided at approximately the tank 10 % fill level to provide a signal to the control module. The level switch shall be stainless steel construction.
3. Actuated Valves: Actauted valves for tank inlet and outlet shall be carbon steel three piece ball valves. Actuators shall be NEMA 4 enclosure and shall include limit switches, position indicator, and manual override.

2.06 Tank Inventory and Leak Monitoring System

A. Manufacturers

1. Veeder-Root: TLS 350 or TLS 300

B. General

1. Provide an aboveground storage tank monitoring system capable of tank inventory management and sensing leaks in the tank and the associated piping.

C. Design Criteria

1. Tank Level Transmitter: The system shall include a probe capable of detecting the fuel level in the tank to the nearest 0.125”.
2. Monitoring Panel: The monitoring panel shall display the tank volume in gallons. The panel shall indicate alarm conditions for fuel high level, fuel low level, tank leak and pipe leak. The panel shall have a minimum of (2) programmable relay outputs and a RS232 communications adapter.

3. Interstitial Monitoring: A sensor shall be provided for installation in the space between the primary tank and the secondary containment barrier to detect a leak in the primary tank. The sensor shall set off an audible and visual alarm on the control panel.
4. Piping Sump Sensor: A sensor shall be provided for installation in the piping sump to detect a leak in the fuel piping system. The sensor shall set off an audible and visual alarm on the control panel.
5. Overfill Alarm and Acknowledgment Switch: Provide an audible and visible overfill alarm and manual acknowledgment/reset switch for mounting in the tank filling area as shown on the plans. The panel shall have a 0-3 minute adjustable timer for automatic shutoff. The alarm shall be connected to an output relay on the monitoring system control panel.

2.07A Tank Fill System

A. Manufacturers

1. Earthsafe M400
2. Controls:: Earthsafe C800

B. General

1. Provide a fill station including spill container to facilitate the safe transfer of fuel to aboveground tanks or tanks in buildings. The system shall accept a hose connection from a pump equipped delivery truck, and provide overfill alarms and fill pipe valve closure

C. Design Criteria

1. Spill Container: Welded steel liquid tight spill container shall have minimum 20 gallon capacity. The spill container shall have an integral lockable weatherproof enclosure. The spill container shall have an epoxy paint finish. Where indicated on the drawings the spill container shall be stainless steel construction.
2. Fuel Piping and Accessories: The hose connection shall be 2, 3, or 4” diameter as shown on the drawings. The piping shall include a camlock type hose adapter, adapter cap, manual shutoff valve, and check valve.
3. Controls: Provide an electronic tank level controller consisting of a tank level sensor, inlet actuated valve, and control module. The module shall be microprocessor based and shall monitor tank levels during the fill operation. The panel shall respond to tank fill levels as follows: green light (normal operation at 85% or less), yellow light (active at 85%), red light and audible alarm (active at 90%), and flashing red light / audible alarm (active at 95%)
4. Control Valve: Provide an actuated butterfly valve for the fill pipe high level shutoff. The valve shall be a lug style iron body butterfly valve with stainless steel trim and viton soft goods. The valve actuator shall be NEMA 4 enclosure with limit switches, position indicator and manual override.

D. Accessory Equipment

1. Overfill Prevention Valve: Where indicated on the drawing provide an in-tank overfill prevention valve for the tank fill connection to close automatically at the tank 90% fill level.
2. Hand Pump: Where indicated on the drawing the spill container shall include a hand pump for transfer of spilled fuel to the tank fill pipe.

3. Indicator for Tank % Fill: Where indicated on the drawing the fill station control panel shall include a readout of the tank % fill.
4. Architectural Access Door: Where indicated on the drawings, the fill station shall be recessed into the building wall and an architectural access door shall be provided. The access door shall have a highly finished aluminum or stainless steel surface, or other finish as approved by the engineer.
5. Multi-Tank Fill Selection: Where indicated on the drawing the control panel shall include capability to select one of multiple tanks for filling. High level fuel conditions in any tank shall disable the fill function for that tank but shall allow for filling of other tanks.

2.07B Tank Fill Pump and Controls

A. Manufacturers
1. Fill Station: Earthsafe M450
2. Centrifugal Pump: ITT/Gould or Gorman Rupp
2. Controls: Earthsafe Systems C800

B. General: Provide a fuel transfer fill pump and controls for tank filling. The unit shall be an integrated system of controls, level sensors, transfer pump, and a spill container.

C. Design Criteria
1. Transfer Pumps: The transfer pump shall be rated at 125 GPM, or the design flow as indicated on the drawings. Pump motors shall be as required to provide the design flow and as a minimum shall be 240 VAC single phase or 3 phase, 2 HP. Motors shall be TEFC.
2. Pump Motor Starters: Each pump shall be equipped with amn individual motor starter disconnect panel. The panel shall include an HOA switch for operator use. The panel shall include output relays for pump overload trip and Not-In-Auto signals. In auto mode the pump shall be controlled by the fill station control module.
3. Integration with Tank Fill Controls. The fuel pump shall be interlocked with the fill station level controls to provide high level warning, alarm and shutoff. A high level warning at 85% tank level shall interrupt power to the pump. Between 85% and 90% the pump shall be capable of operation in manual jog mode to allow drainage of the delivery hose.

D. Accessory Equipment

1. Strainers: Provide Y-type strainer at the inlet of the pump.

2.08 Fuel Filtration / Polishing System

A. Manufacturers
1. Earthsafe Systems M300
2. Engineer approved equal

B. General: Provide a packaged pump and filter set to provide filtration of stored fuel on a timed cycle. The pump and filter set shall be integrated with a control panel to provide motor control, system status, and alarm indication.

C. Design Criteria

1. Transfer Pumps: The transfer pump shall be rated at a minimum of 10 GPM or the design flow as indicated on the drawings. Pump motors shall be as required to provide the design flow. Motors shall be TEFC.
2. Filter Housing: The filter housing shall be welded carbon steel construction rated at a minimum 150 PSI. The unit shall have minimum 1 inch inlets and outlets, and

minimum ¼ inch openings for top air vent, pressure gauge connections, bottom water drain and water sensing. The interior of the housing shall be epoxy coated and the exterior shall have a prime and finish cost of industrial enamel.

3. Filters: The filters shall provide two stage separation and coalescing of water and dirt from the diesel fuel. The stage 1 filter shall be rated at 25 microns, and the stage 2 coalescing filter shall be rated at 10 micron. The filters shall have viton gaskets and corrosion protection metal components. The filters shall be rated at up to 75 PSI differential pressure.
4. Containment Base and Frame: Pumps shall be mounted on a welded steel liquir tight containment basin. The base shall include a welded steel support for piping and accessories.
5. Pump Motor Starters: Each pump shall be equipped with amn individual motor starter disconnect panel. The panel shall include an HOA switch for operator use. The panel shall include output relays for pump overload trip and Not-In-Auto signals. In auto mode the pump shall be controlled by the filter control module.
5. Control Module: The pump set shall be controlled by a microprocessor based control module. The unit shall be programmed to activate the pump on a time cycle to provide one complete filtration cycles each week. The unit shall monitor a differential pressure switch across the filter and shall provide an alarm at a 20 PSI differential pressure. The unit shall monitor a high water level switch and indicate a high water alarm. Indicator lights shall be provided for power on, pump on, and pressure / water alarms.

D. Accessory Equipment

1 Ball Valves: Brass ball valves at unit inlet, outlet and to isolate the pump and filter.
2 Check Valves: Brass swing check valves at the discharge of the pump.
3 Pressure Relief Valve: Brass relief valve set at 100 PSI at pump discharge.
4 Strainers: Brass basket strainers at the inlet for the pump.
5 Flow Switch: Differential pressure switch across filter.
6 Water Switch: High water level switch in the filter housing.
9. Differential Pressure Gauge: Provide filter DP gauge.
10. Leak Sensor: Liquid sensor for containment.
11. Enclosure: Where indicated on the drawings the pump set shall be enclosed within a welded steel weatherproof enclosure.
12. Optional Heater: Where indicated provide unit heater, and thermostat to provide freeze protection for the filter system.
13. Optional Multi-Tank Selection System: Where indicated provide a multi-tank selection system as described above to allow the filter unit to serve multiple tanks.

2.09A Distributed Control and Network Interface

A. Manufacturers:
1. Earthsafe Systems C700
2. Engineer Approved Equal

B. General: The fuel system controls shall be a distributed system with individual C800 controllers for day tanks, duplex pump sets, filtration units, fill stations, and multi-tank selection. The individual controllers shall be linked by an Ethernet network to a C700 Network Interface Module. The Network Interface Module shall monitor status of all individual system status, provide an operator interface, and provide connections to other building management systems.

C. Design Criteria:

1. The Network Interface Module shall provide the following functions: (a) graphic user interface with touch screen navigation, (b) integration of operating status information for all system control modules, (c) central alarm annunciation, (d) integration of tank level gauge / leak monitoring unit to provide common output to building management system (BMS), (e) provide BMS data integration using Modbus protocol, (f) provide 8 programmable dry contact relays for integration with generator controls, paralleling gear, fire alarm systems, or security systems.
2. The Network Interface Module shall be a NEMA 4 enclosure with minimum 6 inch diagonal color touch screen. The panel shall include an alarm horn, and acknowledge switch. The NIM shall be powered by an independent 120 VAC circuit and shall include a 24 VDC power supply

D. Accessory Equipment:

1. Tank Level Functions: Where indicated on the drawings for aboveground tanks the NIM shall integrate tank level transmitters to provide tank level and volume information instead of integrating an independent tank gauge.
2. Tank / Pipe Leak Sensors: Where indicated on the drawings, the NIM shall integrate tank, pipe, sump, or floor leak sensors.
3. UPS: Where indicated on the drawings, the NIM shall include an Uninterruptible Power Supply

2.09B Master Control and Network Interface

A. Manufacturers:
1. Earthsafe Systems C900
2. Engineer Approved Equal

B. General: The fuel system controls shall be a Master Control System based on the C900 CentraPlex Controller. The Master controller shall be in lieu of individual controllers for day tanks, duplex pump sets, filtration units, fill stations, and multi-tank selection. The Master Controller Network shall monitor status of all individual system elements, provide an operator interface, and provide connections to other building management systems.

C. Design Criteria:

1. The Master Controller shall provide the following functions:
   a. Day Tank Level Control: Monitoring of day tank level sensors (high alarm, fill stop, fill start, low alarm) and leak sensors. Control of inlet control valves. Control of return flow pumps.
   b. Duplex Pump Control: Pump selection and start / stop control. Pump monitoring for pressure, flow, or motor current. Operation of secondary pump as alternating, lead / lag, or twin. Pump operating hour monitoring.
   c. Filtration / Polishing Control: Pump On – Off Control, Filter Cycle selection based on time selection, time / day selection, or volume selection. Filter monitoring for water, differential pressure, and leak.
   d. Tank Fill System: Monitoring of high level sensors, control of inlet control valves. Annunciation of tank level and alarms at fill station.
   e. Multi-Tank Selection: Control of fouel oile supply and return control valves. Monitoring of tank high and low alarms. Manual and automatic selection of fuel supply tanks. Valve control for filtration.

2. The Master Controller shall include the following: (a) graphic user interface with touch screen navigation, (b) integration of operating status information for all system control modules, (c) central alarm annunciation, (d) integration of tank level gauge / leak monitoring unit to provide common output to building management system

(BMS), (e) provide BMS data integration using Modbus protocol, (f) provide 8 programmable dry contact relays for integration with generator controls, paralleling gear, fire alarm systems, or security systems.

3. The Master Controller shall be a NEMA 4 enclosure with minimum 6 inch diagonal color touch screen. The panel shall include an alarm horn, and acknowledge switch. The NIM shall be powered by an independent 120 VAC circuit and shall include a 24 VDC power supply

D. Accessory Equipment:

1. Tank Level Functions: Where indicated on the drawings for aboveground tanks the NIM shall integrate tank level transmitters to provide tank level and volume information instead of integrating an independent tank gauge.
2. Tank / Pipe Leak Sensors: Where indicated on the drawings, the NIM shall integrate tank, pipe, sump, or floor leak sensors.
3. UPS: Where indicated on the drawings, the NIM shall include an Uninterruptible Power Supply

PART 3 EXECUTION

3.01 Excavation

A. Excavation, trenching, and backfilling are specified in Division 2.

3.02 Fuel Tank Installation

A. Install tanks in strict accordance with the manufacturer's recommendations, PEI/RP100 and PEI-RP200, and applicable fire and environmental codes. State and local permits shall be obtained prior to installation.

B. Aboveground tanks shall be clearly marked on all sides with warning signs: "FLAMMABLE" or "COMBUSTIBLE", "NO SMOKING", tank volume, product identification, and other signs as required by the applicable codes.

C. Electrical work shall be in accordance with applicable codes and shall be rated for hazardous area as required. Tanks shall be electrically grounded in accordance with N.F.P.A. 78.

D. The tank installation shall be inspected and approved by the tank supplier or its certified contractor. The tank supplier shall submit a comprehensive check-list of quality and safety items critical to the system and verify that the installation has been in accordance with these standards and applicable fire and environmental codes.

3.03 Aboveground Piping Installation

A. Install in accordance with the manufacturer's instructions and PEI/RP200-92.
B. Inspect all materials for signs of damage, and confirm compliance with specifications.
C. Avoid damage to piping materials or coatings during handling, installation and testing.
C. Provide adequate support for piping on 10' centers minimum.
F. Group piping whenever practical at common elevations.
G. Install piping to allow for expansion and contraction so that pipe, joints, or connected equipment will not be stressed.
H. Provide clearance for access to valves and fittings.

I. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of the completed system.
J. Install unions, couplings, valves, and flexible connectors in accordance with manufacturers' recommendations.

3.04 Underground Piping Installation

A. Install in accordance with manufacturer's instructions and PEI/RP200-92.
B. Inspect all materials for signs of damage, and confirm compliance with specifications.
C. Avoid damage to piping materials or coatings during handling, installation and testing.
D. Secondary containment piping must slope to piping sump at a minimum 1/8" per foot.
E. Trench and backfill per manufacturer's instructions.
F. Test primary and secondary pipe for integrity using pressurized air per manufacturer's instructions.
G. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work and isolating parts of the completed system.

3.05 Tank Level and Leak Monitoring System Installation

A. Install in strict accordance with the manufacturer's recommendations, National Electrical Code NFPA 70, and NFPA 30A.
B. Electrical work shall be rated for hazardous area as required.
C. Install the monitoring system control panel as indicated on the drawings.
D. Install the tank level probe and the interstitial leak probe in the proper locations in the fuel tank. Install the piping sump sensor in the piping sump.
E. Install the overfill alarm and acknowledgment switch as shown in the plan.
F. The leak monitoring system installation shall be inspected and approved by the equipment supplier or its certified contractor. The leak monitoring system supplier shall submit a comprehensive check-list of quality and safety items critical to the system and verify that the installation has been in accordance with these standards and applicable fire and environmental codes.

3.06 Electrical System

A. Design, provide and install branch circuit panel board and feeder from main distribution panel. Panel to be equipped with means of disconnecting all fueling system circuits per NFPA 70.
B. Design, provide and install all branch circuit conduit and wiring for equipment installed in this section. All wiring shall be designed and installed in strict accordance with NFPA 70.

3.07 Field Quality Control

A. Test fuel distribution system according to NFPA 30.
B. Test and adjust fuel management and leak monitoring systems controls and devices. Replace damaged and malfunctioning controls and devices.
C. Submit reports of test and procedures in writing to the Engineer.

3.08 Demonstration

A. Train Owner's maintenance personnel on procedures and schedules related to start-up and shutdown, troubleshooting, servicing, and preventive maintenance.
B. Representatives of equipment suppliers for the fuel pumps, day tanks, and leak monitoring system shall provide necessary training and technical support to the Owner so that the Owner may properly operate and maintain the systems.

3.09 Commissioning

A. Perform a complete system commissioning in accordance with the approved commissioning plan.

END OF SECTION 13011