Section 1: Mechanical		
Item	Subject	Description
1-01	**Fuel Storage Capacity**	Total fuel storage capacity shall be sufficient to run the primary generators at full load for 72 hours, based on 90% full tanks. The system shall include a minimum of (2) bulk storage tanks.
1-02	**Fuel Transfer**	The fuel system shall include as a minimum (2) fuel pumps, and (2) independent fuel supply pipes from the bulk storage tanks to the generator tanks. Submersible fuel pumps are preferred. Systems shall be designed to allow for the regular exercise of fuel transfer pumps by alternating duplex pumps and / or continuos operation.
1-03	**Fuel Piping**	Aboveground fuel piping shall be carbon steel primary pipe with butt weld or socket weld connections. Underground fuel piping shall be UL listed fiberglass pipe. Fuel piping shall be contained within secondary piping. The secondary pipe shall be UL listed fiberglass pipe underground and carbon steel pipe (minimum 10 gauge) aboveground.
1-04	**Fuel Valves**	Valves for fuel piping shall be carbon steel. Where required by local code valves shall be FM approved fire safe valves.
1-05	**Piping Design**	Piping systems shall be checked for low head loss, absence of fluid hammer, accommodation of expansion / contraction, thermal expansion relief, and isolation from vibration. Pipe supports shall be designed for required loads, shall be located at required spacing, and shall be seismic restrained where required.
1-06	**Filtration / Polishing**	Fuel systems shall include filtration / polishing systems for both bulk storage and generator tanks over 1000 gallon capacity. Filtration shall include separation and coalescing cartridges to remove both dirt and water. The filtration / coalescing system shall be designed to filter the entire fuel inventory at least once per week. The system shall include a means of introducing a biocide for protection against bacterial and algae growth. Bulk storage tanks shall be monitored by the tank level gauge for water accumulation in the bottom of the tank.
1-07	**Fill Systems**	Underground tanks shall be filled by gravity drop from delivery trucks. Aboveground tanks shall be equipped with systems to allow filling of tanks from the ground. Where fuel delivery by pump equipped trucks is not readily available, the fill systems shall include a truck unloading pump.

Section 2: Environmental		
Item	Subject	Description
2-01	**Secondary Containment**	Tanks and piping systems shall be designed with a minimum 100% capacity secondary containment and as required by local codes. Pump and filter systems at tanks shall be enclosed within secondary containment sumps with allowance for connection of double wall piping.
2-02	**Spill Containment**	Spill containment shall be provided as a minimum 15-gallon capacity at all fill hose connections to storage tanks.
2-03	**Overfill Protection**	Tanks shall be designed for redundant overfill protection. Primary control devices shall prevent filling of tanks to over 90% capacity. Secondary devices shall prevent filling at 95% capacity. A mechanical overfill prevention valve is preferred as a secondary device. Alarms shall be provided to signal an overfill condition. Return piping to tanks shall include an overfill prevention valve where an overfill condition is possible. Generator tanks shall have a gravity return overflow pipe to the main storage tank where practical. Multiple bulk storage tanks shall be connected by an overflow pipe.
2-04	**Leak Detection**	Continuous electronic leak sensors shall monitor secondary containment tanks, piping, sumps, and enclosures. The sensors shall be integrated with the electronic level gauging system.
2-05	**Corrosion Protection**	Underground tanks and piping shall be protected from corrosion by non-metallic exterior protection.
2-06	**Anti-siphon Protection**	Piping from aboveground tanks shall be equipped with anti-siphon devices.
2-07	**Stormwater Quality**	Stormwater systems from tank and generator yards shall be equipped with oil water separation devices.
2-08	**SPCC Plans**	A licensed engineer shall provide spill Prevention, Control, and Countermeasure (SPCC) plans for all facilities. Facilities shall be equipped with spill response equipment to handle small spills.

Section 3: Fire Safety		
Item	Subject	Description
3-01	**General**	Fuel systems shall be designed in accordance with NFPA requirements
3-02	**Isolation from Buildings**	Fuel systems shall be designed to assure isolation from buildings. This includes an assurance that leaks from tanks and piping would flow away from buildings. Tank fill points shall be separated from building openings by a minimum of 15 feet. Tank vents shall be isolated from building openings air intake locations.
3-03	**Fire Rated Tanks**	Outside bulk storage tanks shall be underground or fire rated (UL2085) aboveground tanks.
3-04	**Lightning Protection**	Tanks shall be ground for lightning protection at (2) points with a minimum 4/0 cable.

Section 4: Electrical		
Item	Subject	Description
4-01	**General**	Electrical work shall be in accordance with NEC requirements and local codes.
4-02	**Materials**	Conduit shall be rigid galvanized steel conduit. Conduit accessories shall be cast aluminum. Wire shall be THHN unless otherwise noted. Maximum 3 feet lengths of seal-tight conduit may be used for connection to devices.
4-03	**Power**	Fuel systems shall be designed for 120 / 208 VAC single phase power. The fuel system shall include (2) independent power distribution panel. Power to the panels shall be provided from independent sources in the building.
4-04	**Isolation**	Control wire shall be isolated from motor loads. Intrinsically safe wiring for level gauging and leak detection shall be installed in conduit independent of non-intrinsically safe wires. Communication wire and cable shall be isolated in separate conduit.
4-05	**Area Classification**	Diesel fuel systems shall be classified as ordinary electrical areas, unless required to be hazardous electrical areas by local codes. Heating systems for tanks, piping, filters and associated enclosures shall be rated as Class 1 / Division 2
4-06	**Control Power**	Control power shall be 120 VAC
4-07	**Motors**	Motors shall be protected by overload protection devices. Motors starters shall be capable of manual operation. Disconnect devices shall be located as required for shutoff and lockout of power for motor maintenance. Motors over 0.75 HP shall be 208 VAC single phase.
4-08	**Surge Suppression**	Electrical systems shall include surge suppression from motor starters, solenoid valves, contactors, and other devices.

Section 5: Controls		
Item	Subject	Description
5-01	**Manual Control**	Pump controls shall be capable of manual operation. Actuated valves shall have a manual control or a manual bypass.
5-02	**Redundancy**	Independent control modules shall be provided for each duplex pump set, each generator tank, each filter / polishing set, and each tank manifold control.
5-03	**Secondary Devices**	Failure of any fuel system primary device shall cause control systems to automatically activate the secondary device
5-04	**Pump Control**	Pump controls shall allow for the alternation of duplex pump sets. Pumps shall be monitored by a flow or pressure sensor. Failure of the primary pump shall cause activation of the secondary pump.
5-05	**Generator Tank Level Control**	Generator tanks shall include (2) independent control vales at the fuel inlet. The automatic valves shall be equipped with a manual bypass. The generator tank level shall include (5) points approximately 90 % High Level, 85% Fill Stop, 75% Fill Start, 65% Low Level, 25% Critical Low Level. The low alarm shall activate the secondary fill system. The high alarm shall activate an alarm and overflow pumps if provided.
5-06	**Overfill Protection**	Where mechanical devices are not practical independent level sensors and devices shall be provided for tank overfill protection.
5-07	**Control Equipment**	Control systems shall be constructed of components by manufacturers with worldwide distribution and support

Section 6: Monitoring		
Item	Subject	Description
6-01	**General**	The fuel system controls shall include continuos monitoring which shall interface with the primary building management system (BMS) through a Network Interface Module (NIM). The NIM shall provide a Modbus interface or other protocol as determined by Exodus. The NIM shall also provide (30) output contacts programmable for specific conditions or events.
6-02	**Fuel Inventory**	Bulk fuel tanks shall be equipped with electronic level gauging devices to provide inventory information. The level gauge shall also monitor for excessive water accumulation in the bottom of the tanks. The inventory monitor shall interface with the BMS through the fuel system NIM.
6-02	**Leak Detection**	Leak sensors shall be monitored through the Fuel Inventory system or local control module.
6-03	**Tank Level**	Tanks shall be monitored for high and low level.
6-04	**Pump Activation**	Pumps shall be monitored for activation and low flow / pressure alarms.
6-05	**Filter / Polishing**	Filters shall be monitored for differential pressure and water accumulation

Section 7: Other		
Item	Subject	Description
7-01	**Signage / Marking**	System designs shall include appropriate nameplates, color coding, flow direction indicators, wire markings, safety signs, and posted instructions
7-02	**Cold Weather**	Systems shall be designed for cold weather operation where required. Cold weather protection shall include heating for tanks, piping, filters, mechanical enclosures, and electronic enclosures.
7-02	**Design Documents**	Design documents shall include sitework, concrete, mechanical, electrical, and control drawings in sufficient detail. A standard specification for fuel system construction shall be provided. Equipment data manuals shall be included.
7-02	**Commissioning Plan**	A detailed fuel system commissioning plan shall be prepared and executed.
7-03	**Operation Manuals**	Operation and Maintenance manuals shall be prepared including as-built drawings, spare parts lists, and service contacts.

Section 8: Equipment		
Item	**Subject**	**Description / Manufacturer**
8-01	**Underground Tanks**	UL Listed dual steel walls with fiberglass exterior cladding. Make: STI – ACT 100
8-02	**Aboveground Tanks**	UL 2085 Listed double wall fire rated tanks with access ladders and ground mounted fill. Make: STI – Fireguard
8-03	**Fuel Pumps**	Submersible type preferred. Make: Red Jacket Gear Pumps where required. Make: Viking Centrifugal Pumps where required. Make ITT Gould
8-04	**Filtration / Polishing**	Filters and housings. Make: Racor Controls. Make: Earthsafe
8-05	**Tank Level Gauge / Leak Detection**	Electronic continuous monitoring with communication functions. Make / Model: Veeder Root TLS 350
8-06	**Containment Piping**	Fiberglass pipe UL listed for fuel service. Make: Ameron. Primary pipe schedule 40 steel pipe with centralizer supports
8-07	**Power Distribution**	Square D
8-08	**Controls**	Based on Allen Bradley Micrologic / SLC 500 controllers and components. Make: Earthsafe
8-09	**Monitoring**	Single panel connection for BMS interface to include Modbus and 30 point output module. Make: Earthsafe