CHAPTER 8 - ELECTRIC POWER

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8.1 INTRODUCTION

The Oyster Creek Nuclear Generating Station (OCNGS) is a single unit station. The Electrical Power System comprises the power sources and distribution networks that provide power for the station auxiliaries and the control and instrumentation systems during normal operation, and for the plant protection systems and engineered safety features during abnormal and accident conditions. The safety related electrical power systems are provided adequate capacity, redundancy, independence, and testability to perform their safety related function when required.

8.1.1 Utility Grid Description

The unit output power is normally connected to the FirstEnergy owned Jersey Central Power and Light Company (JCP&L) grid via the 230 kV Oyster Creek substation, which is located on station property. Two sources of offsite power are provided via two separate startup transformers fed from the 34.5 kV Oyster Creek substation, which is also located on station property. Power is supplied to the 34.5 kV Oyster Creek substation from the 34.5 kV JCP&L transmission system and the 230 kV Oyster Creek substation. The 230 kV Oyster Creek substation receives power from the unit itself, and the 230 kV FirstEnergy transmission system. The Offsite Power System is described in Section 8.2.

8.1.2 Onsite Electric System

The Onsite Power System consists of a non-Class 1E system and two redundant Class 1E (safety related) systems. The Onsite Power System consists of an ac power distribution system (4.16 kV, 480/277V, 120/208V), a vital distribution system (120 V ac uninterruptible), and a 125 V dc power distribution system.

The normal source for both the non-Class 1E and Class 1E distribution systems is the turbine generator, which feeds the Station Auxiliary Transformer through the generator isolated phase bus. The preferred power supply for the distribution systems during startup, shutdown, abnormal or accident conditions is the Startup Transformers, which are fed from the FirstEnergy transmission system via the 34.5 kV Oyster Creek substation.

Two separate and independent Emergency Diesel Generators are provided as the redundant onsite standby power supplies for safety related equipment. These are described in Sections 8.3 and 9.5.

The overall Onsite Power System is described in Section 8.3.

The ability of OCNGS to cope and mitigate Station Blackout (SBO) events is described in Sections 8.3.4 and 15.9.

8.2 OFFSITE POWER SYSTEM

8.2.1 Description

The Offsite Power System contains the following elements and interconnections between them:

a. The FirstEnergy utility transmission system

b. The Atlantic City Electric Company utility transmission system

c. The main transformers, station auxiliary and startup transformers, and associated power buses

d. The 230 and 34.5 kV transmission lines to the Oyster Creek substation

The interconnection of the facility with the 230 kV FirstEnergy transmission system and the delivery of generated power are via the 230 kV Oyster Creek substation. The interconnection of the facility with the 34.5 kV First Energy system is via the 34.5 kV Oyster Creek substation. The overall substation interconnections are as shown in Figure 8.2-1.

A function of the Offsite Power System is to provide a backup source of ac power to the station when the main generator is incapable of supplying station loads through the auxiliary transformer. Offsite ac power normally supplies the station auxiliaries through the startup transformers during plant startup. After the station is operating and supplying electric power to the grid, offsite power acts as a standby source of power. Any plant transient, including manual operator action, that causes either or both the main incoming line circuit breakers (1A or 1B) from the auxiliary transformer to trip will automatically close the corresponding incoming line circuit breakers (S1A or S1B, respectively) from the startup transformers thus transferring station auxiliaries to the offsite power sources. An exception to this is that, if a fault exists on Bus 1A or 1B, the respective breakers, S1A or S1B, will not close.

A 230 kV system loss would also result in temporary loss of the 34.5 kV system serving the startup transformers. FirstEnergy system procedures are in place for reestablishing sufficient power to the local 34.5 kV system, to restore offsite power support for the Oyster Creek Nuclear Generating Station (OCNGS) emergency auxiliary power. These procedures require 15 to 30 minutes for completion. During this interval, OCNGS shutdown proceedings and emergency power requirements are served by the onsite Standby Power Supply (diesel generators).

The Oyster Creek Nuclear Generating Station has priority demand on the 34.5 kV system power. During peak periods it may be necessary temporarily to curtail power to JCP&L customers to ensure adequate emergency power availability at, or startup power delivery to, Oyster Creek.

8.2.1.1 230 kV System Connections

The 230 kV Oyster Creek substation features a breaker and a half bus arrangement and comprises the following line connections, as shown in Figure 8.2-2:

a. Oyster Creek Nuclear Generating Station (OCNGS) Main Generator Ties

b. Oyster Creek - Cedar Line No. S2045

c. Oyster Creek - Manitou Line No. N1028

d. Oyster Creek - Manitou Line No. O1029

e. Oyster Creek 230-34.5 kV Substation Tie (Transformer Bank No. 7)

f. Oyster Creek 230-34.5 kV Substation Tie (Transformer Bank No. 8)

The OCNGS main generator ties deliver the station's generated power to the FirstEnergy and/or Atlantic City Electric system via the 230 kV Oyster Creek substation. The 24 kV main generator output is connected to the main transformers by isolated phase bus, with the high voltage side of the transformers connected to the substation by overhead transmission lines. Two main transformers are provided. M1A is rated 350 MVA, 240 kV grounded wye – 24.0 kV delta, and is connected in parallel with M1B which is rated 350 MVA, 230 kV grounded wye - 24.0 kV delta.

The 230 kV Cedar line (Line No. S2045) is connected to the Atlantic City Electric Company system at Cedar substation. This Line can also deliver power from Atlantic City Electric to the Oyster Creek substation for normal shutdown of the OCNGS. The 34.5 kV Manitou Z-52 line and the Whitings Q121 lines are the express feeders, which are described later.

The Manitou lines (Line Nos. N1028 and O1029) deliver power to and from the OCNGS. These two lines provide the station's interconnection with the 230 kV JCP&L transmission system at the Manitou substation and share double circuit transmission towers.

The Oyster Creek 230-34.5 kV Substation ties deliver 230 kV JCP&L system power and the OCNGS generated power to the 34.5 kV Oyster Creek substation via Transformer Bank Nos. 7 and 8. Additionally, these ties provide sources of startup power and independent offsite power to the station. The two transformers are each rated 75/100/125 MVA, 230 kV delta - 34.5 kV grounded wye/19.92 kV.

8.2.1.2 34.5 kV System Connections

The 34.5 kV Oyster Creek substation has two parallel buses (Buses A & B) with a tie breaker between them. The tie breaker connecting the buses will open automatically if either bus is faulted. Each of the buses can be supplied by a separate line from other JCP&L substations, following different rights of way. The substation consists of the following line connections as shown in Figure 8.2-3:

a. Bus A

1. Oyster Creek – Off-Site Emergency Prep Building Line No. I69360 (Alternate Feed) and Dilution Plant Alternate Feed

2. Oyster Creek - Waretown Line No. S145

3. Oyster Creek 230-34.5 kV Substation Tie (Transformer Bank No. 8)

4. OCNGS Startup Transformer Tie (Transformer Bank No. 6)

5. A/B Bus Tie

6. Capacitor Bank Tie (Capacitor Bank No. 1)

7. Oyster Creek - Manitou Line No. Z52

8. Substation Station Service Tie

b. Bus B

1. Oyster Creek - Lakeside Drive Line No. J69361

2. OCNGS Startup Transformer Tie (Transformer Bank No. 5)

3. A/B Bus Tie

4. Capacitor Bank Tie (Capacitor Bank No. 2)

5. Oyster Creek - Waretown Line No. R144

6. Oyster Creek - Whitings Line No. Q121

7. Oyster Creek 230-34.5 kV Substation Tie (Transformer Bank No. 7)

The Lakeside Drive and Waretown lines (Line Nos. J69361, R144 and S145) deliver power to area loads. The 1E1 Unit Substation at Oyster Creek Nuclear Generating Station receives power from either line R144, which is the preferred line, or line J69361, the alternate source. Each of the supplies is provided with a 2000 KVA Transformer. A pair of circuit breakers are used to shift between the two sources of power. The following facilities receive power from the 1E1 Unit Substation:

The New Radwaste Facilities
The Offgas Building
Package Boiler House
Service Water Pumps for New Radwaste
Redundant Fire Pump House

Line R144 can also be interconnected with the Oyster Creek - Manitou Line Z52 by closing of Switch No. 6 at Oyster Creek.

The Oyster Creek 230-34.5 kV Substation ties are as described in Subsection 8.2.1.1 and, as stated therein, they provide two sources of startup and offsite power to the OCNGS.

The OCNGS Startup Transformer ties (Transformer Bank Nos. 5 and 6) are the preferred sources of offsite power for the station, providing both startup and backup auxiliary power. The two transformers are fed from separate and parallel 34.5 kV Buses (A and B) as shown in Figure 8.2-3. The startup power transformers do not supply any continuous station auxiliary power, except during startup and shutdown or for operation of the dilution pumps. Therefore, the station auxiliary power system has a backup power source that is immediately available. Furthermore, in the event both 34.5 kV buses are unavailable, the startup transformers can receive power directly from line Q121 through the manual operation of pole mounted disconnect switches. Either of the two startup transformers has been provided with more than enough capacity to carry the emergency auxiliary power load. Maintenance of proper voltage on the auxiliary buses is discussed in 8.2.1.4.

The Manitou line (Line No. Z52) normally delivers power to area loads, but can also provide power to OCNGS under high grid loading conditions or in case of line/equipment outages. When the Z52 line is connected to deliver power to OCNGS, it also provides an interconnection with the 34.5 kV FirstEnergy subtransmission system at the Manitou substation. This is one of the two 34.5 kV circuits that can be restored as an express feeder to the OCNGS (an express feeder being one that does not pick up any load along the way) if the 34.5 kV system serving the startup transformers is blacked out. The other 34.5 kV express feeder is the Whiting Q121 line, which is described later. An additional express feeder is provided by Cedar line (230 kV line) as described previously. The Manitou Z52 express feeder is established through various lines and substations using FirstEnergy procedures currently in place. It can be restored in sufficient time (15-30 minutes) to satisfy both the controlled shutdown and emergency condition requirements at the OCNGS.

The Substation Station Service tie from the A bus delivers power to local substation loads via a 300 kVA distribution transformer. Back-up emergency Station Service is provided by a 3-100 kVA transformer fed from the Q121 line.

The Whiting line (Line No. Q121) delivers power to the OCNGS and provides an interconnection with the 34.5 kV FirstEnergy subtransmission system at the Whiting substation. This is the second of two circuits used as an express feeder to the OCNGS. The other express feeders are the 230 kV Cedar (S2045) line and the Manitou Z52 line, which are described above. The Whiting Q121 express feeder is established by interconnection with the Whiting-McGuire Line No. K11 at Whiting. It can be restored in sufficient time (15-30 minutes) to satisfy both the controlled shutdown and emergency condition requirements at the OCNGS. An additional feeder is provided by the Cedar 230 kV line, as described previously.

Any specific interconnection route required to re-establish 34.5 kV service to the OCNGS can be affected by a "common failure mode" if the initiating event occurs where the 230 kV lines cross or share right of way with the lines planned for the re-establishment. For example, the 230 kV lines both cross and share rights of way with one line planned to re-establish 34.5 kV at OCNGS and also crosses the line planned as the alternate route to re-establish the 34.5 kV.

Analysis has shown that an initiating event at any one of these and other points does not prevent re-establishment of 34.5 kV service to OCNGS by alternate routes.

8.2.1.3 Protection and Control Circuits

The 230 kV Oyster Creek substation features a breaker and a half bus arrangement. All 34.5 kV substation lines are provided with primary relay protection for phase to phase, three phase, and ground faults, with fault detection causing tripping of the corresponding circuit breaker. Bus differential relays on each of the 34.5 kV parallel buses provide primary relay protection for the buses, with fault detection causing tripping of all breakers on the faulted bus. Additionally, line and bus backup relay protection is provided on each of the buses. This backup relaying causes delayed tripping of all breakers on a particular bus for a faulted line, faulted bus, or stuck breaker.

Transformer Bank Nos. 7 and 8 and Startup Transformer Bank Nos. 5 and 6 are individually protected by transformer differential and ground relays, with fault detection causing tripping and lock out of those breakers necessary to isolate the affected transformer. Additionally, backup ground relaying is provided.

Circuit breakers and motorized switches in each OC substation are provided with control power from a battery power supply, at the substation. The charger is maintained on an energized a.c. source by an automatic transfer scheme.

Potential for line relaying and metering is supplied from potential transformers (PTs) on either of the buses. There is an automatic potential throwover scheme, which switches the 34.5 kV line relays and instruments from the A Bus PTs to the B Bus PTs and vice versa, if either are deenergized.

Indication of relay operation is annunciated in the Control Room.

8.2.1.4 Voltage Control

When the plant is operating and auxiliary power is being provided by the auxiliary transformer, voltage control is provided by the main generator excitation system. If auxiliary power is being provided by the startup transformers, induction voltage regulators connected to the 34.5 kV side automatically accommodate voltage fluctuations in the subtransmission network, providing 20% regulation to maintain proper voltage under normal and contingency system conditions. Three single phase regulators, each rated 667 kVA, 19.92 kV, with regulation in 32 steps of 5/8% are connected to each startup transformer.

Additional voltage support is provided first by use of either or both capacitor banks in the Oyster Creek 34.5 kV substation, followed by operation of the load tap changers (LTC) on the 230 kV/34.5 kV transformer banks feeding the 34.5 kV substation. When the additional support is no longer needed the LTC's are first returned to normal and then the capacitors are deenergized.

8.2.1.5 Testing

All substation circuit breakers are tested throughout the plant life in accordance with established schedules and procedures.

8.2.2 Analyses

Transient stability tests have been made to determine the performance of the Oyster Creek unit. The tests included contingencies involving the 230 kV transmission and 34.5 kV subtransmission systems. The tests consisted of extensive transient stability studies that simulated loss of units (including Oyster Creek), three phase faults with primary and delayed relay clearing, and single phase to ground faults with delayed clearing. Additional load flow computer tests were made to examine the system for overloads and voltage problems due to the loss of generating units and transmission lines.

The status of the various sources to the plant auxiliary equipment was also determined during the studies. The plant auxiliary equipment is supplied from the Oyster Creek unit terminals when the generator is running. When the unit is tripped off or is not running, the plant auxiliary equipment is supplied via startup transformers from the 34.5 kV buses at Oyster Creek. The sources for the 34.5 kV buses are transformation from the 230 kV system and also from the 34.5 kV system through the various 34.5 kV subtransmission lines connected at Oyster Creek (see Figure 8.2-2 and 8.2-3). The 230 kV system sources include two - 230 kV transmission lines and an interconnection to the Conectiv 230 kV system through the Cedar line.

The pertinent results of the studies were as follows:

a. A fault occurring on a single 230 kV line, bus or circuit breaker will not interrupt the sources for the plant auxiliary equipment. The sources still available include the unit terminal bus if the unit is running, the remaining 230 kV line, the 230 kV tie to Conectiv, and the 34.5 kV lines connected to Oyster Creek.

b. A fault occurring on a single 34.5 kV line, bus or circuit breaker, except the bus tie breaker, will not interrupt the sources for the plant auxiliary equipment. The sources still available include the unit terminal bus if the unit is running, the two - 230 kV lines, the 230 kV tie to Conectiv, and the remaining 34.5 kV lines connected to Oyster Creek.

c. Direct tripping of the Oyster Creek unit, whether due to a fault on a single 230 kV line or not, will not interrupt the sources for the plant auxiliary equipment. The sources still available include one or both of the 230 kV lines, the 230 kV tie to Conectiv and the 34.5 kV lines connected to Oyster Creek.

d. There will be no Oyster Creek unit transient instability, system transient instability, transmission line overloads or cascading outages as a result of a three phase fault with primary relay clearing of any one of the two - 230 kV lines emanating from the Oyster Creek station. This is also true for the case where a stuck breaker causes a single phase to ground the fault to be cleared by backup delayed clearing.

e. There will be no Oyster Creek unit transient instability, system transient instability, line overloads or cascading outages as a result of a three phase fault with primary relay clearing involving any of the 34.5 kV lines emanating from the Oyster Creek station.

f. Loss of both 230 kV transmission lines at Oyster Creek will result in the unit being tripped by its out of step relaying. The 34.5 kV system and the 230 kV tie with Conectiv will remain available as sources to the plant auxiliary equipment provided area load is below a certain level. If the load is above the critical level, the procedures for re-establishing power to the plant auxiliary equipment is described in Subsection 8.2.1.

g. The sudden loss of output of the Oyster Creek unit by itself, the largest unit in New Jersey (Salem Unit 2) by itself, or the combination of the loss of output of both units together will not result in unit or system transient instability, transmission line overloads, cascading outages, or intolerable voltage conditions.

8.3 ONSITE POWER SYSTEMS

8.3.1 AC Power System

8.3.1.1 Description

The onsite ac power systems consist of both essential and nonessential auxiliary electrical power systems. The essential auxiliary electrical power systems include the Standby Power Supply, comprising the Emergency Diesel Generators and their associated auxiliaries and electrical distribution buses, and the Vital Instrumentation and Control Power Systems. The non-essential auxiliary electrical power system includes the main unit generator, the auxiliary and startup transformers, and their associated auxiliaries and electrical distribution buses. The principal elements of the auxiliary electrical systems are shown in the electrical one line diagrams presented as Drawings 3E-743-11-001, BR 3001, BR 3002, BR 3028, and EB D-3033 and the Reactor Protection and Control System in Drawing BR 3013.

The basic function of the essential auxiliary electrical power systems is to provide reliable power to station auxiliaries that are important to plant safety. The essential auxiliary electrical power system consists of two independent diesel generators and two independent radial distribution systems, and supplies power at 4160 volts, 480 volts, 277 volts, and 120/208 volts. The power sources for the essential auxiliary power supplies are sufficient in number and of such electrical and physical independence that no single probable event could interrupt all auxiliary power at one time. Non-essential auxiliary power is provided by the main unit generator via the generator isolated phase bus and the station auxiliary transformer. This transformer feeds two nonessential 4160 volt auxiliary buses. These same 4160 volt auxiliary buses are also independently supplied from the 34.5 kV Oyster Creek substation via the startup transformers (Transformer Banks Nos. 5 and 6). Upon loss of the station generator during normal operation resulting in opening of 4160V 1A & 1B breakers, the power requirements are automatically transferred to the startup transformers. If this automatic transfer fails, or if offsite power is not available, a third source of power, the Standby Power Supply, is available to the essential auxiliary electrical power system from two Emergency Diesel Generators (EDGs). The Standby Power Supply is designed to start the diesel generator units automatically and to provide power for all necessary auxiliaries important to plant safety. The Standby Power Supply is physically independent of any normal power system. Each power source, up to the point of its connection to the essential auxiliary power bus, is capable of complete and rapid electrical isolation.

The auxiliary electrical power systems provide:

a. The continuous electrical power necessary for plant operation, startup and shutdown.

b. The necessary flexibility in the essential auxiliary electrical power systems to tolerate the failure of one single component, bus, or power supply and allow continued safe plant operation.

c. The necessary protective devices in the essential auxiliary electrical power systems to shed nonessential loads, which will allow the plant to be shutdown safely.

d. The protective features in the essential auxiliary electrical power systems to prevent a fault in one independent system from affecting other.

8.3.1.1.1 4.16 kV Distribution System

The 4.16 kV Distribution System consists of metal clad switchgear, control and protective relays, and cable and cable connections, which are required to provide power to the station auxiliaries, including safety related loads.

The 4.16 kV switchgear is made up of four separate bus sections or lineups of switchgear, as shown in Drawings 3E-743-11-001, BR 3001, BR 3002. The four bus sections are identified as Bus Sections 1A, 1B, 1C and 1D with Bus Sections 1C and 1D being the essential or emergency switchgear lineups. All are located in the 4.16 kV Switchgear Room of the Turbine Building, which is a vital security area. Essential Bus Sections 1C and 1D are physically isolated from each other, and from Bus Sections 1A and 1B, by two hour rated firewalls.

Bus Sections 1A and 1B are independently fed from either the Auxiliary Transformer Bank No. 4 or the Startup Transformer Banks Nos. 5 and 6. During station operation, Bus Sections 1A and 1B are normally energized and receive power from the Auxiliary Transformer, which receives its power from the 24 kV output of the Turbine Generator. During shutdown, startup, or loss of Auxiliary Transformer Power, Buses 1A and 1B are energized and receive power from the Startup Transformers, which receive their power from the 34.5 kV Oyster Creek substation. The 34.5 kV substation is supplied from either the 230 kV Oyster Creek substation, or from other 34.5 kV GPUE Transmission lines, described in Section 8.2.

The startup buses and the auxiliary buses provide power to the 4.16 kV switchgear Bus Sections 1A and 1B. Separation of the incoming breakers from the Start Up and Auxiliary transformers within the switchgear bus sections provide added reliability.

Both the non-essential and essential auxiliary loads are split between two independent radial systems. The general design requirements is to supply duplicate services from different buses. Essential Bus Sections 1C and 1D supply power to both non-essential loads and loads important to plant safety and vital to safe shutdown under accident conditions. These bus loads are redundant in that in the event of failure of either Bus Section 1C or 1D the remaining loads satisfy the requirements for a safe shutdown under accident conditions.

Bus ties and relaying are provided to keep equipment operating during automatic transfer to startup power when auxiliary power is lost, and to shed non essential loads and restart critical equipment automatically on an automatic emergency transfer to the diesel generator units. Any fault, except for bus faults, that causes a loss of auxiliary power to Bus Sections 1A or 1B will result in a rapid transfer (4 to 8 cycles) to the startup transformers. This transfer will usually result in no loss of loads.

Emergency Bus Sections 1C and 1D are energized and receive power from Bus Sections 1A and 1B during periods of normal power availability.

In the event of loss of normal or startup power to the essential 4.16 kV switchgear Bus Sections 1C and 1D, these buses will separate from the 4.16 kV switchgear Bus Sections 1A and 1B and the Emergency Diesel Generators will automatically start, accelerate and close in to the emergency buses in 20 seconds. Once the diesel generators restore emergency power to Bus Sections 1C and 1D, vital loads will start automatically in a timed sequence to avoid overloading the diesel generator units on high starting current. If, during the automatic starting sequence of

Core Spray pumps and booster pumps, a preferred load fails to start, the system will attempt to start an alternate load.

Undervoltage protection for the plant systems and components is provided by the two sets of relays; the first level or loss of voltage (LOV) relays and the second or the degraded grid voltage relays (DVR). The first level provides protection against the sudden loss of voltage, while the second level or DVRs ensure adequate distribution voltages below which misoperation or damage to plant equipment from prolonged operation is prevented. Trip of these relays due to grid or plant transients such as the starting of a large motor load is prevented by time delay relays. The relays are wired in a scheme of two out of three logic and each scheme is located on safety bus 1C and 1D.

Initiation of either the first or second level relays will disconnect the respective bus from its normal and/or off-site source, initiates the load shedding of non-safety loads, and start the EDG. Trip by the second level relays is prevented when the buses are powered from the EDGs.

The degraded voltage setpoint is based on worst case design basis LOCA loading. This analysis determined the voltage available at the terminals of class 1E electrical equipment. The analysis includes determination of starting and running voltage for 4160v and 480v equipment, voltages for motor starter pickup and dropout and voltage available at the terminals of 120v equipment. The setpoint for the degraded voltage relay includes the relay drift, potential transformer inaccuracy calibration tolerances plus an additional safety factor.

Essential Bus Sections 1C and 1D are provided with bus tie breakers (Breakers EC and ED) that interconnect the essential buses. This permits interconnecting all four buses (Bus Sections 1A, 1B, 1C and 1D) and energizing them from either of the two startup transformers. However, administrative controls prevent closure of these tie breakers unless the reactor mode switch is in the shutdown or refuel positions, and the reactor is in cold shutdown. Both tie breakers are normally racked out. The diesel generator breakers are interlocked such that the units can energize their respective buses only if their respective bus tie breakers are open.

Since Bus Sections 1C and 1D are the station's essential buses, any nonessential auxiliary loads that they supply will be separated in the event of a loss of power. The design of the essential 4.16 kV electrical system and the starting logic of the diesel generator units is such that a single failure will not disable both essential buses. At least one diesel generator unit will be capable of supplying power to its designated essential bus considering a Loss-of-Coolant Accident (LOCA), a Loss of Offsite Power (LOOP), and a single failure.

The capacity of the diesel generator units is adequate to carry out their safety functions. Table 8.3-1 shows the loading on the essential Bus Sections IC and ID that is required under the following conditions:

a. Loss of Offsite Power.

b. Loss of Offsite Power accompanied by a Loss-of-Coolant Accident.

c. Loss of Offsite Power with failure of one Emergency Diesel Generator (EDG) accompanied by a Loss-of-Coolant Accident.

The loads shown in Table 8.3-1 are those emergency loads which must be accommodated, if called on to operate. In the event of single bus operation being required by failure of a diesel generator unit, the loading on the single bus will include automatically transferrable loads such as emergency lighting and instrument loads. The loading under this single bus operation is within the normal kVA rating of the unit.

The 4.16 kV switchgear is of the metal clad magneblast design with stored energy mechanism.

The circuit breakers receive 125 V dc control power from the station batteries of the same division as the safety related equipment being supplied with power.

8.3.1.1.2 480 Volt Distribution System

Unit substations are provided to step down the 4.16 kV system voltage to 480 volts to supply the 480 Volt Distribution System. All the unit substations are fed from the 4.16 kV essential switchgear Bus Sections 1C and 1D, and in turn supply power to the motor control centers and motors throughout the station.

There are six unit substations, as shown in Drawing BR 3002. The unit substations are identified, located in pairs, and generally provide power to station auxiliaries as follows:

a. Unit Substations 1A1 and 1B1, in the Turbine Building basement, for Turbine Building loads. (Non-essential)

b. Unit Substations 1A2 and 1B2, in the 480 Volt Switchgear Room, for Reactor Building loads. (Essential)

c. Unit Substations 1A3 and 1B3, at the intake structure, for auxiliaries outside the plant in the vicinity of the intake structure. (Nonessential)

Each substation comprising a pair is physically separated from the other substation in the pair either by distance or by one hour rated fire walls.

The above sets of unit substations are bus connected with a bus-tie breaker such that the tie breakers can be closed only if both of the following conditions are satisfied:

a. No faults are present on either of the buses which are to be tied together.

b. A feeder breaker to at least one of the two buses that are to be tied together is open.

Under normal conditions, administrative controls are provided to prevent closure of the tie breakers unless the reactor mode switch is in the shutdown or refuel position, and the reactor (except during reactor vessel pressure testing) is in cold shutdown. Under emergency conditions these tie breakers may be used to restore power to plant equipment necessary to cope with specified events as required by plant procedures. Each tie breaker is normally in a racked out conditions.

Unit Substations 1A2 and 1B2 supply power to the vital loads in the Reactor Building. The loads shown in Table 8.3-1 are those emergency loads which must be accommodated, if called on to operate. Cooling fans actuated by thermal switches on the transformers are provided to increase the rating of the transformers and to preclude possible overloading of a transformer by approximately 10% for an indefinite period during an accident condition (LOCA) with off-site power available and the loss of one of the unit substations. The power transformers in the Unit Substations are three phase, liquid filled transformers. The switchgear for each substation is in self supporting metal enclosed sections with continuous main buses having drawout units, which are replaceable under live bus conditions. Control power for the circuit breakers is 125 V dc and is from the station batteries of the same division as the safety related equipment being supplied with power.

The 460V motor control centers supply power to the various motors and auxiliaries as shown on the one line diagrams. Refer to Section 1.7 for a list of auxiliary one line diagrams. The 460 V motor control centers are dead front, metal enclosed, NEMA Class I, Type C, indoor enclosures. Line reactors on the input feeders are provided where necessary to limit fault current. The magnetic starters are combination circuit breaker type with three thermal elements and with individual control power transformers.

Two vital motor control centers are provided for supplying power to some of the vital instrumentation, protection panels, critical isolation valves, vital lighting circuits, and the 125 V dc main battery chargers. These vital motor control centers are identified as Vital MCC 1A2 and Vital MCC 1B2, one each for Division A and Division B safety related loads. They are located in the 480 V Switchgear Room.

460 V distribution panels are provided, and feed lighting panels and the 120/208 V system. These panels feed three phase power to various auxiliaries. Circuits are protected by three pole, air magnetic circuit breakers. Fluorescent lighting is served from the 480 V circuits, line to neutral (277 volts).

8.3.1.1.3 <u>120/208 Volt Non-Essential Distribution System</u>

The 120/208 Volt Non-Essential Distribution System receives power from 460 Volt Motor Control Centers and 460 Volt Distribution Panels through dry type transformers. The system comprises electrical distribution equipment manufactured to industry standards.

The lighting, space heater, and miscellaneous power panels have one, two, and three pole breakers to supply power to various auxiliaries.

8.3.1.1.4 <u>120 Volt AC Vital Distribution System</u>

The 120 Volt AC Vital Distribution System receives normal and alternate power from 460 Volt Vital Motor Control Centers 1A2 and 1B2 through transfer switches, dry type transformers motor generator sets, and the system supplies this power to critical 120 VAC instrumentation, controls and auxiliaries. The system comprises Reactor Protection System (RPS) Motor Generator Sets (Driven by 440 VAC motor and 115 VAC single phase output), Rotary Inverter (Motor Generator Set driven by three phase 440 VAC motor with 125 VDC motor as backup and 120/208 VAC three phase generator output), Electrical Protection Assemblies (EPAs), 120 VAC distribution panels, transformers, transfer switches, cables, and raceway systems. The system is as shown in the electrical one line diagram, Drawing BR 3013.

Continuous Instrument Panel (CIP-3) normally receives 120/208 VAC power from Rotary Inverter and alternate power from 460 V Vital Motor Control Center 1A2 via transformer through auto transfer switch.

Protection System Panels 1 & 2 (PSP-1 and PSP-2) normally receive 120 VAC power from RPS Motor Generator Sets 1-1 and 1-2 respectively. The alternate source of power is available from 460 V Vital Motor Control Center (VMCC) 1A2 or 1B2 to any one of the two Protection System Panels (PSP-1 and PSP-2) via manual disconnect switches through a backup transformer. Normal and alternate power to PSP-1 and PSP-2 also pass through electrical protection assemblies (EPAs), two in series for each power source. The EPAs are circuit breakers equipped with overvoltage, undervoltage and underfrequency trips. The undervoltage or underfrequency shut trip breakers on RPS Motor Generator Sets provide overcurrent protection. The devices protect the Reactor Protection System circuitry from voltage and frequency fluctuations that could cause the system to fail during a seismic event.

Normal and alternate power to remaining panels, Vital AC Power Panel (VACP-1) and Instrument Panel #4 (IT-4) is supplied from 460 V VMCCs 1A2 and 1B2 via auto transfer switches and transformers. Panel IT-4 supplies power to Instrument Panels #4A, 4B, and 4C (IT-4A, IT-4B, IT-4C).

Post Accident Instrument Power Panels 1 and 2 (PDP-733-057 and PDP-733-058) receive power from 460 V VMCC 1A2 and 1B2 respectively through breakers and transformers. These panels do not have alternate power sources.

Local indication is provided at the automatic transformer switches, showing the availability of normal and alternate power. An alarm will annunciate in the Control Room when any of the auto transfer switches transfer power to alternate source.

8.3.1.1.5 Standby Power Supplies (Emergency Diesel Generators)

Two diesel generator units serve as the Standby Power Supply for the station by providing an emergency source of power to the 4.16 kV buses 1C and 1D in the event of a loss of normal power. Each unit is designed to provide ac power at 4.16 kV, three phase, 60 Hertz with a design continuous load rating of 2500 kW, 3128 kVA at 900 rpm, and 2000 hour load rating of 2750 kW, 3440 kVA at 900 rpm. The load capacity and operability are proven by surveillance testing and procedures. Other emergency short term ratings provided by the EDG manufacturer are 2858 kW for 200 hours, 2894 kW for 4 hours and 2948 kW for 1/2 hour. The nonelectrical characteristics of the Emergency Diesel Generators are discussed in Section 9.5.

The diesel generator units are designed to start and load automatically, if required. Non-essential loads are automatically shed by undervoltage sensing devices on loss of offsite power to ensure that the units are not overloaded. The diesel generators may be started manually from either the Control Room panels or local DG switchgear normal START/STOP switch. An emergency start pushbutton switch for each diesel generator is also provided in the Control Room. The capacity of the units is sufficient to sequentially energize for starting all safety related pumps and auxiliaries required for a safe shutdown of the reactor in the event of a Design Basis Accident.

Table 8.3-1 indicates the design loads of each Emergency Diesel Generator under abnormal operating conditions, and emergency or accident conditions.

The diesel generator units are independent of each other, with the exception of a common bulk fuel storage supply, and are provided with auxiliary systems to ensure reliable starting and continuous operation with no operator attention. Power to start the units is self contained and is not dependent on the availability of any other source of normal plant power at the moment of starting. Each diesel engine has its own fuel oil system, cooling water system, lube oil, air intake, starting batteries (120 volt), engine speed governor and protective devices. A further description of diesel generator auxiliaries is contained in Subsections 9.5.4 through 9.5.8.

The two Emergency Diesel Generators (EDGs) are located in the Diesel Generator Building, which is a separate reinforced concrete structure. Each unit and its auxiliaries is located in a separate room within the Diesel Generator Building. The generator room walls and doors have a three hour fire rating. The diesel fuel storage tank is located in a separate area of the Diesel Generator Building with walls also having a three hour fire rating. A fire protection scheme is provided for each diesel generator unit and the fuel storage area. For details on the Diesel Generator Building refer to Subsection 3.8.4.

Loading Description

The EDGs can be operated either from the local panels or from the Control Room. There are two types of automatic start signals to the diesel generator units. The first signal will cause the units to start and idle. The second signal is called the Fast Start Signal. The Emergency Diesel Generator allowable time response to a Loss of Offsite Power (LOOP) event is 20 seconds as a basis for Core Spray System response to accident conditions (See Section 15.6). The time response period includes UV sensor pick-up time, emergency bus logic to isolate and actuate the Emergency Diesel Generators and the period to bring the Emergency Buses to normal voltage level.

The automatic start and idle signals for the Emergency Diesel Generators are:

a. Reactor Low-Low Water Level via Core Spray Logic Relays.

b. High Drywell Pressure via Core Spray Logic Relays.

c. Low Lube Oil Temperature.

The diesel Generators will idle for 15 minutes after the removal of the idle signal.

The automatic fast start conditions for the Emergency Diesel Generators are:

a. An undervoltage condition (either a: loss of voltage for 3 seconds, or b: persistent undervoltage for 10 seconds) on Bus 1C(1D) and no fault on Bus 1C(1D). Combined with a nominal time delay of 1.5 seconds to clear the bus breakers. A fast start signal is issued to the Diesel Generator at the end of this nominal 4.5 or 11.5 second period.

b. Emergency start pushbutton located in the Control Room panel 8F/9F.

The starting logic is such that no single failure prevents at least one of the diesel units from supplying power to its respective bus for safe plant shutdown.

Automatic loading of the units for various loading situations is sequentially shown for each EDG in Table 8.3-1. In the case of loss of offsite power plus loss-of-coolant with both diesel generators starting, the load requirements (all equipment operating) would exceed the three days fuel supply (refer to 9.5.4.1). However, not all of this load is required for three days and loads not required on the diesel will be curtailed. It is reasonable to expect that within 8 hours, the following loads could be curtailed:

a. One Core Spray Pump

b. One Core Spray Booster Pump

c. One Control Rod Drive Pump

d. One Containment Spray Pump

e. One Emergency Service Water Pump

8.3.1.2 Analysis

8.3.1.2.1 Compliance with IEEE 308

OCNGS was built and operational prior to the issuance of IEEE 308.

The Class 1E electrical systems are designed to assure that any design basis event will not cause:

a. A loss of electric power to a number of engineered safety features, surveillance devices, or protection system devices sufficient to jeopardize the safety of the plant.

b. A loss of electric power to equipment which could result in a reactor power transient capable of causing significant damage to the fuel or to the Reactor Coolant System.

Design basis events were established for the OCNGS, and the severity and magnitude of each event defined. The Class 1E electrical systems are capable of performing their function when subjected to the effects of any design basis event at their locations.

The variations of voltage and frequency in the Class 1E electrical systems during any design basis event will not degrade the performance of any load to the extent of causing significant damage to the fuel or to the Reactor Coolant System.
Controls and indicators in the Control Room, and controls outside the Control Room are provided for the following:

a. Circuit breakers required to switch the Class 1E buses between the preferred and standby power supply

b. Standby Power Supply

Class 1E electrical equipment is physically separated from its redundant counterpart or mechanically protected as required to prevent the occurrence of common failure modes.

The separation practices employed in original design and construction are contained in "Separations Practices for Safeguard Systems" by APED Engineering, General Electric Co., (Revision dated November 26, 1968).

An analysis of the failure modes of Class 1E electrical systems and the effect of these failures on the electric power available to Class 1E loads have been performed to demonstrate that a single component failure will not prevent satisfactory performance of the minimum Class 1E loads required for safe shutdown and maintenance of post-shutdown or post accident plant conditions.

8.3.1.2.2 Compliance with General Design Criterion 17

The capacity of either the onsite or the offsite electric power system is adequate to accomplish all required safety functions under postulated Design Basis Accident conditions. The onsite distribution system, in conjunction with the offsite power source and the voltage regulators that are installed on the 34.5 kV primary side of the startup transformers, is capable of providing acceptable voltage under worst case station electric load and grid voltages. The station batteries are redundant as are the distribution systems for both ac and dc power.

Separation of equipment and wireways has been maintained insofar as practicable to make the redundant distribution systems immune to localized damage.

Physical independence of motive and control power for services required for safe shutdown under accident conditions is attained as follows:

a. All 4160 volt power cables are run in independent steel enclosures and follow separate routes to redundant equipment.

b. Controls for redundant power equipment are run in separate raceways.

c. Power cables from the two 480 volt emergency ac switchgear lineups are run in separate raceways.

8.3.1.2.3 Compliance with AEC Safety Guide 6 (Presently Regulatory Guide 1.6)

The Standby Power Systems and sources have been provided with adequate independence. Provisions do exist for automatically transferring loads between redundant power sources for emergency lighting and instrument loads, and for MCC 1AB2 (ac isolation valves). The ac isolation valves are backed up by redundant dc isolation valves.

An evaluation of the Standby Power Systems and sources shows that the station design is in compliance with regulatory positions, as evidenced by the following design features:

a. The electrically powered safety loads at the OCNGS are separated into redundant load groups such that loss of any one group will not prevent safety functions from being performed.

b. Each ac load group has a connection to the startup (offsite) power source and to a standby (onsite) power source. Each standby power source has no automatic connection to the bus serving the other redundant load group. Each startup power source bus serves a redundant group.

c. When operating from the standby sources, redundant load groups and the redundant standby sources are independent of each other at least to the following extent:

   1. The standby source of one load group cannot be automatically paralleled with the standby source of another load group under accident conditions.

   2. No provisions exist for automatically connecting one load group to another load group.

   3. Where means exist for manually connecting redundant load groups together, at least one interlock is provided to prevent an operator error that would parallel their standby power sources.

d. A single generator driven by a single prime mover is provided as the standby power source for each ac load group.

8.3.1.2.4 Compliance with Regulatory Guide 1.9

Regulatory Guide 1.9 or AEC Safety Guide 9 was not the criteria used for assessing the adequacy of the Emergency Diesel Generators. At the time of the Oyster Creek Nuclear Generating Station (OCNGS) original design, Regulatory Guide 1.9 or AEC Safety Guide 9 did not exist. NRC's Systematic Evaluation Program (NUREG-0822) documents the NRC's assessment of the Emergency Diesel Generators.

The diesel generators capacity is more than adequate to support the loads necessary to assure the fuel limits are not exceeded, and the core is cooled and contained. This is so even in the event of a Loss-of-Coolant Accident and a simultaneous Loss of Offsite Power.

8.3.1.2.5 Compliance with General Design Criterion 18

Availability of electrical power is assured through periodic inspection and testing during operation. Periodic verification of operability of power available monitors is possible and the status of each power supply, i.e., voltage frequency and presence of grounds (on ungrounded systems), is continually indicated. Individual circuits of the energize-to-operate safeguards systems have loss of control power annunciation.

In order to detect any signs of wear long before failure, each diesel generator shall be given a thorough inspection at least once per 24 months, with a maximum allowable extension of 25%.

8.3.1.3 Physical Identification of Safety Related Equipment

Physical identification of safety related equipment and wiring is not provided. Safety systems are not identified by color code or other means.

8.3.1.4 Independence of Redundant Systems

The services required for safe shutdown under accident conditions are physically separated within each of the 4.16 kV emergency switchgear Bus Sections 1C and 1D. Feeders for these services are run in individual rigid steel conduits. All 4.16 kV feeders are run in rugged steel enclosures. Controls for each safety system applicable to these services are run in separate steel conduits or separate steel cable trays.

Feeders and controls from 480 Volt Vital Substations 1A2 and 1B2 and 460 volt Vital Motor Control Centers 1A2 and 1B2 are run in separate steel cable trays or conduits.

8.3.2 DC Power System

8.3.2.1. 125 VDC Station DC Power System

There are three complete 125 VDC distribution systems that make up the Station DC Power System at the OCNGS. Two of these systems, designated as DC distribution systems A and B, are the originally installed systems. The third system, designated as DC distribution system C, was subsequently designed and installed as a modification. The principal elements of the DC electrical distribution systems are shown in the electrical one line diagrams in Drawings BR 3028 and EBD 3033.

The function of the Station DC Power System is to provide a continuous source of 125 VDC power. Safety loads are supplied from DC distribution systems B and C, with DC distribution system B supplying Division B safety related loads and DC distribution system C supplying Division A safety related loads. DC distribution system A is used to supply non-safety loads.

A block diagram of the 125 VDC Power System is shown in Figure 8.3-7A & B. It consists of the three 125 VDC main station batteries, five AC powered battery chargers, three 125 VDC distribution centers, three power panels, and two motor control centers. The battery output circuit breakers are normally closed and one battery charger is operated in parallel with the battery to supply power to each DC distribution center (A, B, and C). During normal operation the battery chargers maintain their respective station battery in a fully charged state by keeping it on a float charge. The battery chargers supply normal system loads with the batteries acting as a standby source of DC power upon failure of the battery chargers or during high demand transients.

DC distribution center C in the Turbine Building 4160 VAC switchgear room is physically separated from DC distribution centers A and B, which are located in the Battery Room in the Main Office Building. All batteries are located in enclosed battery rooms provided with ventilation to minimize the buildup of hydrogen gas which is formed during battery operation, and to maintain temperatures within battery design limits.

The 125 VDC Power System is an ungrounded system. Ground detection devices are provided on the incoming battery feeders in each distribution center. Status indications and failure annunciation for each of the 125 VDC distribution systems are provided in the Control Room.

The 125 VDC station batteries and other equipment associated with the 125 VDC Power Systems are easily accessible for inspection and testing. Service and testing is accomplished on a routine basis in accordance with Technical Specifications.

8.3.2.1.1 125 VDC Distribution Systems A and B

Batteries A and B are AT&T round cells each consisting of 60 lead acid type cells in high impact fire retardant transparent PVC containers mounted on two tier racks. Batteries A and B are each rated to provide a minimum capacity of 1504 ampere hours based on an eight-hour discharge rate and are sized to provide power for all connected loads for up to 3 hours while maintaining adequate voltage levels to all loads. The only exception are the motor-operated valves included in the GL 89-10 program which rely on the system battery chargers to provide adequate voltage for HELB isolation. Batteries A and B and their racks are Seismic Class 1. Batteries A and B and their associated power cables meet the IEEE 384 requirement for horizontal separation of 3 feet.

Motor-Generator (MG) set chargers are provided for each DC distribution system and are sized at 60 kW to carry the normal steady state DC loads during station operation while fully recharging their respective battery. A single full capacity 65 kW solid state (static) charger may be connected to either the A or B distribution system in place of its MG set charger. One charger is maintained in-service and connected to each system to maintain the battery in a fully charged condition at a nominal 132 VDC while supplying normal steady state DC loads. Each charger can also provide equalizing charge voltage to its connected battery as required.

The MG set charger for each DC distribution system and the A/B static charger are key interlocked so that only one power source can be supplying a system at any one time. In addition, the static charger is interlocked to supply either DC system A or B but not both at the same time.

The input and output contactors for MG Set A are manually controlled from the Control Room. MG Set B has an auto start capacity in addition to the manual start from the Control Room. The A/B static charger is controlled locally at the charger and will auto start on restoration of AC power. All of the battery chargers for DC distribution systems A and B are supplied with 480 VAC from vital Division B.

Certain loads can be connected to either 125 VDC distribution centers A or B through automatic or manual transfer switches. Local indication is provided at the automatic transfer switches, showing the availability of alternate (backup) power to 125 VDC Power Panels DC-D and DC-E, and Motor Control Center DC-1. An alarm will annunciate in the Control Room when the automatic transfer switches transfer power to the alternate source. Distribution centers A and B can also be interconnected via the A/B static charger while in cold shutdown.

Each of the chargers in the A and B DC distribution systems is provided with a DC ammeter and a DC output voltmeter in the Control Room. Distribution Center voltage and battery charge/discharge current can also be monitored in the Control Room.

8.3.2.1.2 125 VDC Distribution System C

Battery C consists of 60 lead acid type cells, in heat and shock resistant, noncombustible jars, mounted on a two tier battery rack. Battery C is rated at 1200 ampere hours at an eight hour discharge rate and is sized to provide power for all connected loads for up to 8 hours while maintaining adequate voltage levels to all loads. The only exception are the motor-operated valves included in the GL 89-10 program which rely on the system battery chargers to provide adequate voltage for HELB isolation. Battery C and its rack are Seismic Class 1.

Two full capacity solid state (static) chargers are provided, each rated at an output of 500 amperes and sized to fully recharge the C battery while supplying normal steady state DC loads. One charger is maintained inservice and connected to maintain the battery in a fully charged condition at a nominal 132 VDC while supplying normal steady state DC loads. It also can provide equalizing charge voltage to the battery as required. The other charger is maintained in standby.

The static chargers are controlled locally at the chargers and will auto start on restoration of AC power. Both chargers are supplied with 480 VAC from vital MCC Division A.

Each of the chargers in the C DC distribution system is provided with a DC output ammeter, a DC output voltmeter as well as charger failure annunciation in the Control Room. Distribution Center voltage and battery charge/discharge current can also be monitored in the Control Room.

Hydrogen gas detectors are provided in the C Battery Room which will sound an alarm locally and in the Control Room if levels exceed a predetermined limit less than 2%. The C Battery ventilation system is designed to maintain the hydrogen concentration below 2 percent by volume of hydrogen**.**

8.3.2.2 24/48 VDC Power System

A 24/48 VDC Power System supplies power to the reactor nuclear instrumentation system. The 24/48 VDC Power System is made up of two sub-systems with all components located in the lower cable spreading room. Each sub-system uses two 24 VDC battery/charger assemblies connected in series, with a center tap to form a three wire system of ± 24 volts line-to-common or 48 volts line-to-line. The battery chargers supply normal system loads with the batteries acting as a standby source of DC power upon failure of the battery chargers or during high demand transients. Power is supplied to system loads by two power panels, one in each sub-system.

The batteries are rated at 100 ampere hours at an eight hour discharge rate. The 24 VDC chargers are used to maintain their associated batteries in a fully charged condition while supplying normal system loads. All chargers are supplied power from the vital 120 VAC system.

8.3.2.3 120 VDC Emergency Diesel Generator Starting System

A separate 120 VDC battery and battery charger is supplied with each Emergency Diesel Generator. Each battery consists of 56 cells and is rated at 440 ampere hours. Each battery charger is completely automatic, solid state, constant voltage device and is provided with AC voltage compensation, DC voltage regulation and current limiting characteristics. Additional discussion on the Emergency Diesel Generator Starting System can be found in Section 9.5.6.

The Emergency Diesel Generator batteries and other equipment associated with the 120 VDC Emergency Diesel Generator Starting System are easily accessible for inspection and testing. Service and testing is accomplished on a routine basis in accordance with Technical Specification.

8.3.2.4 Analysis

The safety related loads of DC distribution system C or of DC distribution system B can bring the reactor to a safe shutdown condition under normal or accident conditions.

The DC Power System meets the following safety considerations:

a. Redundancy of components and subsystems. This includes power supply feeders, load center arrangements, loads supplied from each bus, and power connections to the instrumentation and control devices of the system.

b. Independence between redundant portions of the system is provided by the electrical and physical separation of redundant power sources.

c. The batteries and chargers have sufficient capacity, capability and reliability to perform their intended function. This considers the combined load demand connected to each battery or battery charger during all operating conditions.

d. The instrumentation, control circuits and power connections of vital supporting systems are designed to the same criteria as those for the Class 1E loads and power systems that they support.

e. Fire detection and suppression is provided in the Battery Rooms.

f. Adequate ventilation is provided to maintain the hydrogen concentration below 2 percent by volume of hydrogen.

g. New equipment is designed to withstand the effects of a seismic occurrence consistent with the seismic design at its location.

h. No single event in a cable tray will prevent the DC Power System from performing its intended safety function.

i. The seismic design of the Battery Room and conduit runs is consistent with present design criteria in that part of the safety related loads are in nonseismic structures.

8.3.2.4.1 Compliance with General Design Criteria 17

The station batteries and DC distribution systems are redundant. Separation of equipment and wireways has been maintained insofar as practicable to make the redundant distribution systems immune to localized damage. DC distribution system C is physically separated from DC distribution systems A and B, which are located in a different area of the plant.

All feeder cables associated with DC distribution system C are run in conduits, thus providing physical separation from DC distribution systems A and B. There are no direct electrical connections between DC distribution system C (Division A safety related loads) and DC distribution systems A and B (Division B safety related loads). There is no automatic or manual transfer of loads between distribution system C and distribution systems A and B. All DC motor operated valve power cables are run in raceways. Controls for redundant power equipment are run in separate raceways.

8.3.2.4.2 Compliance with AEC Safety Guide 6 (presently Regulatory Guide 1.6)

The DC Power Systems have adequate independence between systems. Although the 125 VDC system has three automatic bus transfers between distribution systems, the three transfers are between distribution systems A and B, and distribution system A does not normally supply safety systems. The redundant safety related systems are distribution B and C, and there are no automatic or manual bus transfers between these systems.

An evaluation of the DC Power System has shown that the station design is in compliance with regulatory positions, as evidenced by the following design features:

1. The electrically powered safety loads at the OCNGS are separated into redundant load groups such that loss of any one group will not prevent safety functions from being performed.

2. Each DC distribution bus is energized by a battery and battery charger. The battery charger and distribution system of Battery B has no automatic or manual connection to redundant DC distribution system C.

8.3.2.4.3 Compliance with General Design Criterion 18

Availability of electrical power will be assured through periodic inspection and testing during operation. Periodic verification of the operability of power availability monitors is possible and the status of each power supply, i.e. voltage frequency and presence of grounds (on ungrounded systems) is continually indicated. Individual circuits of the energize-to-operate safeguards systems have loss of control power annunciation.

8.3.2.4.4 Compliance with GL 89-10 Requirements

DC motor operated valves in the Isolation Condenser and Cleanup Demineralizer Systems required for High Energy Line Break isolation are part of the Oyster Creek Nuclear Generation Station GL 89-10 program (V-14-31, 33, 34, 35, and V-16-14). These valves take credit for the availability of the DC system at float voltage to meet these isolation requirements. The battery chargers for the B and C Distribution Systems are designed, or have been modified to automatically load and restart onto the Emergency Diesel Generators and pickup vital loads.

Battery chargers C1 and C2 for the C Distribution System and charger A/B for the B Distribution System are static type chargers that remain connected to their respective power supplies and restart when power is restored. Battery Charger B for the B Distribution System is a MG Set type charger that will restart and reload automatically on restoration of AC power.

The battery chargers can supply float voltage within the time required such that the MOV's can perform their isolation function within their time requirements.

Alarms have been added to the Control Room to provide indication that the voltage is out of procedural tolerance for both the B and C bus. The minimum alarm setpoint is maintained at or above the required voltage to ensure MOV isolation capability.

8.3.3 Fire Protection for Cable Systems

The measures employed for the prevention of, and protection against, fires in the OCNGS are described in Subsection 9.5.1.

8.3.4 STATION BLACKOUT

10CFR50, Section 50.63, requires that each light-water-cooled nuclear power plant be able to withstand and recover from a station blackout (SBO) of a specified duration. It also identifies the factors that must be considered in specifying the station blackout duration. Section 50.63 also requires that, for the station blackout duration the plant must be capable of maintaining core cooling and appropriate containment integrity.

NRC Regulatory Guide 1.155, "Station Blackout", describes a means acceptable to the NRC staff for meeting the requirements of 10 CFR 50.63. Regulatory Guide 1.155 states that NUMARC 87-00, "Guidelines and Technical Bases for NUMARC Initiatives Addressing Station Blackout at Light Water Reactors", provides guidance that is in large part identical to the RG 1.155 guidance and is acceptable for meeting 10 CFR 50.63, and notes where the regulatory guide takes precedence.

In order to comply with the SBO Rule, GPUN has added an Alternate AC (AAC) Power Supply System.

The AAC capability is provided by FirstEnergy dispatched combustion turbines located at the Forked River site. The Forked River Combustion Turbines (FRCTs) supply power to Oyster Creek via an underground ductbank/trench system, a 10MVA, 13.8/4.16KV, 3 phase SBO transformer (bank #3) and a 4.16KV breaker/cubicle added to 4160 VAC Bus 1B. The SBO System is configured such that only one (1) out of two (2) FRCTs is required to supply power to Oyster Creek.

8.3.4.1 Alternate AC (AAC) Power Source

The AAC power source has been designed so that it will be available within one (1) hour of the onset of a station blackout event and has sufficient capability and capacity to operate systems necessary to achieve and maintain the plant in a safe shutdown condition. The FRCTs can be remote started via microwave from FirstEnergy Solutions Office or locally from the CT control rooms. No remote start capability is provided from Oyster Creek. The AAC system and components are not required to meet Class 1E or safety system requirements. SBO components and sub-systems are physically protected against the effects of likely weather related events that may initiate the loss of off-site power event. The AAC has an independent start system and fuel system. The FRCTs and their output breakers have independent DC power sources. However, the remainder of the SBO system is dependent upon station DC sources.

The DC power for the switchgear circuit breaker 1B-BO is provided by the existing switchgear 1B control power. The A/B battery is required to provide power for one (1) hour until the AAC source is established. Once the power is restored to the 1B bus, the A/B battery chargers will be energized and can resume carrying the required DC loads.

The DC power for the SBO transformer, SBO Control Panel and SBO Load Break Switches is provided by DC distribution panel C, which is supplied from station battery C. The C battery is required to provide power for one (1) hour until the ACC source is established. The C Battery charger will be energized upon restoration of power via the AAC source by cross-tying USS1B2 to USS1A2.

Two breakers, one that is non-class 1E and one that is Class 1E separate the AAC supply from the 4160 volt engineered safeguards buses (see Drawing 3E-743-11-001). Failure of the AAC components will not adversely affect Class 1E AC power systems. The AAC source will not normally be connected to the preferred or on-site emergency power system. No single active failure or weather-related event will disable both emergency on-site AC power sources and simultaneously fail the AAC power source. The AAC system will not automatically load equipment on the emergency buses; manual loading shall be employed.

The capacity and reliability of the FRCTs to function as an AAC source shall be ensured by the following surveillance requirements:

a. As a minimum, the FRCTs shall be started and brought to operating conditions consistent with their function as an AAC power source at intervals not longer than three months. Normal operating cycles may be used to satisfy this requirement in lieu of a specific start for testing purposes.

b. At each refueling outage, the following surveillance testing shall be performed.

    1. A timed black start

    2. A simulated grid transient shutdown of the FRCTs with restart.

    3. FRCT operation at no load and required SBO load.

8.3.4.2 <u>Evaluation of Compliance with SBO Rule</u>

The evaluation of the OCNGS compliance with the SBO Rule and its ability to cope with an SBO event is described in Section 15.9.

TABLE 8.3-1[1]
(Sheet 1 of 1)

EMERGENCY BUSES AUTOMATIC LOADING SCHEDULE

Loads	Time** Delay(sec)	LOOP* Bus 1C (hp)	LOOP* Bus 1D (hp)	LOOP + LOCA Bus 1C (hp)	LOOP + LOCA Bus 1D (hp)	LOOP + LOCA + Single Failure Bus 1C or 1D (hp)
Isolation valves (load not included) since it is too brief to add to peak load)	0	-	-	-	-	-
Lighting, Instrumentation and Controls Ventilation, Security, Battery Chargers, miscellaneous small motors and transformer losses	0	Note 2	Note 2	Note 2	Note 2	Note 2
Core Spray Pumps (Main / Back-up)	5 & 15 sec.	-	-	595	580	595, 580 ****
Core Spray Booster Pumps	<5	-	-	310	310	310
Control Rod Drive Feed Pump	60	250	250	250	250	250
Service Water Pump	120	250	250	***	***	***
Reactor Building Closed Water Pump	166	200	200	***	***	***
Containment Spray Pumps	>200			***	***	***
Emergency Service Water Pumps	>200			***	***	***

LOCA, then LOOP	The LOCA condition will cause the DG to come on and idle until the LOCA signal is reset. If normal offsite power should be lost during the LOCA, the following will happen: Running equipment will trip (core spray, containment spray, ESW), breakers 1A1P/1B1P to USS 1A1/1B1 trip, Breakers 1C/1D trip open. The DGs will fast start or accelerate from idle condition and close in on the buses. The loads will come back on according to their sequence timers.
LOOP, then LOCA	The DG is already on line supplying "blackout" loads when the LOCA occurs[1]. The existing plant procedures control the DG loading. The DG will have enough available capacity for the additional ECCS loads.

Notes:

* LOOP - Loss of Offsite Power, LOCA-Loss-of-Coolant Accident

** Time delay reference; Time = 0 when EDG breaker closes.

*** These loads may be manually loaded by Operators depending on the conditions of the emergency.

**** System I BHP = 595, System II BHP = 580. The load rating will depend on failure of DG I or DG II. Nominal BHP of the pumps = 500.

Note 1: Table 8.3-1 incorporated the information from deleted Tables 8.3-2

Note 2: These loads start as needed. Adequate controls are in place to ensure adequate bus capacity