1. DAY TANK AND RETURN PUMPS
2. Acceptable Manufacturers:
3. Critical Fuel Systems
4. Lannon Tank
5. Highland Tank
6. Provide a UL 142 listed fuel oil day tank. Day tank shall be for use with a main tank in order to provide an automatic, self-refilling fuel supply system.

Day tank is a general term for a tank which is located next to the generator or boiler that requires the fuel. Historical reference is to the ability to store a “day” worth of fuel, but as systems have gotten much larger day tanks may only store 1-2 hours’ worth of fuel. Most day tanks are UL142 listed, but some facilities due to fire considerations will make use of UL2085 tanks that offer fire protection.

1. When duplex or remote transfer pump set is used, the day tank shall be equipped at least with an inlet solenoid valve arrangement (flow control manifold) where more than one day tank is used. Where a generator base tank is used, this base tank is the day tank. Control of the level in each base tank shall be by main transfer pump set control panel. Where multiple base tanks are used, day tank flow control manifolds are to be provided. Level controls in the base tank(s) and base tank leak detection, are to be controlled directly by the transfer pump set control cabinet and supplied by pump set manufacturer.
2. Design Criteria
3. Day Tank Capacity: Provide the number of tanks and sizes as indicated on the drawings.
4. Return Transfer Pump: As indicated on the drawings, but always the same or greater flow then the supply pump(s) or supply system.
5. Day Tank Construction:
6. All welded steel atmospheric tank of rectangular construction built in accordance with codes and standards noted above for indoor use with fuel oil.
7. Pipe thread connections shall be provided for fuel oil supply from main tank, supply to prime mover, return from prime mover, and overflow to main tank, vents and drain. Manufacturer shall factory-install a direct reading tank gauge. Provide a multi-level switch probe (rated at 50VA) for day tank level control. Switch device shall be constructed of an integral brass probe with Stainless Steel level switches, and a weatherproof and explosion-proof head. Standard levels shall be:

* Low-low level, (15% tank capacity) to be used to shut down the generator command,
* Low-level (40% tank capacity) for alarming and to turn on both supply pumps
* Lead pump on - fill (50% tank capacity),
* Lead pump off - full (80% tank capacity),
* High level alarm and pump shut down (90% tank capacity).
* As noted in the design drawings a 95% level switch can be used to turn on the return pump to keep the tank from overfilling if no gravity overflow line is available.

1. Provide an additional switch for overfill alarm to be mounted in the vent. Vent switch shall be mounted as close to the top of the tank as possible, no more than one foot.
2. Vent minimum size shall meet UL requirements as determined by the size of the day tank.
3. An inspection port in the top shall be provided, which is easily accessible without removing other equipment on the day tank.
4. The tank shall be equipped with a welded steel channel base suitable for bolt attachment to a concrete pad.
5. Exterior shall be painted in a Chemical-Resistant Finish over a rust-resistant primer. The interior shall not be painted.

The height of the vent and the tank location affect the required tank pressure rating. Also, some jurisdictions will require higher pressure ratings for day tanks, please consult with your local authority.

1. The Tank shall be rated for 5 PSIG. Safety and environmental safety provisions shall be provided to prevent the escape of fuel oil into the environment. This shall include a sealed and pressure tested double wall or single wall with rupture basin day tank built, tested and certified to UL 142 standards.
2. The tank shall be installed and anchored within a steel open top containment basin having a minimum capacity of XXX% with that of the day tank. The containment shall be equipped with a leak detector that shall activate the “rupture” alarm described below. Containment basin shall also have a plugged Drain port.

OR (closed top construction required for outdoor use.)

1. Provide a double wall tank where the containment basin can be enclosed. The containment area shall be XXX% (typically 110%) The containment shall be equipped with a leak detector that shall activate the “rupture” alarm described below. Containment basin shall also have a plugged Drain port.
2. Factory Testing: Fuel oil storage tank and day tank pneumatic testing is required to ensure tightness prior to shipment. The minimum pressure for testing the tank shall be three (3) psi. The pneumatic pressure shall be maintained until all joints and connections have been visually inspected for leaks, but in no case for less than one-half hour. The tank shall not show any permanent deformation as a result of the test. The Rupture basin (open top) shall be hydrostatic tested prior to shipment. The basin shall maintain a full water level while all joints and connections are visually inspected for leaks. The test shall be run for no less than one-half hour. A copy of the test procedures shall be sent to the consulting engineer and owner. The owners and or the consulting engineer, at their discretion, shall observe this and all other tests.
3. Accessory Equipment

For multiple day tank installations. Not needed for a single day tank system.

1. Day Tank Solenoid Valve Assembly: When there are multiple day tanks, each day tank shall be equipped with a flow control manifold. The manifold assembly shall be constructed of ASTM-A53 Grade A or B schedule 40 steel pipe sized for the oil velocity flowing into the day tank from supply pump, and which shall include:

* Two (2) isolation ball valves,
* One (1) bypass ball valve and one (1) globe valve to provide complete by-pass for manual operation.,
* One flow sensing device, one simplex strainer, cast iron body complete with a 100-mesh strainer basket (suitable for up to 200 psi working pressure),
* Two automatic solenoid fill valves (or motorized ball valves with end switches) and shall further be provided with a complete by-pass for manual operation.
* All valves, pipe, and fittings shall be rated for not less than 125 PSI working pressure. Control of this manifold assy. (one for each day tank) shall be by the main pump set control cabinet.

1. Return Fuel Pump: Day tank shall be equipped with a factory installed return fuel oil pump. Return pump shall be fitted with a dip tube that will reach to within six inches from the bottom of the day tank to insure prime. Return pump shall have an external relief, be made of the same materials, and be rated by the same standards as the supply pumps.
2. If shown on the drawings, the day tank shall be further fitted with an emergency overflow pipe port that must be attached to the “FOR” return line. Drawing note shall say that installing contractor is to pipe the return line so that when the return pump is running, it cannot discharge fuel back into the day tank. The emergency overflow port shall not be fitted with a dip tube. If, however, at any time the return piping rises above the day tank before returning to the main tank, and also in the circumstance where the main tank is higher in elevation than the day tank, contractor is to cap off the emergency overflow port and omit its use.
3. Fitted onto the pump return (discharge of pump) piping, where shown on drawing a flow switch. The flow switch will signal if the return pump is flowing oil. The Return Pump will operate when day tank high tank level has been reached (90 or 95% tank level) and/or when the day tank fuel temperature RTD has indicated the fuel oil temperature in the tank is too high. Day tank shall have a factory installed Oil Temperature RTD to provide the day tank fuel oil temperature information to the control panel. This assembly shall have a 0.10% accuracy, Waterproof head, spring loaded element, with 304 Stainless Steel reduced tip, have an adjustable dead band, and always reach down to 2” off the bottom of the day tank. As set, the RTD will provide the signal for the oil return pump to activate and return the heated day tank oil back to the main tank at the temperature setting. This pump operation is to assure that the day tank oil does not overheat. The Return pump will lower the day tank oil level to the 50% tank level and shut off, whereupon the lead supply pump will start (or, for multiple tanks) solenoid manifold shall open whereupon cool oil from the main tank will refill the tank to the 80% level. If the RTD still indicates the fuel is too hot, the pumping sequence will repeat until RTD temp declines below RTD temp. set point.
4. The return pump shall be sized to provide approximately at least 100% of the total fuel supply capacity.
5. The return pump shall be activated and controlled by the control cabinet. This cabinet will include a HOA switch to allow both automatic operator as well as manual operation.
6. For multiple main tank installations and where one or more fuel pump sets are used, provide for the use of multiple automatic ball valves for both supply (FOS) and return lines (FOR) to select which main tank to draw oil from and return to. Automatic Oil flow strategy is to draw from and return oil to the same main storage tank, one at a time. Main Fuel Oil Control panel will be required to control this function and offer a clear sequence of operations when this strategy is used.
7. Where shown on drawings, supply (X) automatic motorized ball valves for automatic main tank selection via control of the fuel oil management control center. Control shall be either by the operator manually selecting the primary tank or by the tank gauging system performing an automatic changeover if the primary fuel reaches the low-level alarm condition. Valves shall have proof of closure and open switches. All valves shall have manual bypass valve operation, both with hand operated valve positioners and with a manual bypass line at each valve.

May also desire a double wall day tank instead of an open top rupture basin

1. Each day tank shall be equipped with top mounted ports. The only drain shall be for the containment. No drain shall be provided for the tank itself to keep from an accidental spillage. The drain port shall be provided near the floor with a hand valve and plug. All tank ports are to be clearly labeled as their function.
2. Major system components (sizes as show on drawings or as required by UL142)
3. Tank fill-tank connection with drop tube.
4. Tank overflow/return connection.
5. Tank normal vent and interstitial normal vent connection.
6. Tank normal emergency vent and interstitial emergency vent connection.
7. Equipment supply connection with drop tube with foot valve.
8. Equipment return connection with drop tube.
9. Double wall interstitial or rupture drain connection
10. Level control switch port(s)
11. Temperature monitoring port
12. Inspection port
13. Interstitial or rupture basin port
14. Day Tank Accessories
15. Fill Manifold shall be sized to replace the fuel consumed and not returned back to the day tank by the generator, at full load, by a ratio of no less than 4-1. The fill manifold shall be pre-piped and prewired to a local control module.
16. The piping shall be schedule 40 or heavier and consist of the following components:
17. Two (2) automatic fill valves piped in sequence to provide 2 valve protection, greatly reducing the chance of flooding the day tank due to valve leak by. These valves shall be normally closed, opening upon a call for fuel.
18. Three (3) valve bypass arrangement, consisting of full flow ball valves rated for fuel service at the design pressure of this system and a single globe valve to be used as a manual flow control. This shall be arranged in a way that provides full isolation of the filters, strainers, flow switch, and automatic valves while allowing manual control of the day tank fill.
19. Flow switch shall be installed to verify that flow is established when the control system opens the fill valves. If flow is not established the control system should sound alarm and illuminate alarm lamp on fill manifold junction box.
20. Flow limiter shall be sized to replace the fuel consumed by the generator at a ratio of no less than 4-1 and no more than 6-1 to prevent foaming in the day tank or starving the fuel transfer system.
21. Basket strainer shall be provided with a 100-mesh removable basket. “Y” type strainers are not allowed.
22. Differential pressure switch will be piped across the strainer and fuel filter, monitoring the combined differential pressure.
23. Fuel oil filter shall have a replaceable element.
24. Fuel oil gauges shall be glycerin filled with a 2.5” dial and be designed for rugged duty, wetted parts shall be bronze or stainless steel and the gauges shall be suitable for system design pressure.
25. Visual flow indicator shall be of a maintenance free design and guaranteed to be leak free for a minimum of 3 years. This device shall be a paddle wheel or propeller type indicator visible through glass window on both sides.
26. Electrical local control module shall be UL 508 listed and NEMA 4 rated, it shall be provided with a red alarm lamp, blue lamp that indicates that the fill valves are energized, and a hand-auto switch, all pilot devices shall be rated NEMA 4 or better. The alarm lamp will be energized by Total Fuel Management Center upon a flow failure. The hand-auto switch when placed in auto will allow the controller to energize the automatic fill valves. In the hand position the switch shall energize the automatic fill valves, if the fuel level in the day tank reaches the high level switch all power will be cut to the circuit causing the automatic fill valves to close and energize the alarm lamp.
27. The electrical conduit and fittings shall be liquid tight to maintain the NEMA 4 integrity of the junction box. The conductors shall be stranded copper suitable for the application.
28. High Temperature switch shall be installed in the day tank. The temperature switch shall be set for 130 deg F and shall open upon a temperature rise. This switch shall be monitored by the Fuel Management System; the system shall sound an alarm and/or start the return pump.
29. Flooded Vent Switch, a float operated switch shall be installed no more than 12” from the day tank in the first vertical run of the vent line. This flooded vent switch contact shall be normally closed, opening on an accumulation of liquid in the vent line.
30. Interstitial Leak Detector, A float operated leak detector shall be installed in the interstitial space of the double wall tank within 2” of the tank floor. This leak detector contact shall be normally closed, opening on an accumulation of liquid in the interstitial. The leak detectors switch shall be installed through the top of the tanks to limit penetrations through the double wall.
31. Tank vent shall be capped to allow an open path for air to enter and exit the tank during normal operation. The vent cap shall prevent intrusion into the vent line from rain, debris, and insects.
32. Return Pump
33. Acceptable manufacturers subject to compliance with the specifications:
34. Critical Fuel Systems
35. Viking Pump
36. IMO Pump
37. Provide a simplex return pump that is factory assembled with components piped and mounted on a common base plate. Pipe shall be schedule 40 ASTM A-53 Grade “A” with ANSI B16.3 Class 150 malleable iron threaded fittings. Base pan shall include a minimum 3" steel side rails and be continuously welded out of minimum ¼” plate steel for containment and mounted to the top or off the top of the tank. Provide a ½" containment basin plugged drain connection. The basin shall also be sized to contain potential leaks from all factory installed piping and components. The return pump shall be rated at XXX GPH of fuel oil against a discharge pressure of 50 psig as manufactured by Critical Fuel Systems.
38. Positive Displacement Return Pump: Provide and mount a positive displacement internal gear rotary type pumps, with cast iron housing and self-adjusting mechanical, Carbon ring seals. The pump shall be capable of developing 25” Hg. Vacuum at 0 PSIG as factory tested, however, for normal operation; vacuum shall not exceed 15” Hg. Pump and motor combination to be rigidly, direct mounted to ASTM-A36 channel. Pumps that have aluminum, brass, or bronze housings or rotors are not acceptable. Packing gland equipped pumps, close-coupled pumps, Carbonator shaft mounted pumps or centrifugal pumps are not acceptable.
39. Motor: Provide and mount TEFC/TEPE, rigid base, standard NEMA frame motors. Motors sized to develop no less then X HP at YYYY RPM using XXX V, Y P, 60 Hz electrical service. Motor shall have copper windings; a dynamically balanced rotor, ball bearings and a heavy gauge steel NEMA Frame.
40. Pump and Motor Assembly: The return pump and motor assemblies shall be welded to the base pan as noted on the drawing. Pumps and motors shall be mounted on an ASTM-A36 structural steel channel and equipped with flexible coupling and full OSHA approved coupling guard. Pumps and motors shall be mounted with bolts threaded into the steel channel for ease of maintenance. Mounting bolts shall not penetrate the containment basin.
41. Flexible coupling: The return pump shall be connected to the motor by an elastomeric jaw type flexible coupling that does not require lubrication. The coupling wear member shall be replaceable without disturbing the alignment of either the pump or motor. Sizing of the flexible coupling shall be based on motor horsepower and rpm. Materials of construction: The coupling body shall be sintered iron and cast iron. The elastomeric wear member shall be NBS Rubber.
42. Pump Isolation: Provide and mount a pump isolation valve on the outlet of the return pump after the relief valve. Isolation valves shall be ball type, rated 600 WOG, include stainless steel ball and Teflon seat. Valve to provide full flow while open and positive shutoff when closed. Additionally, one class 125 # spring check valves shall be provided and mounted on the discharge of each pump to prevent back pressure from a common return line.
43. Fuel Oil Strainer: Factory install one (1) Simplex strainer, basin mounted, on the suction side of the pumps. Strainer to be sized for less than ½ psi of mercury drop through a clean strainer basket with the maximum anticipated flow in the suction line. Strainer shall be one-piece cast iron body and shall be suitable for 200 psi. Strainer baskets shall be 40-mesh stainless steel. Strainer shall come complete with lever wrench handle and be bolted in place without bolting through pan.
44. Relief Valves: Provide and mount an external relief valve sized to relieve the full outlet flow of the return pump without causing the pump motor to overload or any component’s pressure rating to be exceeded if the discharge is inadvertently closed off by a closed valve.
45. Pressure Gauges: Provide and mount a pressure gauge on the discharge side of the return pump. Each gauge shall be equipped with an isolation ball valve.
46. Return pump basin leak detection switch: Provide a factory mounted and wired float operated Containment Basin Leak Detection Switch to shut off the pumps and energize an audible and visual alarm should a leak be detected. The leak sensor shall be a plasma welded stainless steel construction. The leak sensor shall be internally mounted within the pump basin. Electrical connections shall be contained in a factory installed weatherproof junction box.
47. Day Tank Control Cabinet: Provide a control cabinet factory mounted on the day tank. System shall be custom designed to accomplish the control strategy as outlined. To allow pump operation in the event of pump set PLC failure, provide hard wired, safety interlocked, Hand-Off-Auto manual switches for the return pump. Control hardware shall include combination magnetic motor starter with overload protection and circuit breaker for the return pump.
48. Operator Interface Terminal (HMI): The day tank control panel shall include a 10” color touch screen for day tank status, tank level indication, alarm listing, and other trouble-shooting functions. The control system shall monitor the position of the return “Hand-Off-Automatic” control switch. Should a switch be put into the “Off” position, the controller shall alarm and log the event with a Time/Date stamp in the HMI. The Fuel Oil Overview display shall include the following information:
49. Return Pump Selection – Auto/Manual
50. Pump Status – Off/Run
51. Day Tank Status – Normal/High/Low/Leak
52. Alarm history
53. Day Tank Relay Based Control System
54. This is a 24vdc relay-based controller designed to interface with the day tank’s level switches, and leak/overflow detector switches to control the level of a single day tank.
55. Major system components
56. NEMA 4 steel enclosure
57. Alarm light and alarm silence button
58. Power on lamp
59. Level alarm lights as shown on drawings
60. Alarm horn
61. Major functions of the fuel oil control system shall be as follows
62. The system shall monitor the level switches and send a “call for oil” signal to the pump set control panel. A hardware interlock from the high-level switch will be used at the pump set control panel to not allow pump operation even in manual (hand).
63. Day tank fill manifold control and monitoring.
64. Other functions as shown on the drawing.
65. Interface and communication (discrete I/O)
66. Call for Oil
67. High level interlock
68. Low level alarm
69. Leak detected
70. Environmental, Safety, Quality
71. Environmental Conditions
72. The fuel oil control system shall be constructed to NEMA 4 or NEMA 4X standards.
73. Wiring shall be in accordance with NEC standards, using stranded copper conductors in liquid tight conduit. Special care shall be taken to ensure conduits are not over capacity and in accordance with NEC requirements.
74. Safety and environmental safety provisions
75. The system shall be designed to operate in a “fail Safe” mode. Fail safe is defined as to prevent the overflow of oil into the environment upon a power loss or circuit break
76. For arc flash protection as defined by NFPA 70e. This system shall be designed to operate with 24vdc, no voltage over 49vdc shall be permitted in the panel.
77. Quality Assurance: The Control Cabinet shall be manufactured and labeled in accordance with UL508A (CSA C22.2 #14 for use in Canada). Simply supplying UL recognized individual components are not sufficient. The assembled control cabinet, as a whole, must be inspected for proper wiring methods, fusing, etc., and must be labeled as conforming to UL508A.
78. Approved manufacturers
79. The only manufacturers approved shall be actively involved in the manufacturing of fuel oil equipment. The overall system shall be provided by one manufacturer: Critical Fuel Systems or approved equal.