DSAR-8.4

Electrical Systems

Emergency Power Sources

Rev 2

Safety Classification: **Safety**

Usage Level: **Information**

Change No.:	**EC 70072**
Reason for Change:	**Revised to state that fuel oil in FO-10 is now a non-credited source of diesel fuel that can be made available for transfer provided it is tested and meets the receipt inspection criteria for fuel oil in FO-1.**
Preparer:	**Schulte, T.**

Fort Calhoun Station

Table of Contents

List of Tables

List of Figures

The following figures are controlled drawings and can be viewed and printed from the listed aperture card.

8.4 Emergency Power Sources

8.4.1 Diesel-Generators

8.4.1.1 Design Bases

The Diesel-Generators are designed to furnish reliable in-plant a-c power when no offsite energy is available. One unit is connected to each of the two 4.16-kV systems (one system consists of bus 1A3, the second system consists of bus 1A4.) Only one unit is credited to remain functional.

The Diesel-Generators are located in separate rooms. The rooms are separated from each other by a three-hour fire rated barrier and are of a seismic Class 1 design. The installation is designed to survive without impairment of function, any of the design basis environmental conditions referenced in Section 8.1.1. The Diesel-Generators and associated fuel supply have the capability to provide required power during a flooding event or as the result of other non-flooding events that may cause offsite power to become de-energized for a 7 day period (Ref 8.7.1).

The Diesel-Generators do not meet the definition of Class 1E in IEEE 308-1974 or safety related as defined in10 CFR 50.2 and are therefore classified as non-safety related. Diesel-Generator mechanical systems and components are classified as Non-Nuclear Safety Class 1 (NNS CL-1) as stated in DSAR Appendix N.

8.4.1.2 Description and Operation

There are two diesel-generators similar in design and characteristics (there are minor differences in the intake damper configuration) with only one credited to remain functional. Each unit is complete with all auxiliaries necessary for operation and for ensuring quick starts. Other than the diesel engine fuel oil storage tank, no auxiliaries are shared. No offsite power or external energy source, other than DC control power, is required for starting or subsequent operation of the units. The capacity rating of each unit at 4.16-kV, 0.8 power factor lagging, and 60 Hz, is listed in Table 8.4-1.

Table 8.4-1 – Diesel-Generator Unit Capacity

CONTINUOUS HP/KW RATING

CONTINUOUS ENGINE RATING	3600 HP	2685 KW
RADIATOR FAN DRIVE DERATING	-120 HP	-89 KW
GENERATOR COOLING DERATING	-20 HP	-15 KW
GLYCOL SOLUTION COOLING	-180 HP	-134 KW
NET AVAILABLE ENGINE CAPACITY		2447 KW
GENERATOR EFFICIENCY MULTIPLIER		0.97
NET AVAILABLE DIESEL GENERATOR CAPACITY		2373 KW*

*The Diesel-Generator available capacity is then further derated based on Turbocharger intake air temperature and engine coolant temperature. If the engine coolant is changed to a treated water mixture the 134 KW derating for glycol coolant need not be applied.

The engines are started with stored pressurized air. Each engine is provided with two separate starting air systems. Each engine has a primary starting air system and a secondary starting air system. Each primary starting air system has a motor driven booster compressor and each secondary starting air system has a motor driven booster compressor. The booster compressors draw air from the instrument air system. Each engine is also provided with a single diesel driven air compressor that uses ambient air. Each of the three compressors, provided for each engine, is capable of supplying air to the primary starting air system receiver tanks, the secondary starting air system receiver tanks, or both. The receiver tanks of the primary starting air systems are maintained between 200 and 240 psig. The primary starting air system on each engine has the capacity, when fully charged, for five engine starts. The secondary starting air system on each engine also has the capacity, when fully charged, for five engine starts. The compressors are not required for engine starting; the receivers are required.

Fuel for both diesels is supplied from a common 18,000 gallon underground storage tank, FO-1, by a separate supply line to each diesel. Additional diesel fuel oil can be made available from the auxiliary boiler underground storage tank, FO-10 (non-credited), for transfer to the diesel generator storage tank to permit extended operation of a diesel generator provided it is tested and meets the receipt inspection criteria for fuel oil in FO-1. Fuel oil transfer pump, FO-37, Auxiliary Feedwater Pump FW-54 Fuel Oil Transfer Pump, can be used, with temporary hoses, to transfer fuel between FO-10 and FO-1. There are other alternate manual methods available.

Each diesel has two fuel oil transfer pumps mounted on the engine. The pumps transfer fuel oil from the underground storage tank to a 300 gallon wall mounted auxiliary fuel tank in the diesel room. Fuel oil is gravity fed from the wall mounted auxiliary fuel tank to a 550 gallon engine mounted fuel tank. The engine mounted fuel tank provides for more than three hours of operation of the engine before fuel transfer is necessary.

Power is supplied to the two fuel oil transfer pumps by means of a transfer switch, fed by the station's 480 volt power system. Should normal and alternate power sources be lost to the transfer switch during engine operation, a manually interlocked breaker fed from a transformer connected to the diesel generator output will supply power to the pumps. The loss of power to the transfer pumps is annunciated in the control room.

Each transfer pump has a separate **MAN-OFF-AUTO** control switch and a common pump selector switch which selects one pump as the lead pump with the other pump as backup.

The level in the wall mounted auxiliary fuel tank is maintained by automatic operation of the fuel oil transfer pump in response to low and high level signals. Low or high level in the wall mounted auxiliary fuel tank is alarmed in the control room. Low head pressure in the engine mounted fuel tank is alarmed in the control room.

Each diesel engine is equipped with a cooling water system immersion heater and a lube oil circulating system. When an engine is in start-ready standby the immersion heater heats the water in the cooling system which, in turn, heats the lube oil by way of its lube oil cooler. The lube oil circulating system circulates the heated lube oil to the idle engine and turbocharger. The heated lube oil ensures proper lubrication when starting the cold engine and keeps the engine in readiness for an immediate fast start.

The radiator type cooling system for each engine is of the completely integral type, requiring no energy sources except the diesel engine itself.

Manual starting and control provisions are provided in the control room and at local control panels near each unit. Automatic start of the units is normally administratively disabled.

The Diesel-Generators cannot be operated in parallel. There is no bus-tie breaker between 4.16-kV buses 1A3 and 1A4, and interlocks prevent the interconnection of the diesels auxiliaries at the 480-Volt level.

Periodical maintenance and inspection of the Emergency Diesel Generators is performed to maintain functionality of a minimum of one of the units.

8.4.1.3 Design Analysis

The capacity of each Diesel-Generator is adequate to support the station load requirements in case of a loss of offsite power due to an external event or during a flood exceeding an elevation of 1004', both for a period of 7 days. (Ref 8.7.1)

8.4.2 Station Batteries

8.4.2.1 Design Bases

Station batteries are a backup source of d-c and a-c power for instrumentation and control, and are elements of the d-c systems generally described in Section 8.3.4.

The battery installation is designed to survive without interruption of output or impairment of function of the environmental design bases cited in Section 8.1.1 although functioning of the batteries is no longer credited for mitigation of any design basis accidents.

The capacity of the storage batteries in the d-c system is adequate for the operation of all necessary control and instrumentation devices in the event all 480v power is lost.

Analysis has demonstrated that the installed station batteries have adequate capacity to meet the load demand for the historical design basis accidents and other operating conditions (Ref 8.7.2). These conditions for which the analysis was prepared are no longer applicable. The analysis supports adequate capacity to supply present industrial safety requirements for egress lighting, switchgear operation, and diesel-generator starting and operation in the event of a power loss. These loads represent a subset of the loads included in the analysis.

The Station Batteries do not meet the definition of Class 1E in IEEE 308-1974 or safety related as defined in10 CFR 50.2 and are therefore classified as non-safety related.

8.4.2.2 Description and Operation

Two storage batteries are provided. Each battery has sufficient capacity to meet the power demands as described in Section 8.4.2.1. Each battery is installed in a separate room for physical segregation and protection; the rooms are separately ventilated. Battery racks are designed to hold the battery cells in position in the event of the maximum hypothetical earthquake. The arrangement of the battery rooms and their ventilation is as shown in Figure 8.4-3.

During normal operation, the batteries share in meeting control power demand only during peaks when the battery charger rating is exceeded; otherwise the battery chargers meet system demand and simultaneously float-charge the batteries to maintain full charge.

8.4.2.3 Design Analysis

During any period that ac auxiliary power is not available from normal sources or the Diesel-Generators, the station storage batteries are the only available source of d-c and a-c control power. Thus, under such conditions the batteries are relied on for the control power for starting and loading the Diesel-Generators.

Two batteries, buses, and distribution systems are provided. The batteries are in individual, closed, ventilated rooms. The distribution apparatus is in individual enclosures, and the feeders of the two systems are separately routed.

Routine maintenance is performed on the batteries to ensure they remain functional.

8.4.3 Power Restoration

8.4.3.1 Design Bases

Restoration of 4.16-kV power is manually performed in the event of a loss of power. A Diesel-Generator must remain functional during and after design basis environmental conditions referenced in Section 8.1.1. The Diesel-Generators are rated seismic Class 1.

No automatic bus transfers are provided at the 480-Volt level.

The 480-Volt buses remain connected to the associated 4.16-kV bus and transfer with that bus.

8.4.3.2 Description and Operation

4,160-Volt Bus Transfer

Restoration of 4.16-kV power is through manual action. Diesel-Generator bus connection and loading are manually controlled in the event of a loss of offsite power.

8.4.3.3 Design Analysis

Time to boiling in the Spent Fuel Pool is normally greater than 24 hours and increasing with time. This is sufficient time to manually restore 4.16-kV power utilizing a Diesel-Generator or other alternate source to support Spent Fuel Pool cooling.