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8 ELECTRICAL SYSTEMS

8.1 DESIGN BASIS

The electrical design of nuclear Units 3 and 4 at Turkey Point is based on the principle that each unit shall be self-sufficient to the extent practicable, considering shared systems/components, and shall have adequate auxiliary equipment to meet emergency conditions. The electrical system has been designed to provide sufficient normal and emergency auxiliary electrical power to assure the capability for a safe and orderly shutdown as well as to maintain of the units in a safe condition under all credible circumstances.

8.1.1 PRINCIPAL DESIGN CRITERIA

Performance Standards

Criterion: “Those systems and components of reactor facilities which are essential to the prevention of accidents which could affect the public health and safety or the mitigation of their consequences shall be designed, fabricated, and erected to performance standards that will enable the facility to withstand, without loss of the capability to protect the public, the additional forces that might be imposed by natural phenomena such as earthquakes, tornadoes, flooding conditions, winds, ice, and other local site effects. The design bases so established shall reflect: (a) appropriate consideration of the most severe of these natural phenomena that have been recorded for the site and the surrounding area, and (b) an appropriate margin for withstanding forces greater than those recorded to reflect uncertainties about the historical data and their suitability as a basis for design." (1967 Proposed GDC 2)

Electrical systems and components vital to safety, including the Emergency Diesel Generators (EDGs), are designated as seismic Class/Category I and designed so their integrity is not impaired by the maximum hypothetical earthquake, wind storm, floods or disturbances on the offsite electrical system. Power, control and instrument cable systems, motors and other electrical equipment required for operation of the engineered safety features are protected against the effects of either a nuclear system accident or severe external environmental phenomena to assure a high degree of confidence in the operability of such components in the event that their use is required.

For the safety related 4160V switchgear and 480V load centers, equipment qualification has been conducted by the vendors to ensure that they meet the necessary seismic criteria specific to the site. In addition, the seismic qualification of these switchgear and load centers is not adversely affected by the breakers being procedurally placed in the racked out position.

<u>Emergency Power for Engineered Safety Features</u>

Turkey Point Units 3 and 4 were designed prior to the implementation of 10 CFR 50, Appendix A, General Design Criteria (GDC) for Nuclear Power Plants, and utilized the criteria of1967 proposed GDC 39, Emergency Power for Engineered Safety Features, in the design of the site electric power systems. Subsequently, 1967 proposed GDC 39 was implemented in 1971 as GDC 17, Electric power systems, and established more specific requirements than previously identified. An evaluation of the site electrical system design was performed in 1982 and concluded (Reference: FPL letter L-82-509, November 16, 1982) that Turkey Point complies with the requirements of GDC 17. C23

Criteria: 1. 1967 Proposed GDC 39
"Alternate power systems shall be provided and designed with adequate independency, redundancy, capacity and testability to permit the functioning required of the engineered safety features. As a minimum, the onsite power system and the offsite power system shall each, independently, provide this capacity assuming a failure of a single active component in each system."

2. GDC 17, Electric Power Systems C23

In order to satisfy the above criteria, independent alternate power systems are provided for each unit. These alternate power systems have adequate capacity to supply the power required for engineered safety features and protection systems. The following normal, standby and emergency power sources are available:

1. The source of auxiliary power during normal operation is the main generator and switchyard. The auxiliary transformer is connected to the generator isolated phase bus and the C bus transformer is connected to the switchyard. Both supply power to the 4.16 kV system.

2. Standby power during unit startup, shutdown and after unit trip is supplied from a startup transformer and a C bus transformer, which are connected to the switchyard 240 kV bus and feed the 4.16 kV system.

3. Four EDGs supply emergency power. Each EDG is connected to a separate power train, two per unit. With any credible single failure, the EDGs are capable of assuring a safe shut down of both units with a loss of offsite power concurrent with Maximum Hypothetical Accident (MHA) conditions in one unit.

4. Emergency power for vital instrumentation and controls is supplied from four 125V DC station batteries. Each is capable of feeding its associated load for two hours without charging. A spare 125V DC Station Battery is also provided which can be substituted for any of the four 125V DC Station Batteries to allow for maintenance or testing.

5. For each unit, a non-safety related 125V DC bus provides power to the non-safety related C-bus 4.16 kV and 480V switchgear, C-bus transformer relay panels and the turbine emergency oil pumps.

8.1.2 REFERENCES

1. FPL Letter L-82-509, from R.E. Uhrig (FPL) to S.A. Varga (NRC), Adequacy of Station Electric Distribution System Voltages, dated November 16, 1982. C23

8.2 ELECTRICAL SYSTEM DESIGN

8.2.1 NETWORK INTERCONNECTIONS

The main generators are rated for 1032 MVA at 0.85 power factor, 3 phase, 60 Hz, and generate power at 22 kV. Each is connected to its step up transformer through an isolated phase bus rated at 28,500 amps. The main generator step up transformers are rated at 970 MVA, 55°C ODAF. It transforms the voltage to 240 kV and is connected to the 240 kV switchyard through a 590 foot long transmission line with 2 x 1691 MCM AAAC cables per phase.

The existing 240 kV switchyard consists of four buses, South East, South West, North East, and North West, which are divided into eleven bays. The eleven bays contain breakers and isolation switches for the nine 240 kV transmission lines and 5 power plants. The circuit breakers and isolating switches in Bays 1, 2 and 4 through 10 are arranged in a breaker and a half configuration. The breakers in Bays 0, and 3 are arranged in a double breaker configuration. In the event that both Units 3 and 4 are inoperative, power is still available at the 240kV switchyard from as many as three Turkey Point fossil power plants having a combined maximum output of approximately 2,304 MW when all three units are in the generation mode, or from one of the 240kV circuits. Unit 2 is configured as a dual-convertible synchronous condenser/generator and, when in the condenser mode, reduces on-site maximum fossil generating capacity by approximately 20%.

The switchyard is connected to Florida Power and Light Company's transmission network through nine 240 kV circuits as shown in Figure 8.2-2. The total capacity of the nine lines at the Turkey Point Switchyard is approximately 5000 MVA (between 536 and 594 MVA each).

Eight of the nine 240 kV circuits out of Turkey Point are on a common right of way that follows a route roughly northwest in direction from the site. These 240 kV circuits are carried on five transmission line structures. Three of the structures carry two outgoing 240 kV circuits each, and the remaining two carry a single 240 kV circuit. The structures are designed to carry two 240 kV circuits and to withstand hurricane winds up to 150 MPH.

The remaining 240 kV circuit is on a right of way that follows a route roughly west in direction from the site.

Three of the nine circuits are connected to the Davis Switching Station, two to the Flagami Switching Station, one to the Levee, one to the Lindgren, one to the Princeton, and one to the Florida City Switching Stations as shown in Figure 8.2-2.

8.2.2 STATION ELECTRICAL SYSTEM

The station electrical system is designed to provide a simple arrangement of buses, requiring a minimum of switching to restore power to a bus in the event the normal supply to the bus is lost. The basic components of the station electrical system are shown on the single line diagram contained in Figure 8.2-2. Figure 8.2-2 includes the 240 kV switchyard, the 4.16 kV system and 480V system. The 120V Instrument AC System and the 125V DC System are shown in Figures 8.2-4a, 8.2-4b, 8.2-4c, 8.2-4d, 8.2-4e and 8.2-4f.

Unit Auxiliary, Startup Transformers and C Bus Transformer

Each of the two units has an auxiliary transformer connected to the generator isolated phase bus to serve as the normal source of auxiliary electrical power. Each transformer is rated 50 MVA, ONFA at 55°C. The auxiliary transformers are connected to the 22 kV isophase bus on their primary side and have two secondary windings connected to the 4.16 kV buses. In addition, there are two C Bus transformers rated at 30/40/50 MVA, OA/FA/FOA at 55°C. The C bus transformers are connected to the 240 kV switchyard on their primary side and have two secondary windings at 4.16 kV. The auxiliary and C bus transformers are capable of supplying the electrical power requirements associated with its unit as well as those requirements common to both units.

In addition to the unit auxiliary transformers, there are two startup transformers, one for each unit, rated at 33.6/44.8 MVA, ONAN/ONAF at 65°C. The startup transformers are connected to the 240 kV buses on their primary sides and have two secondary windings at 4.16 kV. The startup and C bus transformers serve the unit during startup, shutdown, and after a unit trip. The C bus transformers are isolated from their respective startup transformer. The startup transformer also constitutes a standby source of auxiliary power in the event of the loss of the unit auxiliary transformer during normal operation. In the event the turbine trips, an automatic transfer connects the A and B 4.16 kV buses to the unit startup transformer.

Each startup transformer has the capability of being connected to different 240 kV buses. In the event of a 240 kV bus fault, at least one startup transformer could be quickly restored to service. The Unit 3 startup transformer is normally connected to the northeast and southwest switchyard bus. The Unit 4 startup transformer is normally connected to both the southeast and southwest switchyard buses. Thus, a 240 kV bus fault will not result in the loss of a startup transformer.

The unit auxiliary transformer can be isolated by means of removable links in the connection to the generator bus. The startup transformer for the adjacent nuclear unit is available as a redundant source of emergency power. A 4.16 kV tie is provided from the "Y" secondary winding of each startup transformer to provide emergency power to the 4.16 kV A bus of the adjacent nuclear unit as a redundant offsite power source.

In the event of a loss of the preferred power sources, station onsite power is supplied by the onsite EDGs and station batteries.

8.2.2.1 ONSITE AC POWER SYSTEM

8.2.2.1.1 DESCRIPTION

Power Bus Arrangement

The power bus arrangement for the plant onsite AC power system is shown in Figure 8.2-2.

4.16 kV System

For each unit there are three safety related 4.16 kV switchgear, two of which are fed separately from the double secondary windings of its unit auxiliary transformer under normal operating conditions. At any time when power from the auxiliary transformer is not available, these buses are energized from the double (“X” and “Y”) secondary windings of the startup transformer. Complete loss of power at these safety related 4.16 kV switchgear causes the EDGs to start and feed power to them directly.

Two of the switchgear, labeled as "A" and "B", provide power to the A and B trains of Engineered Safety Features, respectively, in each unit. The A and B train switchgear buses are high resistance grounded by means of 3-10 kVA single phase, 4.16 kV grounding transformers/resistor arrangement.

The third safety related 4.16 kV switchgear, labeled as the "D" switchgear, is utilized as a swing bus. It can be manually aligned to either the A or B 4.16 kV bus of its respective unit. An automatic transfer switch provides control power from one of two different DC sources to assure control power will always be available for manual alignment of this swing switchgear. Interlocks ensure that the swing switchgear can only be connected to one 4.16 kV bus at a time. When the 4.16 kV swing switchgear is connected to either 4.16 kV supply bus, it is considered an extension of that power supply bus.

The control logic of the power supply bus, utilized for the bus stripping of loads on loss of bus voltage and development of a bus cleared signal to permit application of emergency power to the bus, is extended to the swing switchgear through interlocks with the 4.16 kV swing bus breakers.

The third ("C") Intake Cooling Water (ICW) and Component Cooling Water (CCW) pump of each unit is powered from its associated unit's D bus. In addition, a crosstie, installed to resolve the 10 CFR 50.63 Station Blackout (SBO) Rule, is provided via a tie between the D buses of each unit.

A non-safety related 4.16 kV bus in each unit, labeled as the "C" bus, is fed from the 3C/4C transformers. This switchgear supplies power to Standby Steam Generator Feed Pump P82A, non-safety related auxiliary motors (“B” Steam Generator Feedwater Pump and “C” Condensate Pump) and 480V load centers. The non-safety related "C" bus of each unit can be connected to either "A" or "B" safety related bus. The inter-tie is administratively controlled with both tie breakers maintained racked-out and is only provided for an unanticipated plant condition (i.e., outside of the design basis criteria) to be used at the discretion of the Nuclear Plant Supervisor (Reference 3).

<u>480V System</u>

The 480V system of load centers is arranged in an identical manner for Units 3 and 4, with the exception of the 4J Load Center, which has no corresponding Unit 3 load center. For each unit there are five safety related 480V load center buses, four of which are arranged in double-ended load center configuration.

Each of the four double-ended load center buses is fed from its associated unit by a separate load center transformer rated at 1000 kVA, 4160-480V. Each load center transformer is high resistance grounded via a ground resistor connected to the neutral of the low voltage winding. The two transformers of each double-ended unit are energized from different 4.16 kV buses (Load Centers A and C are fed from Train A and Load Centers B and D are fed from Train B). This arrangement ensures the availability of equipment associated with a particular function in the event of loss of one 4.16 kV bus.

The fifth safety related 480V load center in each unit is a swing load center, which can swing between Load Center C and D of its associated unit. As such, they do not have dedicated transformers. These load centers are labeled as 3H for Unit 3 and 4H for Unit 4, and are located on the ground floor in the Auxiliary Building Electrical Equipment Room. When the 480V swing load center is connected to either 480V supply bus, it is considered to be an extension of that 480V supply bus. The control logic contains interlocks to prevent parallel connection to Load Centers 3C (4C) and 3D (4D).

While the swing load center can be manually aligned to either Train A or B, the swing load center bus will automatically transfer in the event of a loss of power on the supply load center to which it was aligned, provided that the other supply load center is powered and no faults have occurred on load center 3H (4H) or intertie breakers. This action is accomplished by the utilization of a dead bus, voltage seeking logic design which initiates automatic circuit breaker operation, on loss of power, to connect the bus to the available power source. An automatic transfer switch provides power from one of two different DC sources to assure control power will always be available for alignment of the swing load center. A timing circuit is provided to prevent initiation of transfer in the event of a momentary voltage drop. In the event of loss of offsite power, an interlock will prevent immediate transfer. No transfer will be initiated, unless one is necessary upon voltage restoration. If a transfer is necessary, it will occur during Load Block 1 or during or after Load Block 7. The sequencer prevents transfer during Load Blocks 2 through 6 to prevent the possibility of overloading the EDG. The EDG loading is acceptable with the load center aligned to either train.

Also, since Charging Pump C is powered from Load Center H and failure of the charging pump to strip from the Load Center as designed may result in an EDG overload during load center transfer, Load Center H will be isolated if this occurs. After normal EDG loading by the load sequencer and isolation of the charging pump, Load Center H can be manually loaded by the operator, if desired.

Three non-safety related 480V load centers in each Unit 3 and 4 supply power to non-vital 480V motors and the non-vital section of Motor Control Centers (MCCs) 3B, 3C, 4B, and 4C. Each load center is fed from the C bus 4.16 kV switchgear through a separate 1000 kVA transformer. Load center 4J can be supplied from either 3C or 4C 4.16kV switchgear.

MCCs 3A and 4A also have non-vital sections, but they are powered by separate feeds from the safety related 480V Load Center A of the respective unit.

There are 31 MCCs as listed below: C26

1) MCCs 3A and 4A, Turbine Area, one for each unit.
2) Non-vital MCCs 3A and 4A, Turbine Area, one for each unit.
3) MCCs 3B and 4B, Reactor Area, one for each unit.
4) Non-vital MCCs 3B and 4B, Reactor Area, one for each unit.
5) MCCs 3C and 4C, Fuel Area, one for each unit.
6) Non-vital MCCs 3C and 4C, Fuel Area, one for each unit.
7) MCCs 3D and 4D, Waste Disposal Area and Electrical Equipment Rooms, respectively.
8) Non-vital MCC D, Waste Disposal Area.
9) MCCs 3E and 4E, Intake Area, one for each unit.
10) MCC F, Water Treatment Area, common for both units.
11) MCCs RA and RB, Radwaste Building, one for each unit.
12) MCCs 3B43 and 4B43, Turbine Area, one for each unit.
13) Deleted C26
14) MCCs 3H and 4H, Component Cooling Water Area, one for each unit.
15) MCC 4J, Unit 4 EDG Building.
16) MCCs 3K and 4K, Unit 3 and Unit 4 EDG Buildings, respectively.
17) MCCs 3L and 4L, Unit 3A and Unit 4A Switchgear and Load Center Rooms, respectively.
18) MCCs 3M and 4M, Unit 3B and Unit 4B Switchgear and Load Center Rooms, respectively.

120 Volt Instrument AC Supply System

The safety related 120V AC power sources associated with Unit 3 instrumentation are shown in Figures 8.2-4a, 8.2-4b, and 8.2-4c. Similarly, the safety related 120V AC power sources associated with Unit 4 instrumentation are shown in Figures 8.2-4d, 8.2-4e and 8.2-4f.

The 120V Instrument AC System has four sets of equipment for each unit, each set consisting of a 7.5 kVA, 125V DC/120V AC inverter, distribution panel, static transfer switch and an associated constant voltage transformer (CVT) for alternate 120V AC supplied from a vital MCC. Each inverter is normally powered by a separate bus of the vital DC system. Upon overload or loss of the inverter AC output, the static switch in the output of the inverter automatically fast transfers to the alternate AC supply (CVT), if available, to maintain continuity of output power.

Four 7.5 kVA, 125V DC/120V AC spare inverters are provided to allow maintenance on the normal inverters. One spare inverter is provided for each pair of normal inverters of the same channel. The spare inverters are manually placed in service, and can serve as backup to the normal source for each unit, subject to Technical Specification limitations.

The alternate AC supply (CVT) is normally aligned with its associated normal inverter but can be aligned with a spare inverter by actuating the Alternate Source Transfer Switch. Each spare inverter can be aligned with the CVT associated with the inverter it is replacing.

The vital instrumentation load for each unit is distributed on the four buses in such a manner to avoid the complete loss of any particular function with the loss of any one bus. The arrangement described above assures a reliable 120V AC supply to the vital instrument load.

One non-safety related 10 kVA and one non-safety related 20 kVA inverter are available on each unit for non-safety related loads. These inverters are supplied from the non-vital 125V DC buses.

8.2.2.1.1.1 STANDBY POWER SUPPLIES

EDGs 3A and 3B, previously labeled as A and B, were the two original safety related EDGs which comprised the onsite standby power source and were used to provided all the emergency AC power for both units. As part of the Emergency Power System (EPS) Enhancement Project modifications made during the 1990-1991 Dual Unit Outage, these EDGs were relabeled as 3A and 3B and were realigned to power the Unit 3 loads and some common loads. These EDG sets are General Motors (Electro Motive Division) EMD Model 999-20. Each set consists of an EMD design 20-645E4, turbocharged, two-cycle engine which is coupled to an EMD design Model A-20 generator. The output of each EDG set is nominally rated as follows:

Base Continuous Rating - 2500 kW
Basic Overload Rating - 2750 kW
2000 Hour Peaking Rating - 2850 kW
168 Hour Emergency Rating - 2950 kW
1/2 Hour Exceptional Rating - 3050 kW

Tables 8.2-2a and -2b demonstrate that all of the required automatic and manual loads powered by EDGs 3A and 3B are within the Continuous Rating of these EDGs.

EDGs 4A and 4B, added during the Dual Unit Outage of 1990-1991, were supplied by Morrison-Knudsen, Inc. Each set consists of a General Motors Electro-Motive Division Model 20-645F4B design, turbocharged, two-cycle engine which is coupled to a Model 140 Electric Products generator. The output of each EDG set is nominally rated as follows:

Base Continuous Rating - 2874 kW
Basic Overload Rating - 3162 kW
2000 Hour Peaking Rating - 3095 kW
200 Hour Emergency Rating - 3237 kW
4 Hour Rating - 3266 kW
1/2 Hour Exceptional Rating - 3295 kW

Tables 8.2-2c and -2d demonstrate that all of the required automatic and manual loads powered by EDGs 4A and 4B are within the Continuous Rating of these EDGs.

The 3A and 3B EDGs are in separate rooms in a Class I structure located east of the turbine area. The 4A and 4B EDGs are in separate rooms in a Category I structure located northeast of the Unit 3 containment. Each EDG system is monitored to alert personnel to off-normal conditions. Visual and audible alarms are provided in both the EDG Building near the set and in the Control Room on the annunciator panel.

Starting Initiating Circuits

Each EDG is started on the receipt of a Safety Injection Signal (SIS) in either unit or the loss of voltage on its associated 4.16 kV bus. Upon loss of voltage, the following automatic sequence starts.

1. The EDG for the respective bus is started.
2. All motor feeders and main supply breakers are tripped via the load sequencer.
3. EDG breaker closes.
4. All required emergency shutdown loads are sequenced onto the EDG via its load sequencer. To continue the shutdown of the unit on loss of power, all further operations are done manually by the operator.

Upon initiation of a Safety Injection Signal, the EDGs start and continue to operate in a no-load condition (EDG breaker open) at normal operating speed unless an undervoltage signal is received or until they are stopped manually.

Trips and Interlocks

Protective and alarm relays are provided for the generator of the EDGs as follows:

1. Generator Differential
2. Generator Overcurrent
3. Loss of Excitation
4. Reverse Power
5. Voltage Balance (control and alarm only)
6. Underfrequency
7. Over/Undervoltage (alarm only)
8. Generator Temperature (alarm only)

All of the above protective relays, except the generator differential, are bypassed under emergency operation. In addition to the generator differential relay, the only other devices that will trip the EDG under emergency operation are a mechanical engine overspeed trip and the emergency stop button. For interlocks associated with the EDG auxiliaries, refer to Section 9.15. Note that all interlocks associated with the EDG auxiliaries are bypassed during emergency operation.

Load Shedding Circuits

A loss of normal power supply is detected by undervoltage relays, which initiate, via the bus load sequencer, the bus stripping action on the affected 4.16 kV and associated 480V load center bus by energizing bus stripping relays. The bus stripping relays open all required bus supply and feeder breakers.

Fuel Oil Storage and Transfer System

Refer to Section 9.15.1 for description and details.

Cooling and Heating Systems

Refer to Section 9.15.2 for description and details.

Starting Mechanism and System

Refer to Section 9.15.3 for description and details.

Lubrication System

Refer to Section 9.15.4 for description and details.

Combustion Air Intake and Exhaust Systems

Refer to Section 9.15.5 for description and details.

Instrumentation and Alarms

Indicators are provided on the EDG local control panel in the associated EDG Building. Abnormal conditions are alarmed in the Control Room via an EDG trouble indicator (one for each EDG).

Instrumentation for EDG 3A and 3B are on Control Console 3C02 while the instrumentation for EDGs 4A and 4B are on Console 4C02. All safety related instrumentation installed in the Control Room during the 1990-1991 Dual Unit Outage are qualified for Class 1E use; all Control Room modifications comply with NUREG 0700, "Guidelines for Control Room Design Review."

Details of the EDG alarms and annunciation are provided in Section 9.15. Local and Control Room annunciation for the Unit 3 and Unit 4 EDGs differ slightly as the Unit 4 EDGs have approximately 90 inputs versus approximately 10 for the existing units.

The logic diagram of the EDG control and alarm system is shown on Figures 8.2-18a through -18g for Unit 3 and Figures 8.2-18h through -18n for Unit 4.

Monitoring instrumentation is provided for each EDG at the main Control Room and at local panels in their respective EDG Building.

EDG Control

Controls in the Control Room for EDG 3A and 3B are on Control Consoles and Vertical Panels 3C02, 3C04 and 3C06, while the controls for EDGs 4A and 4B are on Consoles and Vertical Panels 4C02, 4C04 and 4C06. All safety related controls installed in the Control Room during the 1990-1991 Dual Unit Outage are qualified Class 1E; all Control Room modifications comply with NUREG 0700, "Guidelines for Control Room Design Review."

During the normal (test) mode of EDG operation, the point of control, local control panel or main control board, is determined by the position of a Master Selector Switch. However, the change in point of control during the test operation has no effect on the emergency operation of the EDG.

In the normal (test) mode, the EDG is started manually by operating the normal (idle) start/stop selector switch, rapid start pushbutton or emergency start/stop selector switches either locally or remotely in the Control Room.

During the normal start-up period, the EDG idles at 450 rpm to allow controlled warm up of the engine to minimize wear. After the warm up period is completed, the idle control is disengaged and the EDG accelerates to rated speed (900 rpm) in preparation for loading. An undervoltage signal or SIS will take precedence over the normal (test) mode of operation, as long as the key-operated auto start bypass switch has not been activated at the local control panel with the master switch in the "local" position.

Once the EDG is at normal speed and normal voltage is established, the operator may proceed with synchronization of the generator with the 4.16 kV bus and manually close the EDG breaker. Once the EDG is tied to the 4.16 kV bus, it is manually loaded.

To initiate the normal shutdown process, the load on the EDG is first reduced to a preset minimum value before the EDG breaker is manually opened via the control switch. When the EDG is disconnected from the 4.16 kV bus, the normal start/stop selector switch is operated to initiate the normal EDG shutdown. During the shutdown period, the diesel will operate for a period of time (20 minutes) at idle speed to allow the engine heat to dissipate in a controlled manner. After this period of cooldown, the EDG is stopped. EDG normal start/stop is overridden by an automatic (emergency) start signal, as long as the auto start bypass switch has not been activated as previously before mentioned.

A rapid start function is provided for a fast start test of the EDG. The period of engine warm up, at idle speed, is eliminated from the EDG start up process during the rapid start function, thus resulting in a fast start of the EDG. All machine electrical and mechanical protective features are enforced during the rapid start function.

The emergency start function is the same as the rapid start function described above, except that protective features are bypassed as designed for emergency operation.

The EDG can be manually stopped from the Control Room or locally, depending on the position of the master switch, by actuating the normal stop. Normal stop requires a previous resetting of the SIS or operation of an administratively controlled key-locked auto start bypass switch.

Emergency stop, which can be actuated from the Control Room or locally at the EDG control panel or at the engine control panel, does not require a previous resetting of the emergency signal, but will actuate the shutdown relay. The shutdown relay can only be reset locally.

Prototype Qualification Program (Applicable to EDGs 4A and 4B Only)

The Electro-Motive Division (EMD) of General Motors model "F" engine, normally produced for stationary, railroad, drill rig and marine service, is the type of engine utilized in the 4A and 4B EDGs. At time of EDG 4A/4B purchase, EMD had produced approximately 861 "F" units. Those produced for stationary service are used both as standby and base power.

The "F" engine series is basically a standard 645 model design. They have the same crankcase, crankshaft, power pack (cylinder, head, piston and connecting rod), main and connecting rod bearing, accessory and camshaft drive gears, rocker arms, etc. EMD has produced approximately 80,000 model 645 diesels of which approximately 26,000 are in stationary power service. The varied applications for railroad, oil rig drilling, marine, off-road vehicles and stationary power service, subjects the basic standard design to all types of operational conditions. The extensive use of this basic design provides assurance that the EDG design will provide reliable service.

The manufacture of the 645 diesel is performed in compliance with the EMD Quality Assurance Program that includes control of the engineering, production and material control processes.

In light of the above, the selection, design and qualification of the 4A and 4B EDGs and associated auxiliary systems comply with the requirements of Regulatory Guide 1.9 with the following exception:

> An exemption from the 300 Start and Load Acceptance Test provisions of IEEE Standard 387-1984 was taken due to the EDGs' similarity to

previously qualified designs (Reference FPL letter L-88-454 dated October 19, 1988). In lieu of a 300 Start and Load Acceptance Test, a 30 Start and Load Acceptance Test was performed. NRC reviewed and accepted this exemption (Reference NRC letter to FPL dated August 10, 1989 with Safety Evaluation enclosed).

8.2.2.1.1.2 SPECIFICS OF THE ONSITE AC POWER SYSTEM

Loads Supplied From Each Bus

All 300 HP and above motors are powered from the 4.16 kV switchgear. This includes the High Head Safety Injection pumps, the Residual Heat Removal pumps, the Component Cooling Water (CCW) pumps, and the Intake Cooling Water (ICW) pumps. The swing switchgear powers the third ICW and CCW pumps associated with its respective unit.

Certain 100 HP loads and all loads above 100 HP and below 300 HP are connected to the 480V load centers, e.g., the Containment Spray pumps, Charging pumps, and Spent Fuel Pool Cooling pumps. The load centers also power their associated train MCCs.

The swing 480V Load Center 3H supplies power to MCC 3D and to Charging Pump (CP) 3C; likewise, the swing Load Center 4H supplies power to MCC 4D and to Charging Pump 4C. These charging pumps are available as installed spares for either the A or B pumps of a unit.

All 460V motors rated 100 HP and less are connected to the 480V MCC's, except the Spent Fuel Pit Cooling pump motors, and the Normal Containment Cooling Fans 3B and 4D, which are powered by the safety related 480V load centers. C26

MCC 3A and 3K supply EDG 3A and 3B auxiliaries, respectively. MCCs 4J and 4K provide power to the auxiliary loads for the EDGs 4A and 4B, respectively.

MCC 3D and 4D supply power to loads for their respective unit as well as various plant common loads.

The remaining safety related MCCs primarily power various safety related loads associated with its train and unit. However, a few systems common to both units are also powered by these MCCs.

The non-safety related MCCs power miscellaneous non-safety related loads.

Manual/Automatic Interconnection Between Buses and Their Loads and Supplies

The swing safety related 4.16 kV switchgear D can be manually aligned to either the A or B 4.16 kV bus of its respective unit.   An automatic transfer switch provides power from one of two different DC sources to assure control power will always be available for manual alignment of this swing switchgear. Interlocks ensure that the swing switchgear can only be connected to one 4.16 kV bus at a time.

The station blackout cross-tie provides a 500 ampere tie between the Unit 3 and Unit 4 swing switchgear. The control circuitry includes permissives and interlocks to prevent inadvertent closure of the station blackout tie breakers. When the required permissives are satisfied, the station blackout tie breakers can be manually closed by operation of administratively controlled, key-lock control switches (one for each unit) provided in the Control Room. The status of station blackout permissives and breaker position indicating lights are provided in the Control Room. Refer to Section 8.2.2.2 for additional details.

The 480V Load Center 3H/4H is designed as a swing bus capable of being powered from either 480V Load Center 3C/4C (Train A) or 3D/4D (Train B). Load Center 3H/4H has been designed to be aligned manually to a related train or to automatically transfer from the aligned source, on loss of power, to the other train, provided the other train has available power and other permissives are satisfied. An automatic transfer switch provides power from one of two different DC sources to assure control power will always be available for alignment of this swing load center.

The tie breakers between 480V Load Centers 4A and 4B, 4C and 4D, 3A and 3B, and 3C and 3D are normally racked out to prevent an operator error that would parallel these power sources during plant operation. When required, e.g., during an outage, they are administratively controlled by plant procedures.

Separation for Engineered Safeguards Equipment

For all the engineered safeguard items where duplicate equipment is provided, the motors are fed from separate buses of the 4.16 kV system, separate 480V load centers or separate MCCs in order to ensure continued source of supply. Both power and control circuits to the redundant equipment are routed in separately located cable trays, ducts, conduits, etc., ensuring that any physical damage affecting one circuit will not affect its redundant components.

In general, 4.16 kV circuits are in individual conduits and pass through manholes that are exclusively for the A or the B 4.16 kV bus. Cable trays are used in some instances for such cables, but each tray is used only for the high voltage cables associated with a given bus.

Power cables for 480V devices may be in the same cable tray with associated 120V control cables. Low level instrumentation cables are in wireways that are separate and at least one foot distant from those carrying any other type of circuit, with shielding provided as required. Cables for redundant safeguard circuits and for different protection channels are in cable trays separated approximately one foot (horizontally and vertically) from each other. Where physically impossible to maintain this separation, fire barriers of Marinite or sheet metal are installed.

This physical separation is indicated in Figures 8.2-8 through 8.2-17.

Safety Related Equipment Identification

Turkey Point is not committed to the identification requirements for Class 1E cable of IEEE 384. As such, cables installed in exposed Class 1E raceways are not marked as specified by IEEE 384.

Automatic Loading and Stripping of Buses

The loading and stripping functions of the emergency power distribution system response to undervoltage signals and/or SIS is controlled by the load sequencers. The four load sequencers (one per train/EDG) are qualified solid-state type sequencers which primarily perform two functions, "Bus Stripping/Clearing" and "Load Sequencing."

The bus stripping function trips and blocks starting of electrical loads on the 4.16 kV switchgear, 480V load centers or 480V MCCs; the bus clearing function verifies that the required 4.16 kV switchgear breakers have tripped. The EDGs are designed to obtain rated speed and voltage within 15 seconds following the receipt of a start signal. Note that the EDG breaker closes once the EDG has reached rated speed and voltage and the appropriate buses have been stripped in accordance with the design. The control logic is such that no loads can be sequenced onto the bus following a loss of power on a 4.16 kV switchgear until the EDG breaker is closed. This, in turn, requires that all loads are previously stripped from the bus to permit EDG breaker closure. Upon initiation of stripping, after detection of a LOOP condition (one second), the sequencer starts loading automatically at 15.5 seconds. The timing contacts of the sequencer close the breakers or energize the contactors of the equipment required for the safe shutdown of the plant in a predetermined sequential order.

The stripping and loading of equipment are summarized below:

1. For a loss of offsite power on a given unit, all associated 4.16 kV and 480V loads will be stripped. Output relays that strip the essential loads are reset when power is restored. This enables the essential loads to be loaded, by the sequencer, onto the bus for safe shutdown. Output relays that strip non-essential loads are automatically reset only after offsite power is restored to the 4.16 kV bus. This inhibits non-essential loads from being loaded to the 4.16 kV bus when the bus is being powered by the EDG.

2. If either unit experiences an SIS while offsite power is available, load shedding, bus stripping and EDG breaker closure signals will not be initiated by the sequencer. However, vital loads required for emergency reactor shutdown will be sequentially connected to the bus by the sequencer. This occurs without any timing delay for start of the EDGs. The SIS, in this case, starts the EDGs but they are not connected to the plant distribution system unless a loss of offsite power also occurs.

3. If a loss of offsite power is experienced subsequent to the occurrence of an SIS, any train experiencing the loss of voltage will be stripped

by the sequencer and upon closure of the EDG breaker, the affected bus(es) will be sequentially loaded.

4. If an EDG is in the test mode and paralleled to the offsite power and an SIS is initiated, the EDG breaker will trip, the EDG will continue to run and vital loads required for emergency shutdown will be sequentially loaded to the bus by the sequencer, with the power being supplied from the offsite power source.

5. If an SIS occurs subsequent to a loss of offsite power, while the EDGs are providing emergency onsite power, the EDGs will continue to operate, and the buses associated with the unit experiencing the SIS will be stripped and then the loads required for emergency shutdown will be loaded to the buses by the associated sequencer. The timing contacts of the sequencer will be reset to the zero time condition regardless of the state of progress of the EDG LOOP loading operation. Additionally, the buses associated with the non-SIS unit will be stripped and sequentially loaded for safe shutdown as well as starting both SI pumps associated with that unit. For both units the EDG breakers remains closed during these scenarios.

The load blocks associated with the operation of the sequencer and the equipment released by the sequencer during these load blocks are shown in Figure 8.2-19a for an SIS with offsite power available and in Figure 8.2-19b for an SIS with a concurrent loss of offsite power.

Manual Loads

The Normal Containment Cooling (NCC) Fans, which are required for normal operation, are tripped on loss of offsite power and are blocked from automatically restarting upon restoration of bus voltage. Manual control capabilities are provided in the Control Room. Operator actions required to manually load the Normal Containment Cooling Fans for a unit in a non-accident condition are specified in the plant procedures. Containment heat removal for a unit in an accident condition is accomplished via the Emergency Containment Cooling and Containment Spray Systems, which are loaded automatically.

Upon loss of offsite power, the Boric Acid (BA) transfer pumps may remain deenergized for the short term (up to eight hours). Manual control is available in the Control Room for the BA transfer pumps. Plant procedures specify operator actions required to load the BA transfer pumps manually.

The Motor Operated Instrument Air Compressors (IACs) are powered from non-vital sources. The unavailability of the Instrument Air Compressors following a loss of offsite power is adequately compensated for through the use of air receivers, nitrogen accumulators, and non-safety related, self-contained air compressors that do not require the EDG for power. To ensure that instrument air moisture criteria are met at all times, the instrument air dryers are
automatically loaded onto the EDGs. This is a small load of approximately 17 kW per unit.

The turbine auxiliaries such as the turbine turning gear oil pump, turbine bearing lift pump, and turbine turning gear drive provide a protective function to the main turbine generator but do not perform any safety related function. Accordingly, these turbine auxiliaries are blocked from automatic starting whenever offsite power is not available. While these loads are not required to be powered following a loss of offsite power, the operator may manually initiate these as specified in the plant procedures. The Control Rod Drive Mechanisms (CRDM) cooler fans are required for normal operation only and are shed during EDG loading. If required, CRDM cooler fans can be manually loaded onto the EDGs.

The electric driven fire pump feeder breaker is tripped on loss of offsite power. The operator may manually load the electric driven fire pump on EDG 3A if needed. The electric or diesel driven fire pump can each meet the fire water demand of the design basis fire.

Load Sequencer Operation

Since the sequencers are required for safe shutdown of the reactor in the event of a loss of offsite power and to mitigate the consequences of a design basis accident, they are qualified for Nuclear Safety Related, Class 1E service. The Emergency Bus Stripping and Load Sequencers and their interfaces have been designed for dedicated channel operation. This configuration assures reliable sequencer power and meets the single failure criteria of IEEE 379-1977 by maintaining channel to channel independence of the emergency bus stripping and load sequencers and associated circuit breakers, power supplies and inverters.

The Emergency Bus Stripping and Load Sequencers are Programmable Logic Controller (PLC) based cabinets utilizing a PLC for bus stripping and loading logic and control. The throughput structure of the PLC utilizes dedicated input modules, control logic, and dedicated output modules. Each input and output is passed through a solid state buffer to limit signal irregularities (voltage spikes, etc.) and the effect of contact bounce and transients.

Each Emergency Bus Stripping and Load Sequencer is designed to respond to an SIS to initiate High Head Safety Injection pump start on its respective train, as well as each pump on the opposite unit.

Load Sequencer Qualification Testing

The load sequencers utilize solid state Programmable Logic Controllers (PLCs) to perform the logic functions. PLCs, like other electronic devises, can be susceptible to electromagnetic interference (EMI). The Nuclear Regulatory Commission's (NRC) Supplemental Safety Evaluation of the Emergency Power System Enhancement Project (Reference 1) requested verification that the electromagnetic emissions levels at the sequencer locations are enveloped by the manufacturer's qualification testing for the sequencers and PLCs. Therefore, EMI testing (both susceptibility and environmental) of the solid state sequencers was performed during the 1990-1991 Dual Unit Outage. An evaluation of this testing verified that the sequencers are suitable for the electromagnetic emission environment at their installed locations and are enveloped by the operational EMI susceptibility qualifications established for the sequencers by the manufacturers. In addition, this evaluation identifies that increases in the 4160V AC loading will have little or no effect on the EMI emissions (leakage) in the area. Therefore, minor changes made in the future to the 4160V AC bus loading will not alter the conclusions of the evaluation. The results of this evaluation of the sequencer testing along with a description of the testing sequences conducted are documented in Reference 2.

Electric Circuit Protection System Network

To maintain the A and B bus undervoltage sensing schemes independent of each other for bus shedding, EDG starting and load sequencing, undervoltage relaying logic and subsequent change-over of bus source from offsite to onsite the following logic is provided:

1. Originally, two instantaneous relays were connected on each 4.16 kV bus to monitor for undervoltage conditions. The relays of Buses A and B were interconnected such that the loss of voltage on both buses was required for initiation of load shedding, EDG start, and subsequent load sequencing on both buses.

2. The revised relaying scheme reconnects the four relays discussed in Item 1 above such that the load shedding, EDG start and sequencing function occurs only for that bus on which the degraded voltage condition existed. Hence, the relaying scheme for Bus A is independent of that for Bus B. Load shedding, EDG start, and sequencing will occur for both buses only upon a concurrent loss of voltage on each bus. To provide reliability, the two instantaneous undervoltage relays are connected across two secondaries of the potential transformer for each bus. Thus, failure of a single relay or voltage source would not cause a spurious transfer. Therefore, undervoltage on one bus alone is sufficient for the separation of that system from offsite sources, while the other bus, if not disturbed, would still be fed from offsite sources. However, loss of reactor coolant pump due to tripping of the affected bus would result in a unit trip.

3. An undervoltage monitoring system on the 480V safety related load centers is provided so that degraded load center voltage concurrent with a SIS would initiate transfer to onsite power. A set of two instantaneous undervoltage relays on each safety related load center are installed to monitor the load center voltage. The two relays in each load center are connected in an AND logic and when actuated due to a degraded voltage concurrent with a SIS and an open EDG breaker would initiate a sequencer time delay. After timing out, the sequencer will initiate load shedding, onsite power connection and sequencing of the necessary loads.

In addition to the load center undervoltage concurrent with safety injection signal protection scheme (SI) as described above, a degraded voltage without a safety injection signal protection scheme (non-SI) is used to monitor load center voltages. This scheme upon detection of load center degraded voltage initiates a signal to the sequencers which transfers power on the 480V safety-related load center buses from off-site power to on-site power sources. Each load center bus has two inverse time relays (one per channel) to protect against large transient voltage drops of short duration and two (one per channel) definite time-delay relays to protect for degraded voltage over long durations. These four protective relays for each load center are interconnected in a two out of two channel trip logic such that the logic trips if degraded voltage is detected by either Channel 1 inverse time or definite time delay relay concurrently with either Channel 2 inverse time or definite time delay relay. This relay logic circuitry is interlocked with "a" contacts of the 4 kV breaker feeding that load center and the 480 volt load center main (incoming) breaker (manually operated). The interlock with the 4.16 kV and 480V load center breakers disables this circuit when one or both of the applicable breakers are opened to take that load center out of service for maintenance. A sequencer logic interlock with a closed EDG breaker disables this inverse time and definite time-delay relay logic circuit once the EDG is connected to the 4.16 kV bus and the startup and auxiliary transformer breakers are open.

These 480V inverse time and definite time-delay undervoltage relays have a key-locked bypass switch. This switch has a set of contacts connected in parallel with each of the undervoltage relay logic channels. This switch will be used to place one undervoltage relay channel in the trip mode when one or both of the relays of that channel are taken out of service.

These relays initiate load shedding, EDG start and onsite power connection, and load sequencing in the same manner as the instantaneous undervoltage relays in Item 2 above.

All loads are stripped on bus undervoltage by relays 127X1 (five relays), X2 (five relays), X3, X4, X5, and X6.

Upon restoration of the emergency bus voltage by the EDG, the 127X1, X3 and X5 relays cited above are reset. 127X2, X4, and X6 relays remain actuated until offsite power source is returned to the bus via the startup transformer. Loads required to run in response to the LOOP are sequenced to their buses by the emergency bus loading sequencers. Certain plant investment loads, having been tripped previously by a 127X1, X3, or X5 relay, are capable of being manually loaded by the operator within the EDG loading capacity. Equipment which cannot be energized are those loads or supplies blocked or inhibited from starting by 127X2, X4, or X6 relay signals.

The receipt of an SIS during or after LOOP sequencing resets the emergency bus loading sequencers and will shed all loads from the EDGs. This is accomplished by reactuation of the 127X1 relays, restarting the sequencer in the LOCA/LOOP mode and sequentially loading equipment onto the EDG for mitigation of the MHA. Not tripping the EDG breaker for the subject scenario reduces the challenges to the breaker to successfully reclose.

Following SIS without LOOP, no loads are stripped by the sequencer from the safety related buses as long as offsite power is available. Voltage on the 4.16 kV buses will be maintained by transferring to the associated startup transformers.

The breaker and equipment descriptions provided below apply to emergency power (Trains A and B).

4.16 kV Feeder Breakers to EDGs

The automatic operation of these breakers is tied to the start-up and operation requirements of the EDGs, bus stripping and bus clearing relays and permissives. During EDG load testing, these breakers are manually closed after synchronizing with the bus. However, on an SIS with offsite power available, these breakers will automatically trip. Protection is provided via induction type relays with overcurrent elements.

4.16 kV Feeder Breakers to 480V Load Center Transformers

Each breaker is automatically tripped, under LOOP conditions, by the load sequencer, through the stripping logic relays, and each breaker is automatically closed by the load sequencer. Protection is provided via induction type relays with overcurrent and instantaneous elements.

Each breaker can be closed/tripped with controls at the switchgear or with a control switch in the Control Room. Position indication is provided in the Control Room and locally at the switchgear.

4.16 kV Feeder Breakers to Motors

Each breaker is automatically tripped under LOOP conditions, and the required breakers are automatically closed by the load sequencer. Protection is provided via induction type relays which have overcurrent, locked rotor, and instantaneous elements.

Each breaker can be closed/tripped with controls at the switchgear or with a control switch in the Control Room. Position indication is provided in the Control Room and locally at the switchgear.

4.16 kV Bus Tie Breakers

The breakers associated with the various bus crossties on the 4.16 kV switchgear are administratively controlled in the open position (with the exception of the swing switchgear [3D/4D] bus ties). Overload protection is provided via induction type relays with overcurrent elements.

The swing switchgear (3D/4D) is considered an extension of the switchgear supplying its power. As such, both the supply breakers in the A and B switchgear and the incoming breakers on the swing switchgear remain closed under loss of offsite power or loss of offsite power/LOCA conditions for the train to which the swing switchgear is aligned. However, the individual breakers of aligned equipment, e.g. CCW and ICW Pumps, are tripped.

Although the swing switchgear (3D/4D) is considered an extension of the switchgear supplying its power, it has separate controls. The 4.16 kV tie breaker control switches, a station blackout key-operated breaker control switch, a lockout relay reset pushbutton and indicating lights are installed in Vertical Panels 3C04 and 4C04 for 4.16 kV Swing Switchgear 3D and 4D, respectively. Annunciator alarms in the Control Room include inputs from 4.16 kV 3D/4D bus tie breakers overcurrent, isolation switches and 3D/4D lockout relays.

Each 4.16 kV swing switchgear (3D/4D) is provided with tie feeders to the 4.16 kV Buses A and B via two circuit breakers in series for each train. Thus, a swing bus has capability to receive power from either the A or B power train of its associated unit. The tie breakers for each switchgear are interlocked so that the 4.16 kV swing bus can be manually connected to only one source of power supply at any given time. The breakers can be closed/tripped by a local control switch or from the Control Room, and position indication is provided in Control Room. The 4.16 kV Switchgear 3D/4D are isolated for bus faults by a lockout circuit so that the supply breakers, feeder breakers, or station blackout tie breaker will trip and cannot be re-closed, unless the lockout relay has been reset.

The station blackout intertie is a cross connection between Turkey Point Units 3 and 4, 4.16 kV Switchgear 3D and 4D. Refer to Section 8.2.2.2 for additional details.

480V Bus Tie Breakers

The breakers associated with the bus ties on the 480V load centers are administratively controlled in the open position [with the exception of the swing load center (3H/4H) bus ties]. Overload protection is provided via direct acting/series or solid-state trip devices with long-term and short-time elements.

Load centers 3A/4A and 3B/4B, and load centers 3C/4C and 3D/4D are cross-tied and powered from either 4160 VAC switchgear 3A/4A or 3B/4B when one of the switchgears is taken out of service during a unit refueling outage. Appropriate electrical bus load reductions are implemented and other precautions are taken during this condition to ensure that onsite power sources can perform required safe shutdown functions. Appropriate evaluations have been performed to impose required restrictions during these periods (Reference 4).

Each 480V swing load center (3H/4H) is provided with tie feeders to 480V load centers (3C/4C, 3D/4D) via two circuit breakers in series for each train. The C and D load centers are associated with the A and B power trains. Thus, a swing load center has a capability of receiving power from either power train. The tie breakers are interlocked so that the 480V swing load center is connected to only one source of power at any given time. Each breaker is closed/tripped as a result of any of the following actions: (1) operation of a local control switch; (2) operation of the transfer switch in the Control Room; (3) automatic transfer action; or (4) overcurrent conditions. Position indication is provided in the main Control Room.

Operation of the tie breakers is controlled through the use of a three-position, spring return to "AUTO", control switch in the Control Room installed in Vertical Panels 3C04 and 4C04 to allow manual or auto transfer of supply power between the A and B trains. Indicating lights, which indicate the breaker status are installed for each of the feeder and supply breakers that tie Load Center 3H/4H to Load Centers 3C-3D/4C-4D, respectively. Alarms in the Control Room include 480V swing load center undervoltage/trouble.

Manual alignment of the load center to either train can be accomplished by manual manipulation of the switch to either the "C" or "D" position. Manipulation of the selector switch to the "C" position, will result in the tie breakers aligned with Load Center D receiving a trip signal and the tie breakers aligned with Load Center C receiving a close signal. Manipulation of the selector switch to the "D" position, will result in the tie breakers aligned with Load Center C receiving a trip signal and the tie breakers aligned with Load Center D receiving a close signal. Once a power source is selected, the tie breakers are subject to an automatic transfer scheme as follows:

> If the voltage on the primary supply bus is not present, the auto-transfer circuit checks the voltage on the alternate supply bus. If the voltage on the alternate supply bus is available, the auto-transfer action to the alternate supply bus is initiated. The auto-transfer action issues a signal to trip the tie breakers to the primary supply bus and, once the primary supply breaker is in an open position, issues a signal to close the tie breakers to the alternate supply bus. However during a LOOP scenario, the failure of Charging Pump C to strip from Load Center H may result in an EDG overload after load center transfer; therefore, transfer will be blocked if stripping did not occur. After normal EDG loading by the load sequencer, Load Center H can be manually loaded by the operator, if desired.

480V Load Center Supply Breakers

Each breaker can be closed/opened at the 480V Load Center. The breaker is maintained in the closed position. With the exception of the swing load centers (3H/4H - refer to discussion above), these non-automatic breakers are opened only for maintenance purposes.

480V Load Center Feeder Breakers to 480V MCCs

Each breaker can be closed/opened with controls located at the load center and can be opened manually. Protection is provided via direct acting/series or solid-state trip devices with long- and short-time elements.

480V Load Center Feeder Breakers to Motors

Each breaker is automatically tripped under LOOP conditions, and the required breakers are automatically closed by the load sequencer. Protection is provided via direct acting/series or solid-state trip devices with long-time and instantaneous elements.

Each breaker can be closed/tripped with controls at the load center or with a control switch in the Control Room. Position indication is provided in the Control Room and locally at the load center.

<u>480V MCC Supply Breakers</u>

Each breaker can be closed/opened at the 480V MCC. The breakers are non-automatic and maintained in a closed position, except for maintenance purposes.

<u>480V Motor Control Center Feeders</u>

The 480V MCC combination motor starters are provided with magnetic (instantaneous) trip breakers and thermal overload relays. Other feeders have thermal-magnetic trip breakers.

<u>125V DC Switchgear</u>

The 125V DC switchgear combination motor starters are provided with magnetic (instantaneous) trip breakers and thermal overload relays. Other feeders have thermal-magnetic trip breakers.

<u>Physical Layout of Electrical System</u>

The electrical system equipment is located in a manner to minimize vulnerability of vital circuits to physical damage as a result of any accident. Refer to the Fire Protection System NFPA 805 Design Basis (Reference 5) for more detail on protection of vital circuits. The main generator transformer, auxiliary transformer, startup transformer and C bus transformer are located outdoors, physically separated from each other and spaced to minimize their exposure to fire, water and mechanical damage. The Fire Protection System NFPA 805 Design Basis contains a description of the fire protection features in this area.

Lightning protection is provided for the plant electrical system. Refer to the Fire Protection System NFPA 805 Design Basis for a detailed description of lightning protection.

The 4.16 kV switchgear and 480V load centers are located in areas which minimize their exposure to mechanical fire and water damage. The 480V MCCs are located in close proximity to the equipment served.

Circuits to the containment pass through leak-proof penetration assemblies such as those shown in Figures 8.2-6 and 8.2-7. These penetrations have provisions for pressure testing. The two penetration enclosures for each containment are approximately 60 degrees apart, thus providing many feet of separation. One enclosure cares for the Train A circuits; the other handles the redundant Train B circuits. No more than two protection channels go through a given penetration enclosure. The two channels passing through a penetration enclosure are widely separated vertically and horizontally. Penetration canisters have about two feet of space between them in all directions, and those carrying 4.16 kV circuits form the top horizontal row.

Cables are run in overhead trays and conduits, and in underground ducts and conduits. The guidelines for raceway fill are as follows:

Trays (power and control)	-	40%	(All areas except Cable Spreading Room)
Trays (power and control)	-	60%	(Cable Spreading Room)
Conduit (one cable)	-	53%	
Conduit (two cables)	-	31%	
Conduit (three or more)	-	40% cables	

For higher raceway fill percentages, an evaluation would be prepared to address ampacity and seismic concerns.

Conductor insulation is crosslinked polyethylene, Kerite FR, Kerite HTK or ethylene-propylene rubber (EPR) for all cables within the containment. 4.16 kV cables within the scope of license renewal are lead sheathed. For use outside the containment, insulation is as follows:

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4.16 kV power	-	butyl rubber, HT Kerite, crosslinked polyethylene, or EPR
480V power	-	butyl rubber or crosslinked polyethylene
AC and DC control	-	high molecular weight polyethylene or crosslinked polyethylene
Shielded instrumentation	-	polyethylene, crosslinked polyethylene

C23

EPR, Kerite FR or Kerite HTK is acceptable for all of the above applications. PVC, neoprene, Kerite FR or HTK, chlorinated polyethylene, crosslinked polyethylene, hypalon, or non-halogen flame retardant thermoplastic jacketing is provided in the above cases. C26

Table 8.2-1 lists the maximum ampere loading used for the principal cable sizes; all conductors have been derated to suit ambient conditions.

Systems and Equipment Shared Between Units

Major equipment shared by both units includes:

COMPONENT	NUMBER AVAILABLE
High Head Safety Injection (HHSI) Pumps	4
Auxiliary Feedwater Pumps	3
Battery Chargers	8
125 V DC Batteries	4 Plus 1 Spare Battery
Control Room AC Units	3
Boric Acid Pumps	4
Miscellaneous HVAC	Plant Specific

Each HHSI pump is powered from its own 4.16 kV bus, which has a single EDG associated with it. Thus the single failure of an EDG does not result in the loss of more than one HHSI pump.

Each of the four 125V station batteries has two dedicated safety related battery chargers powered by separate power supplies. A spare battery is also provided which can be used as a substitute for any one of the existing station batteries during maintenance or testing.

The remaining shared safety related equipment is powered such that a single failure on a unit does not result in loss of the minimum required equipment. This is primarily accomplished by utilizing the swing load center and swing MCC provided on each unit. Even though the equipment is powered from a bus of a given unit, the equipment function can be shared between units.

Cathodic Protection

Cathodic protection is provided to make the iron negative with respect to the soil and thus prevent galvanic corrosion caused by dissimilar metals in an electrolyte, from stray currents, or from a moist environment.

The metallic portion of the containment to be protected includes the liner, the reinforcing bars and the tendon assemblies. These have been made electrically continuous by welding and are connected to the negative potential of the cathodic protection rectifier (one per unit). The rectifier positive output potential is connected to the anode strings located on a deep bed backfilled with coke breeze (calcined fluid petroleum coke) to lower the ground to anode resistance. The well bed originates in the equipment hatch ramp area and is directed at a 45 degree angle for approximately 310 ft. (Unit 3) beneath the containment. The entrance to the well bed is protected by a man-hole designed for heavy roadway loads. The anode strings are approximately 240 ft. long and are centered on the containment axis.

The rectifier and anodes are capable of a maximum output of 100 amps. The anode assemblies consist of mixed metal oxide elements arranged in the coke breeze bed with provisions for replacement should premature failure occur. A reference electrode has been positioned in the well bed approximately at the containment center. Additional reference electrode test locations are positioned in the containment tendon inspection gallery for measuring the potential gradient.

C26

The component cooling water heat exchangers are provided with cathodic protection by means of sacrificial anodes located in the heat exchanger inlet and outlet channel heads.

The turbine plant cooling water heat exchangers are provided with cathodic protection by means of sacrificial anodes located in the heat exchanger inlet C26 and outlet channel heads.

8.2.2.1.1.3 DESIGN CRITERIA FOR CLASS 1E EQUIPMENT ADDED DURING THE 1990-1991 DUAL UNIT OUTAGE

Mechanical System Design

1. EDG 4A and 4B Auxiliary Systems

   Refer to Section 9.15

2. EDG Building Ventilation System

The ventilation associated with the EDG control panel rooms and 3D/4D 4.16 kV switchgear rooms is designated safety related and meets seismic Category I requirements.

The design of these systems meets the following performance requirements:

a. Each EDG control panel room is equipped with a dedicated ventilation system with the ability to be powered by its associated EDG, a single active failure resulting in loss of one ventilation system will not affect the performance capability of more than one EDG. For each 4.16 kV switchgear room, a dedicated ventilation system consisting of 100 % redundant fans (i.e., one fan connected to an A Train power source and the other connected to a B Train power source), is provided. Therefore, a single active failure will not result in the loss of both fans to either switchgear room.

b. Failure of non-seismic Category I equipment or components will not result in damage to essential portions of the ventilation system.

c. The ventilation system is designed to maintain a suitable ambient temperature range in the areas serviced.

d. The ability of the safety related equipment to function under the worst anticipated degraded ventilation system performance is assured.

e. The capability of the system to automatically actuate components not operating during normal conditions, or to actuate standby components (redundant equipment) in the event of a failure or malfunction, as needed, is provided.

f. The capability of the system to control airborne particulate material (dust) accumulation is provided.

g. Functional capability of the ventilation system will not be adversely affected during periods of abnormally high water levels (i.e., maximum probable flood).

h. Ventilation system components have sufficient physical separation or shielding to protect the system from internally or externally generated missiles.

i. The system components are protected from the effects of pipe cracks and breaks in piping since there are no high- or moderate-energy lines in the Unit 4 EDG Building.

Electrical/Control System Design

Under the EPS Enhancement Project during the 1990-1991 Dual Unit Outage, EDGs 4A and 4B and associated electrical equipment were installed and integrated into the existing Turkey Point EPS. The electrical modifications required to implement the EPS enhancements took place throughout existing plant areas and inside the Unit 4 EDG Building.

Outside the Unit 4 EDG Building, electrical design, as a minimum, meets the original Turkey Point design criteria, or the latest standards wherever practical. This approach to the application of electrical design standards was considered acceptable and appropriate for the following reasons:

1. From a human factors standpoint, it is important to maintain a consistent design approach inside the existing plant. The application of latest standards for electrical design outside the Unit 4 EDG Building would introduce physical configuration differences with the surrounding systems and components. The application of FSAR criteria ensured that a consistent design approach was maintained throughout the existing plant.

2. Since most of the existing EPS was unchanged by the EPS enhancement modifications, considering the capability of the EPS as a whole, an appreciable increase in safety would not have be achieved through the application of latest standards outside the Unit 4 EDG Building.

The electrical design inside the Unit 4 EDG Building complies with the latest standards as specified below. The use of these standards in conjunction with the original criteria ensures that the capability of the enhanced Emergency Power System to comply with the original Turkey Point General Design Criteria, as specified in the FSAR, continues to remain valid.

1. Protection Against Natural Phenomena

   The 4A and 4B EDGs and safety related power distribution system components are located in seismic Category I structures which provide protection from the effects of earthquakes, tornadoes, hurricanes and floods. Refer to Section 5.3.4 and Appendices 5A, 5E, 5F, and 5G for additional details.

2. Environment and Missiles

   Refer to Appendices 5E, 5F and 5G.

3. Sharing of Power Systems

   Refer to Appendix A.

4. Independence Between Redundant Load Groups

   For electrical design in the Unit 4 EDG Building, the enhanced EPS complies with the requirements of Regulatory Guide 1.6 for independence between redundant load groups (i.e., AC trains).

5. Design of EDG Units

   a. For the selection, design and qualification of EDGs 4A and 4B, refer to Section 8.2.2.1.1.1.

   b. Physical independence of the new EDGs, equipment and circuits within the Unit 4 EDG Building is discussed in Item 7 below.

6. Bypassed and Inoperable Status Indication

Turkey Point Units 3 and 4 does not employ a Bypassed and Inoperable Status Indication System.

7. Physical Independence

Physical independence of the 4A and 4B EDGs, equipment and circuits within the Unit 4 EDG Building complies with the requirements of Regulatory Guide (RG) 1.75 and IEEE 384-1981 except as follows:

a. Non-Class 1E circuits which are associated with Class 1E circuits via electrical connection to a Class 1E power supply without the use of an RG/IEEE isolation device, and/or proximity to Class 1E circuits and equipment without the required physical separation or barriers, comply with the requirements of associated circuits except as follows:

   1) Identification

      Associated circuits are not uniquely identified as such.

   2) Qualification Requirements

      Connected non-Class 1E circuits comply with the requirements placed on Class 1E circuits such as derating, environmental qualification (mild environment), flame retardance, splicing restrictions and raceway fill, except that connected non-Class 1E loads are seismically supported, not seismically qualified.

      Miscellaneous 120V AC circuits (i.e., lighting and receptacles) which are routed in independent conduit systems and located within Class 1E enclosures meet the flame retardance requirements of UL 83 in lieu of IEEE 383.

b. Dry contacts of relays and control switches are considered isolation devices for instrumentation and control circuits. In the enclosure where these relays and switches are located, the wiring associated with the contacts are routed in the same wireways as the wiring associated with the redundant or non-Class 1E circuits. Once the cables exit the enclosure, control circuits to redundant equipment are routed in separate raceways per current plant criteria, ensuring that any physical damage affecting one circuit will not affect the redundant circuit.

c. Identification of Class 1E Cable - IEEE 384 requires that cables installed in exposed Class 1E raceways be marked at intervals of approximately five feet to facilitate initial verification that the installation is in conformance with the separation criteria. In accordance with Turkey Point criteria, this marking is not provided.

d. For Class 1E control panels, boards and racks, IEEE Standard 420-1982 requires that non-Class 1E equipment and circuits located within the same control panel be separated consistent with the criteria of IEEE 384. For the EPS Enhancement Project, the exceptions to the separation criteria of IEEE 384 as noted above apply.

8. Application of Single Failure Criteria

Single failure criteria as specified in Regulatory Guide 1.53 were applied to the modifications implemented under the EPS Enhancement Project.

8.2.2.1.1.4 TEST AND INSPECTIONS

The tests specified are designed to demonstrate that the EDGs will provide adequate power for operation of equipment. They also assure that the EDG control systems for safeguard equipment will function automatically in the event of a loss of normal 4.16 kV offsite power.

Frequent tests will be made to identify and correct any mechanical or electrical deficiency before it can result in a system failure. The control components are in enclosures having space heaters for humidity control. The fuel supply and starting circuits and controls are continuously monitored and any faults are annunciated. An abnormal condition in these systems will be signaled without having to place the affected EDG on test.

To verify that the emergency power system will properly respond within the required time limit when required, the following tests are performed.

1. The ability of the EDGs to start, synchronize and deliver power within a specified load band when operating in parallel with other power sources is demonstrated on a frequency of at least every 31 days in accordance with the plant's Technical Specifications. At least once every 184 days, the ability of the EDGs to start, synchronize and deliver power within a specified load band within a specified time limit when operating in parallel with other power sources is demonstrated in accordance with the plant's Technical Specifications. Normal unit operation will not be affected.

2. The readiness of the EDG system and the control systems of vital equipment to automatically start, or restore to operation, the vital equipment by initiating various combinations of an actual loss of all normal station AC service power and simulated SIS actuations is demonstrated on an interval specified in the Surveillance Frequency Control Program. This testing can also be performed while the other unit remains in operation and on offsite power. This test will be conducted during each refueling outage of the respective unit. C28

3. Demonstration of the automatic sequencing equipment during normal unit operation. This test exercises the control and indication devices, and may be performed any time, the sequencing equipment being redundant to normal operations. If there is a SIS while the test is underway, it takes precedence and immediately cancels the test. The equipment then responds to the SIS in the manner previously described.

The Emergency Power System design provides for taking one train of a shutdown unit out-of-service (OOS) without impacting the opposite unit. The non-shutdown unit will have sufficient equipment available for both normal operation and accident mitigation while one train on the shutdown unit is out-of-service for testing, maintenance or inspections.

The pre-operational testing performed during the 1990-1991 Dual Unit Outage, plus the integrated acceptance testing outlined in FPL letter L-90-196 meets the recommendations of Regulatory Guide 1.108 (Rev. 1, August 1977). The onsite testing program also meets the recommendations of Regulatory Guide 1.41 (Rev. 0, March 1973), as it applies to the AC portion of the electric power distribution system. Regulatory Guide 1.41 states in part:

> "... after major modifications ... to a facility, those on-site electric power systems designed in accordance with Regulatory Guides 1.6 and 1.32 (Safety Guides 6 and 32) should be tested as follows to verify the existence of independence among redundant on-site power sources and their load groups."

In accordance with Regulatory Guide 1.41, Positions C.1 through C.3, the following tests were performed:

1. The plant electric power distribution system, not necessarily including the switchyard and the startup and auxiliary transformer, is isolated from the offsite transmission network. This isolation is effected by direct actuation of the undervoltage-sensing relays within the onsite system.

2. Under the conditions above, the onsite AC electric power system was functionally tested in the various possible combinations of one power source and load group (i.e., train) available at a time with all the remaining onsite AC power sources for three load groups (i.e., trains) at a time completely disconnected. Each test includes injection of simulated accident signals, startup of the onsite power source(s) and load group(s) under test, sequencing of loads, and the functional performance of the loads. Each test is of sufficient duration to achieve stable operating conditions and thus permit the onset and detection of adverse conditions which could result from improper assignment of loads.

3. During each test, the onsite AC buses and related loads under test are monitored to verify proper operation. The above testing demonstrates conformance to Regulatory Guide 1.41 as it applies to the enhanced Emergency Power System configuration.

The testing performed during the 1990-1991 Dual Unit Outage, as described in FPL letter L-90-196, demonstrated that the onsite electrical distribution systems adequately support the necessary systems during a simulated emergency condition.

8.2.2.1.2 ANALYSIS

8.2.2.1.2.1 GENERAL DESIGN CRITERIA (GDC) AS DEFINED IN 10 CFR 50 APPENDIX A

GDC 2 - Design Basis for Protection Against Natural Phenomena

The Unit 4 EDG Building, described in Section 5.3.4, is designed and constructed as a seismic Category I structure and is designed to withstand design basis natural phenomena including earthquake (Maximum Hypothetical Earthquake of 0.15g), wind, tornado (including tornado-generated missiles) and flooding. The latest criteria, including the applicable Regulatory Guides which address natural phenomena (e.g., Regulatory Guide 1.76), were used in the design of this structure. The equipment housed in this structure thus meets the 10 CFR 50 Appendix A GDC 2. Refer to Section 5.3.4 and Appendices 5A, 5E, 5F and 5G.

GDC 4 - Environmental and Dynamic Effects Design Basis

The Unit 4 EDGs and associated equipment is appropriately specified and designed to accommodate the effects of and be compatible with the environmental conditions associated with normal operation, maintenance and testing. The equipment in the Unit 4 EDG Building is in a mild environment, and is not subject to a design basis accident harsh environment as currently defined in 10 CFR 50.49. Associated equipment located in the Auxiliary Building is designed as a minimum to meet the environmental conditions specified for the existing equipment located in the same locations.

The equipment installed in the Unit 4 EDG Building is not subject to high energy pipe break effects (i.e. dynamic effects, missiles, pipe whip or jet impingement) or to moderate energy pipe cracks. Any associated equipment located in the Auxiliary Building is evaluated against the existing pipe break criteria presented Section 5.4. In addition, the location of Unit 4 EDG equipment considered the pipe break criteria presented in NUREG-0800, Appendix B to Branch Technical Position ASB 3-1.

GDC 5 - Sharing of Structures, Systems, and Components

Shared systems at Turkey Point Units 3 and 4 are discussed in Appendix A. Consistent with GDC 5, such sharing does not significantly impair their ability to perform their safety functions including (in the event of an accident in one unit) an orderly shutdown and cooldown of the other unit.

GDC 17 - Electric Power Systems

Turkey Point's design of the electric power distribution system for engineered safety features equipment is in accordance with the 1967 Proposed GDC 39 and GDC 17, as stated in Section 8.1. C23

GDC 18 - Inspection and Testing of Electric Power Systems

The design of the electric power distribution system at Turkey Point does permit appropriate periodic inspection and testing of important areas and features. The testing and inspection of the electric power distribution system is governed the surveillance requirements of Section 3/4.8 of the Turkey Point Technical Specifications. These surveillance requirements are based on the draft Revision 5 of the Standard Technical Specifications for Westinghouse Pressurized Water Reactor, NUREG 0452.

8.2.2.1.2.2 REGULATORY GUIDE IMPLEMENTATION

The design, installation, testing and operation of the electrical equipment added during the 1990-1991 Dual Unit Outage conforms to the current NRC guidance contained in the applicable regulatory guides (RGs) listed below. As indicated, these regulatory guides, in turn, endorse (generally with some qualification) the industry standards noted. Some of the regulatory guides listed do not pertain, primarily, to testing requirements but are listed for completeness. Also refer to the FPL responses to the NRC's January 1989 Request for Additional Information (FPL letters L-90-196).

Regulatory Guide 1.6

"Independence Between Standby (Onsite) Power Sources and Between Their Distribution Systems", Revision 0, dated March 1971. For electrical design in the Unit 4 EDG Building, the enhanced Emergency Power System complies with the requirements of this regulatory guide for independence between redundant load groups (i.e., AC trains). Testing of the AC electric power distribution system was performed during the 1990-1991 Dual Unit Outage to assure compliance with Section D.1 of this regulatory guide.

Regulatory Guide 1.9

"Selection, Design, and Qualification of Diesel Generator Units Used as Standby (Onsite) Electric Power Systems at Nuclear Power Plants", Revision 2, dated December 1979. This regulatory guide provides the NRC position on EDG capacity pursuant to GDC 17, and on testing pursuant to 10 CFR 50 Appendix B. The regulatory guide endorses (with comment) IEEE Standard 387-1977. The selection, design and qualification of EDGs 4A and 4B and their associated auxiliary systems comply with the requirements of this regulatory guide with certain exceptions. Details of these exceptions are provided in FPL letter L-90-196.

Regulatory Guide 1.41

"Preoperational Testing of Redundant On-Site Electric Power Systems to Verify Proper Load-Group Assignments", Revision 0, dated March 1973. This regulatory guides provides the NRC position on testing of onsite emergency power systems which have been designed to Regulatory Guides 1.6 and 1.9, to meet GDC 1 and 10 CFR 50 Appendix B. Regulatory guide 1.41 clarifies a portion of IEEE Standard 308-1971. The AC portions of the Turkey Point Emergency Power System were tested in accordance with positions C.1 through C.3 of Regulatory Guide 1.41 as described in Section 8.2.2.1.1.4.

Regulatory Guide 1.75

"Physical Independence of Electric Systems," Revision 2, dated September 1978. Physical independence of the 4A and 4B EDGs, equipment and circuits within the

Unit 4 EDG Building complies with the requirements of this regulatory guide and IEEE 384-1981, except as discussed in Section 8.2.2.1.1.3, Electrical/ Control System Design, Item 7 (Physical Independence).

Regulatory Guide 1.108

"Periodic Testing of Diesel Generator Units Used as Onsite Electric Power Systems at Nuclear Power Plants", Revision 1, dated August 1977 (including Errata published September 1977). This regulatory guide provides the NRC position for complying with GDCs 17 and 18 of 10 CFR 50 Appendix A, and with the testing provisions of 10 CFR 50 Appendix B. It encompasses preoperational and periodic testing of EDG electric power units to ensure they will meet their availability requirements. Following the modifications of the EPS Enhancement Project, pre-operational testing and integrated acceptance testing was performed in accordance with the recommendations of this regulatory guide. Periodic testing is conducted in accordance with the Surveillance Frequency Control Program. C28

Regulatory Guide 1.137

"Fuel Oil Systems for Standby Diesel Generators", Revision 1, dated October 1979. This regulatory guide provides the NRC position for complying with GDC 17 and 10 CFR 50 Appendix B, and endorses, with comment, ANSI N195-1976 regarding fuel oil systems for standby EDGs and assurance of adequate fuel oil quality. Fuel oil quality is assured at Turkey Point by administrative procedures which follow ANSI N195, and the quality of fuel oil is tested in accordance with the diesel fuel oil testing program described in the Technical Specifications.

8.2.2.1.2.3 INDEPENDENCE OF REDUNDANT SYSTEMS

Refer to the discussions above on implementation of Regulatory Guides 1.6 and 1.75.

8.2.2.2 STATION BLACKOUT (SBO)

This section describes the design of the station blackout crosstie utilized at Turkey Point to effect resolution of the Station Blackout Rule of 10 CFR 50.63.

Methodologies acceptable to NRC to achieve compliance with the SBO Rule are provided in NUMARC 87-00 and NRC Regulatory Guide 1.155. In accordance with these guidelines, Turkey Point's design satisfies the SBO Rule by providing for a unit crosstie at the 4.16 kV level. Specifically, resolution of the station blackout issue for the Turkey Point nuclear units is by use of an alternate safety related, Class 1E, seismic Class/Category I, power source with the ability to align the source to the station blackout unit within 10 minutes of confirmation of a station blackout condition.

The ability to align the source to the station blackout unit in 10 minutes is provided by a crosstie which allows the 4.16 kV switchgear "D" of each unit to be connected together. The crosstie is sized to carry 500 amperes which is the continuous Unit 4 EDGs' rated capacity. The 4.16 kV system has the capability via the crosstie and the swing switchgear to connect any EDG with either the "A" or "B" switchgear of the opposite unit. The design provides the capability to perform this function from within the Control Room.

Each EDG is sized to maintain both units in Hot Standby for the postulated station blackout scenario. Tables 8.2-5a and 8.2-5b demonstrate that all of the auto-connect loads and required manual loads associated with an EDG and its respective unit for a loss of offsite power condition, plus the additional loads required on the opposite unit, can be supplied by any one EDG. Thus manual connection of the station blackout crosstie, during station blackout conditions, provides an adequate power supply for both units to maintain Hot Standby conditions.

The station blackout tie breaker controls are provided in the Control Room on Vertical Panels 3C04 and 4C04. The control circuitry includes interlocks and key-operated switches to prevent inadvertent closure of the station blackout crosstie. In order to establish the station blackout intertie, the following permissive conditions must be satisfied:

1. Loss of Offsite Power (to either one or both units)
    a. Start-up transformer breakers must be open on unit(s) with loss of offsite power conditions.
    b. Auxiliary transformer breakers must be open.
2. Loss of both EDGs associated with one unit (i.e. a unit blackout)
    a. The EDG breakers associated with the blackout unit must be open with the swing 4.16 kV switchgear aligned to either the "A" or "B" 4.16 kV switchgear of the blackout unit.
3. 4.16 kV Cleared Bus Permissives
    a. The 4.16 kV switchgear D and the bus to which it is aligned (the A or B switchgear) must be stripped of all connected loads.

With these permissives satisfied, the blackout intertie breaker associated with the blackout unit, either 3AD07 or 4AD07, can then be manually closed by the operation of its key-operated control switch. Closure of the breaker associated with the blackout unit will then enable the opposite blackout intertie breaker (the breaker associated with the non-blackout unit) to be closed. The design provides for the connection of this crosstie within ten minutes of confirmation of the existence of the blackout condition, in accordance with the SBO Rule. After the establishment of the crosstie, the loads required to maintain Hot Standby conditions in the blackout unit will be manually loaded in accordance with plant procedures.

AC power will be available to the blackout unit within 10 minutes. Seal cooling can be restored following the procedure used to prevent thermal shock from the introduction of cool water into the seal components which involves ensuring that CVCS return temperature has decreased to less than 235°F after restoring cooling water to the thermal barrier. If cooling flow is not restored within one hour, total flow rates in excess of 34 gpm per pump consisting of 4 gpm steam or 30 gpm water past the upper stage, and 4.3 gpm controlled bleed off flow into the seal return line per pump could develop until the abeyance seal is activated. After the abeyance seal is activated, leakage is limited to flow out the CVCS seal return line which is approximately 4.3 gpm per pump or less than 15 gpm total.

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NUMARC 87-00 states that RCS leakage under such conditions could reach 25 gpm per pump, however subsequent analysis documented in Westinghouse Nuclear Safety Advisory Letter NSAL-14-1 dated February 10, 2014 updates the flow value due to analysis results showing leakage as high as 32 gpm could develop during the coping time. In the NSAL-14-1, it is concluded that calculated increase in seal leak rate conditions during the coping time would not create a substantial safety hazard for Station Blackout scenarios because the overall coping time is not impacted. Analysis has shown that the blackout unit can remain at Hot Standby conditions for eight hours with a 100 gpm leak without challenging core cooling or containment integrity.

C28

8.2.2.3 DC POWER SYSTEMS

8.2.2.3.1 BATTERIES AND BATTERY CHARGERS

Emergency power for vital instrumentation and controls is supplied by a station DC power system which contains five safety related 125V batteries and four DC distribution panels. Two battery banks are associated with each unit, one 1800 Ampere-Hour (AH) and one 1200 AH, and a spare 1945 AH battery bank (all ratings are for 8 hours at 77°F) which can be substituted, to allow for testing or maintenance, for any of the other four battery banks. Each 1800 AH battery bank has two safety related full capacity 400 ampere solidstate battery chargers associated with it, while each 1200 AH has two safety related full capacity 300 ampere solidstate battery chargers associated with it. The spare battery bank is normally isolated from the vital DC buses and maintained in a fully charged condition by a non-safety related battery charger.

Each battery has been sized to support operation of its required loads for two hours without terminal voltage falling below its minimum required value. The capability of the safety related batteries to provide required power is demonstrated by the performance of service and performance tests in accordance with the plant's Technical Specifications. The service testing time of 30 minutes is conservatively based on the time required to manually load a charger during a station blackout event. The emergency DC electrical loading for each of the four safety related station batteries (not including the spare battery) is delineated in Tables 8.2-4a (3A and 3B) and 8.2-4b (4A and 4B).

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The safety related battery chargers have been sized to meet the requirements of Position C.1.b of Regulatory Guide 1.32, i.e., the supply is based on the largest combined demands of the various steady-state loads and the charging capacity to restore the battery from the design minimum charge state to the fully charged state, irrespective of the status of the plant during which these demands occur. They also are sized to recharge a partially discharged battery within 24 hours while carrying the battery's normal load.

One of the two safety related battery chargers associated with each battery is powered by a vital MCC of the same train and unit of its associated battery. The second safety related battery charger for each battery is powered by the vital swing MCC of the opposite unit. The stability of the battery charger output is not load dependent, but is self-regulating over the working range from no load to full load.

The Technical Specifications require the performance of a battery service test at least once every 18 months and a battery performance test at least once every 60 months. In order to provide additional assurance for reliable and continuous operation of the reactors, it is desirable to keep the affected DC bus energized and connected to an equivalent battery during the testing of the station batteries. The spare station battery is an equivalent source for any of the four station batteries during maintenance or testing, and allows continuous operation of the units without entering into a Limiting Condition for Operation while performing these functions. The spare battery charger is non-safety related and is used to keep the spare battery charged when not in use. The spare battery charger is also used to recharge a battery following testing or maintenance prior to its return to service. The charger is fed from a non-vital MCC and is not used to feed plant loads.

All circuits related to engineered safeguards, such as automatic sequence equipment, loss of voltage logic, and containment isolation logic, have redundant circuits fed from separate DC buses. Also, as shown in Figures 8.2-4a through 8.2-4f, there are dual feeds to each 4.16 kV safety related switchgear. No credible single failure in any portion of the DC system can adversely affect the starting and loading of more than one EDG.

To protect the DC system against gross overvoltages from the battery chargers, an overvoltage relay is connected internally, across the output terminals of each charger. Actuation of this relay will trip the charger off the line and provide an alarm.

Two non-safety related switchyard batteries, each with two associated battery chargers, are provided for DC control power in the switchyard. Switchyard Gas Circuit Breaker (GCB) control and primary relaying with associated trip coils, are supplied from switchyard Battery No. 1. This load can be transferred to fossil Units 1 and 2 station battery, if necessary, through a normally open tie breaker and interconnecting cable. Switchyard Battery No. 2 supplies the backup relaying and secondary trip coil on each GCB.

The switchyard batteries have no effect on plant equipment, load shedding or EDG operation.

Each unit also has a non-safety related DC bus, battery and battery charger. This non-vital bus supplies power to the non-safety related 4.16 kV C Bus, non-safety related 480V switchgear, non-safety related 120V AC inverter, C Bus transformer relay panels, and the turbine emergency oil pumps. A spare non-safety related charger is capable of being tied to the non-safety related DC bus of either unit.

8.2.3 REFERENCES

1. NRC Supplemental Safety Evaluation of the Emergency Power System Enhancement Project dated October 1, 1991.

2. Engineering Evaluation JPN-PTN-SEIP-91-012, Revision 0, "Engineering Evaluation of Electromagnetic Interference (EMI) Testing for the Sequencers," dated February 20, 1992.

3. NRC Letter from Richard Croteau to J. H. Goldberg Dated May 20, 1994, TURKEY POINT UNITS 3 & 4 -ISSUANCE OF AMENDMENTS RE: ELIMINATION OF CRANKING DIESEL GENERATORS (TAC NOS. M87662 AND M87663).

4. Safety Evaluations JPN-PTN-SEEJ-89-085 (Unit 3) and JPN-PTN-SEEJ-88-042 (Unit 4), "De-Energization of Unit 3 (4) 4160 Volt Safety Related Busses".

5. 5610-016-DB-001, Fire Protection System NFPA 805 Design Basis C28

TABLE 8.2-1

POWER CABLE AMPACITIES*

Power cable ampacities are based on a maximum conductor temperature of 85°C. Nominal loadings and derating factors for the various conditions of service do not exceed those recommended in the IPCEA Handbook.

5 & 8 KV CABLES

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Outside Containment:	1/C butyl rubber, crosslinked polyethylene, EPR or HT Kerite insulation, lead sheath (or copper tape shielded) with PVC neoprene, chlorinated polyethylene, hypalon or non-halogen flame retardant thermoplastic jacket.
Inside Containment:	1/C, cross-linked polyethylene or EPR insulation with PVC, hypalon or chlorinated polyethylene jacket.

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	Ampacity			
	IPCEA	Maximum Loading		
Conductor Size	1 Cable in Air	U. G. Duct	Exposed Conduit	Tray With Maint. Spacing
1500 MCM	1286	- - - -	- - - -	1050 A 82%
1250 MCM	1157	485 A 42%	540 A 47%	- - - -
750 MCM	850	350 A 42%	475 A 56%	- - - -
350 MCM	525	210 A 40%	350 A 67%	- - - -
#4/0 AWG	382	165 A 43%	225 A 59%	- - - -

600 V CABLES

Outside Containment:	1/C butyl rubber, crosslinked polyethylene or EPR insulation, PVC, neoprene, hypalon or Kerite FR or HTK, or chlorinated polyethylene jacket.
Inside Containment:	1/C cross-linked polyethylene or EPR insulation with PVC, Kerite FR or HTK, hypalon or chlorinated polyethylene jacket.

	Ampacity			
	IPCEA	Maximum Loading		
Conductor Size	1 Cable in Air	U. G. Duct	Exposed Conduit	Tray With Maint. Spacing
750 MCM	858	325 A 38%	- N/A -	600 A 70% (Single Application)
500 MCM	664	265 A 40%	- N/A -	270 A 41%
350 MCM	528	195 A 37%	- N/A -	- - - -
#4/0 AWG	383	185 A 48%	- N/A -	- - - -

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* The ampacities shown in this table are not applicable to the cables added as part of the EPS Enhancement Project. The ampacities utilized in the EPS Enhancement Project were based on a maximum conductor temperature of 90°C, and are in accordance with the calculations performed for that effort.

FINAL SAFETY ANALYSIS REPORT

TABLE 8.2-2a

REFER TO ENGINEERING DRAWING

5613-E-6 SHEET 1

C23

08/21/2007

FLORIDA POWER AND LIGHT COMPANY
TURKEY POINT PLANT UNIT 3

EDG 3A LOAD LIST

TABLE 8.2-2a

FINAL SAFETY ANALYSIS REPORT

TABLE 8.2-2b

REFER TO ENGINEERING DRAWING

5613-E-6 SHEET 2

C23

08/21/2007

FLORIDA POWER AND LIGHT COMPANY
TURKEY POINT PLANT UNIT 3

EDG 3B LOAD LIST

TABLE 8.2-2b

FINAL SAFETY ANALYSIS REPORT

TABLE 8.2-2c

REFER TO ENGINEERING DRAWING

5614-E-6 SHEET 1

C23

08/21/2007

FLORIDA POWER AND LIGHT COMPANY
TURKEY POINT PLANT UNIT 4

EDG 4A LOAD LIST

TABLE 8.2-2c

FINAL SAFETY ANALYSIS REPORT

TABLE 8.2-2d

REFER TO ENGINEERING DRAWING

5614-E-6 SHEET 2

C23

08/21/2007

FLORIDA POWER AND LIGHT COMPANY
TURKEY POINT PLANT UNIT 4

EDG 4B LOAD LIST

TABLE 8.2-2d

FINAL SAFETY ANALYSIS REPORT

TABLE 8.2-3

REFER TO ENGINEERING DRAWING

5613-E-6 SHEET 1 AND 2
and
5614-E-6 SHEET 1 AND 2

C23

08/21/2007

FLORIDA POWER AND LIGHT COMPANY
TURKEY POINT PLANT UNIT 3 AND 4

AUTOMATIC LOADING SEQUENCE
OF DIESEL GENERATOR

TABLE 8.2-3

FINAL SAFETY ANALYSIS REPORT

TABLE 8.2-4a

REFER TO ENGINEERING DRAWING

5613-E-1605

C23

08/21/2007

FLORIDA POWER AND LIGHT COMPANY
TURKEY POINT PLANT UNIT 3

BATTERY 3A AND 3B
LOAD PROFILES

TABLE 8.2-4a

FINAL SAFETY ANALYSIS REPORT

TABLE 8.2-4b

REFER TO ENGINEERING DRAWING

5614-E-1605

C23

08/21/2007

FLORIDA POWER AND LIGHT COMPANY
TURKEY POINT PLANT UNIT 4

BATTERY 4A AND 4B
LOAD PROFILES

TABLE 8.2-4b

FINAL SAFETY ANALYSIS REPORT

TABLE 8.2-5a

REFER TO ENGINEERING DRAWING

5613-E-1712
and
5613-E-1713

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08/21/2007

FLORIDA POWER AND LIGHT COMPANY
TURKEY POINT PLANT UNIT 3

3A AND 3B EDG LOAD LIST
STATION BLACKOUT

TABLE 8.2-5a

FINAL SAFETY ANALYSIS REPORT

TABLE 8.2-5b

REFER TO ENGINEERING DRAWING

5614-E-1712
and
5614-E-1713

C23

08/21/2007

FLORIDA POWER AND LIGHT COMPANY
TURKEY POINT PLANT UNIT 4

4A AND 4B EDG LOAD LIST
STATION BLACKOUT

TABLE 8.2-5b

FIGURE 8.2-1 (DELETED)

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FINAL SAFETY ANALYSIS REPORT

FIGURE 8.2-2

REFER TO ENGINEERING DRAWING

5610-T-E-1591 , SHEET 1

REV. 13 (10/96)

FLORIDA POWER & LIGHT COMPANY
TURKEY POINT PLANT UNITS 3 & 4

MAIN AC DISTRIBUTION SYSTEM
ONE LINE DIAGRAM

FIGURE 8.2-2

FIGURE 8.2-3 (DELETED)

FINAL SAFETY ANALYSIS REPORT

FIGURE 8.2-4a

REFER TO ENGINEERING DRAWING

5613-E-11 , SHEET 1

REV. 15 (4/98)

FLORIDA POWER & LIGHT COMPANY
TURKEY POINT PLANT UNIT 3

ELECTRICAL 125V DC AND
120V INSTRUMENT AC
ONE LINE DIAGRAM - SHEET 1
FIGURE 8.2-4a

FINAL SAFETY ANALYSIS REPORT

FIGURE 8.2-4b

REFER TO ENGINEERING DRAWING

5613-E-11 , SHEET 2

REV. 13 (10/96)

FLORIDA POWER & LIGHT COMPANY
TURKEY POINT PLANT UNIT 3

ELECTRICAL 125V DC AND
120V INSTRUMENT AC
ONE LINE DIAGRAM - SHEET 2
FIGURE 8.2-4b

FINAL SAFETY ANALYSIS REPORT

FIGURE 8.2-4c

REFER TO ENGINEERING DRAWING

5613-E-12

REV. 13 (10/96)

FLORIDA POWER & LIGHT COMPANY
TURKEY POINT PLANT UNIT 3

ELECTRICAL 125V DC AND
120V INSTRUMENT AC
ONE LINE DIAGRAM - SHEET 3
FIGURE 8.2-4c

FINAL SAFETY ANALYSIS REPORT

FIGURE 8.2-4d

REFER TO ENGINEERING DRAWING

5614-E-11, SHEET 1

REV. 13 (10/96)

FLORIDA POWER & LIGHT COMPANY
TURKEY POINT PLANT UNIT 4

ELECTRICAL 125V DC AND
120V INSTRUMENT AC
ONE LINE DIAGRAM - SHEET 1
FIGURE 8.2-4d

FINAL SAFETY ANALYSIS REPORT

FIGURE 8.2-4e

REFER TO ENGINEERING DRAWING

5614-E-11 , SHEET 2

REV. 13 (10/96)

FLORIDA POWER & LIGHT COMPANY
TURKEY POINT PLANT UNIT 4

ELECTRICAL 125V DC AND
120V INSTRUMENT AC
ONE LINE DIAGRAM - SHEET 2
FIGURE 8.2-4e

FINAL SAFETY ANALYSIS REPORT

FIGURE 8.2-4f

REFER TO ENGINEERING DRAWING

5614-E-12

REV. 13 (10/96)

FLORIDA POWER & LIGHT COMPANY
TURKEY POINT PLANT UNIT 4

ELECTRICAL 125V DC AND
120V INSTRUMENT AC
ONE LINE DIAGRAM - SHEET 3
FIGURE 8.2-4f

FIGURE 8.2-5 (DELETED)

SWITCHYARD AC AND DC
DISTRIBUTION

FINAL SAFETY ANALYSIS REPORT

FIGURE 8.2-6

REFER TO ENGINEERING DRAWING

5610-E-54-1, SHEET 1

REV. 13 (10/96)

FLORIDA POWER & LIGHT COMPANY
TURKEY POINT PLANT UNITS 3 & 4

COMPOSITE DWG. OF CONTAINMENT
ELECTRICAL PENETRATION CANISTERS

FIGURE 8.2-6

FINAL SAFETY ANALYSIS REPORT

FIGURE 8.2-7

REFER TO ENGINEERING DRAWING

5610-E-54A-1

REV. 13 (10/96)

FLORIDA POWER & LIGHT COMPANY
TURKEY POINT PLANT UNITS 3 & 4

5KV ELECTRICAL POWER
PENETRATION ASSEMBLY

FIGURE 8.2-7

Security - Related Information Figure Withheld Under 10 CFR 2.390

FLORIDA POWER & LIGHT COMPANY
TURKEY POINT PLANT UNITS 3&4

MAIN PLANT AREA
ELECTRICAL DUCT BANKS
LAYOUT PLAN EL. 18'–0"

FIGURE 8.2-8

Security - Related Information Figure Withheld Under 10 CFR 2.390

FLORIDA POWER & LIGHT COMPANY
TURKEY POINT PLANT UNITS 3&4

UNIT 4 EDG BUILDING
ELECTRICAL DUCT BANKS
LAYOUT PLAN EL. 18'-0"

FIGURE 8.2-8A

Security - Related Information Figure Withheld Under 10 CFR 2.390

AUXILIARY BUILDING UNDERGROUND CONDUIT AND TRAY
LAYOUT PLAN EL. 10'-0" & BELOW
FIG. 8.2-9

Security - Related Information Figure Withheld Under 10 CFR 2.390

FLORIDA POWER & LIGHT COMPANY
TURKEY POINT PLANT UNITS 3&4

INTAKE STRUCTURE
ELECTRICAL DUCT BANKS
LAYOUT PLAN EL. 18'–0"

FIGURE 8.2-10

Security - Related Information Figure Withheld Under 10 CFR 2.390

FLORIDA POWER & LIGHT COMPANY
TURKEY POINT PLANT

TRAY ARRANGEMENT ABOVE FLOOR PLAN EL. 18’-0”

FIGURE 8.2-11

Security - Related Information Figure Withheld Under 10 CFR 2.390

FLORIDA POWER & LIGHT COMPANY
TURKEY POINT PLANT

TRAY ARRANGEMENT INTERMEDIATE PLAN

FIGURE 8.2-12

Security - Related Information Figure Withheld Under 10 CFR 2.390

FLORIDA POWER & LIGHT COMPANY
TURKEY POINT PLANT UNIT 3

TYPICAL EXAMPLE OF CABLE SEPARATION & ROUTING IN CONTAINMENT
FIGURE 8.2-13

Security - Related Information Figure Withheld Under 10 CFR 2.390

FLORIDA POWER & LIGHT COMPANY
TURKEY POINT PLANT UNIT 3

ROUTING OF PRESSURIZER HEATER CABLES
FIGURE 8.2-14

Security - Related Information Figure Withheld Under 10 CFR 2.390

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FLORIDA POWER & LIGHT COMPANY
TURKEY POINT PLANT UNITS 3 & 4

SEPARATION & ROUTING OF CABLES
FOR
EMERGENCY COOLERS & FILTERS

FIGURE 8.2-15

Security - Related Information Figure Withheld Under 10 CFR 2.390

FLORIDA POWER & LIGHT COMPANY
TURKEY POINT PLANT UNITS 3 & 4

SEPARATION & ROUTING OF NUCLEAR
INSTRUMENTATION CABLES IN
CONTAINMENT

FIGURE 8.2-16

Security - Related Information Figure Withheld Under 10 CFR 2.390

FLORIDA POWER & LIGHT COMPANY
TURKEY POINT PLANT UNITS 3

TYPICAL EXAMPLES OF CABLE SEPARATION & ROUTING FOR PROCESS INSTRUMENTATION IN CONTAINMENT

FIGURE 8.2-17

FINAL SAFETY ANALYSIS REPORT

FIGURE 8.2-18a

REFER TO ENGINEERING DRAWING

5613-T-L1 , SHEET 9A1

REV. 13 (10/96)

FLORIDA POWER & LIGHT COMPANY
TURKEY POINT PLANT UNIT 3

EDG START SIGNALS
LOGIC DIAGRAM

FIGURE 8.2-18a

FINAL SAFETY ANALYSIS REPORT

FIGURE 8.2-18b

REFER TO ENGINEERING DRAWING
5613-T-L1 , SHEET 9A2

REV. 13 (10/96)

FLORIDA POWER & LIGHT COMPANY
TURKEY POINT PLANT UNIT 3

EDG ENGINE START
LOGIC DIAGRAM

FIGURE 8.2-18b

FINAL SAFETY ANALYSIS REPORT

FIGURE 8.2-18c

REFER TO ENGINEERING DRAWING

5613-T-L1 , SHEET 9A3

REV. 13 (10/96)

FLORIDA POWER & LIGHT COMPANY
TURKEY POINT PLANT UNIT 3

EDG VOLTAGE REGULATOR AND
ELECTRIC GOVERNOR
LOGIC DIAGRAM
FIGURE 8.2-18c

FINAL SAFETY ANALYSIS REPORT

FIGURE 8.2-18d

REFER TO ENGINEERING DRAWING

5613-T-L1 , SHEET 9A4

REV. 13 (10/96)

FLORIDA POWER & LIGHT COMPANY
TURKEY POINT PLANT UNIT 3

EDG STOP/ ENGINE SHUTDOWN
LOGIC DIAGRAM

FIGURE 8.2-18d

FINAL SAFETY ANALYSIS REPORT

FIGURE 8.2-18e

REFER TO ENGINEERING DRAWING

5613-T-L1 , SHEET 9A5

REV. 13 (10/96)

FLORIDA POWER & LIGHT COMPANY
TURKEY POINT PLANT UNIT 3

EDG LOCKOUT AND
ENGINE AUXILIARIES
LOGIC DIAGRAM
FIGURE 8.2-18e

FINAL SAFETY ANALYSIS REPORT

FIGURE 8.2-18f

REFER TO ENGINEERING DRAWING

5613-T-L1 , SHEET 9A6

REV. 13 (10/96)

FLORIDA POWER & LIGHT COMPANY
TURKEY POINT PLANT UNIT 3

EDG BREAKER CONTROL
LOGIC DIAGRAM

FIGURE 8.2-18f

FINAL SAFETY ANALYSIS REPORT

FIGURE 8.2-18g

REFER TO ENGINEERING DRAWING

5613-T-L1 , SHEET 9A7

REV. 13 (10/96)

FLORIDA POWER & LIGHT COMPANY
TURKEY POINT PLANT UNIT 3

EDG INDICATIONS AND ALARMS
LOGIC DIAGRAM

FIGURE 8.2-18g

FINAL SAFETY ANALYSIS REPORT

FIGURE 8.2-18L

REFER TO ENGINEERING DRAWING
5614-T-L1 , SHEET 9A1

REV. 13 (10/96)

FLORIDA POWER & LIGHT COMPANY
TURKEY POINT PLANT UNIT 4

EMERGENCY DIESEL GENERATOR
START LOGIC DIAGRAM

FIGURE 8.2-18L

FINAL SAFETY ANALYSIS REPORT

FIGURE 8.2-18m

REFER TO ENGINEERING DRAWING

5614-T-L1 , SHEET 9A2

REV. 13 (10/96)

FLORIDA POWER & LIGHT COMPANY
TURKEY POINT PLANT UNIT 4

EMERGENCY DIESEL GENERATOR
ENGINE START LOGIC DIAGRAM

FIGURE 8.2-18m

FINAL SAFETY ANALYSIS REPORT

FIGURE 8.2-18n

REFER TO ENGINEERING DRAWING

5614-T-L1 , SHEET 9A3

REV. 13 (10/96)

FLORIDA POWER & LIGHT COMPANY
TURKEY POINT PLANT UNIT 4

DIESEL GENERATOR GOVERNOR &
VOLTAGE REGULATOR CONTROL
LOGIC DIAGRAM
FIGURE 8.2-18n

FINAL SAFETY ANALYSIS REPORT

FIGURE 8.2-18o

REFER TO ENGINEERING DRAWING

5614-T-L1 , SHEET 9A4

REV. 13 (10/96)

FLORIDA POWER & LIGHT COMPANY
TURKEY POINT PLANT UNIT 4

DIESEL ENGINE & GENERATOR
STOP AND LOCKOUT
LOGIC DIAGRAM
FIGURE 8.2-18o

FINAL SAFETY ANALYSIS REPORT

FIGURE 8.2-18p

REFER TO ENGINEERING DRAWING

5614-T-L1 , SHEET 9A5

REV. 13 (10/96)

FLORIDA POWER & LIGHT COMPANY
TURKEY POINT PLANT UNIT 4

DIESEL GENERATOR BREAKER AND
FUEL OIL PUMP CONTROL
LOGIC DIAGRAM
FIGURE 8.2-18p

FINAL SAFETY ANALYSIS REPORT

FIGURE 8.2-18q

REFER TO ENGINEERING DRAWING

5614-T-L1 , SHEET 9A6

REV. 13 (10/96)

FLORIDA POWER & LIGHT COMPANY
TURKEY POINT PLANT UNIT 4

DIESEL ENGINE & GENERATOR
ANNUNCIATION AND INDICATION
LOGIC DIAGRAM - SHEET 1
FIGURE 8.2-18q

FINAL SAFETY ANALYSIS REPORT

FIGURE 8.2-18r

REFER TO ENGINEERING DRAWING

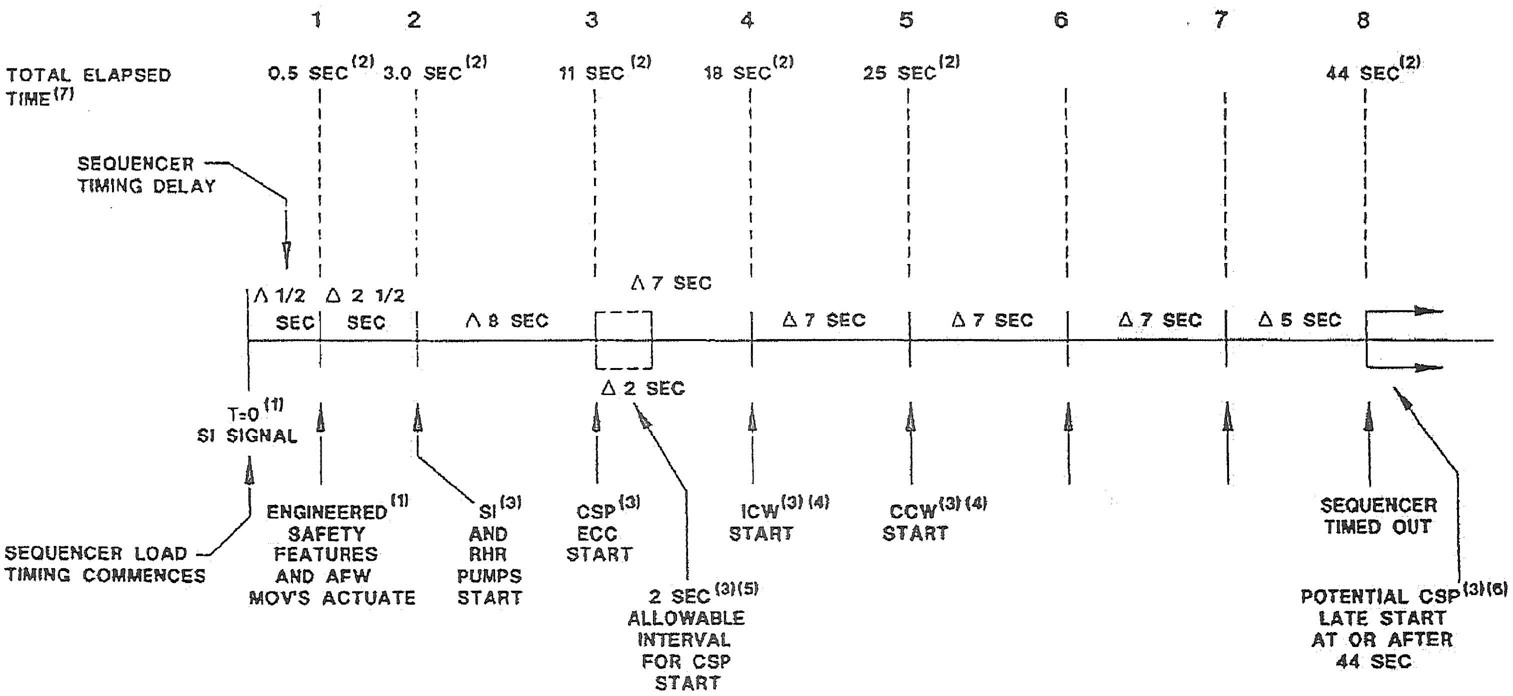
5614-T-L1 , SHEET 9A7

REV. 13 (10/96)

FLORIDA POWER & LIGHT COMPANY
TURKEY POINT PLANT UNIT 4

DIESEL ENGINE & GENERATOR
ANNUNCIATION AND INDICATION
LOGIC DIAGRAM - SHEET 2
FIGURE 8.2-18r

AUTOMATIC SEQUENCER LOAD BLOCKS



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(1) LOAD CENTER BREAKERS SHOULD ALREADY BE CLOSED AT T=0: IF LC BREAKERS ARE CLOSED AT T=0, MOV'S ACTUATE AT T=0.

(2) LOAD BLOCK TIMES ARE NOMINAL DESIGN VALUES. TECHNICAL SPECIFICATION 4.8.1.1.2.g.12 REQUIRES THE INTERVAL BETWEEN LOAD BLOCKS TO BE WITHIN ± 10% OF THE DESIGN INTERVAL.

(3) BREAKER (CONTACTOR) CLOSURE TIMES ARE REPRESENTED.

(4) ICW/CCW BREAKERS MAY ALREADY BE CLOSED AT T=0, FOR THOSE ICW/CCW PUMPS THAT WERE RUNNING PRIOR TO T=0.

(5) CONTAINMENT SPRAY PUMPS ARE PERMITTED TO START DURING THE INTERVAL 11 TO 13 SEC. IF A HI-HI CONTAINMENT PRESSURE SIGNAL IS PRESENT DURING THE PERIOD 0-13 SEC.

(6) FOR CONTAINMENT PRESSURE SIGNALS BETWEEN 13-44 SEC. CSP'S WILL START AT 44 SEC. (OR LATER UPON RECEIPT OF A HI-HI CONTAINMENT PRESSURE SIGNAL, WITH A SAFETY INJECTION SIGNAL (SIS) NOT RESET).

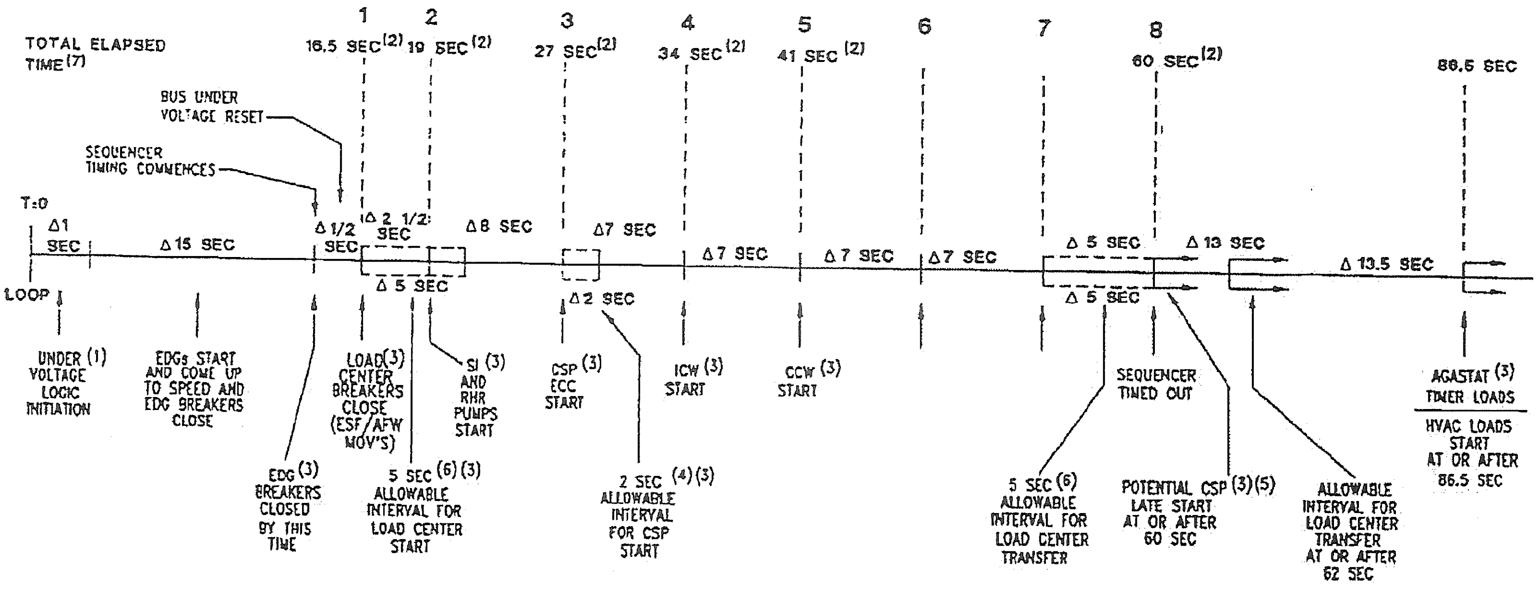
(7) LOAD BLOCK TOTAL ELASPED TIMES MAY BE DELAYED BY UP TO 1.0 SEC. BEYOND THAT SHOWN ABOVE TO ACCOUNT FOR THE MANUAL TESTING RESET TIME OF THE SEQUENCERS AND LOAD BLOCK TOLERANCES. MANUAL TEST RESET TIMES ARE DOCUMENTED IN VENDOR MANUAL V00506E.

Revised 02/14/2013

FLORIDA POWER & LIGHT COMPANY
TURKEY POINT PLANT UNITS 3 & 4

ONSITE AC POWER SYSTEM
AUTOMATIC SEQUENCER LOADING SCHEME
FOR SIS WITH OFFSITE POWER AVAILABLE
FIGURE 8.2-19a

AUTOMATIC SEQUENCER LOAD BLOCKS



C26

(1) SEQUENCER STRIPPING LOGIC DELAY TO VERIFY UNDER VOLTAGE CONDITION.

(2) LOAD BLOCK TIMES ARE NOMINAL DESIGN VALUES. TECHNICAL SPECIFICATION 4.8.1.1.2.g.12 REQUIRES THE INTERVAL BETWEEN LOAD BLOCKS TO BE WITHIN ± 10% OF THE DESIGN INTERVAL.

(3) BREAKER (CONTACTOR) CLOSURE TIMES ARE REPRESENTED

(4) CONTAINMENT SPRAY PUMPS ARE PERMITTED TO START DURING THE INTERVAL 27 TO 29 SEC. IF HI-HI CONTAINMENT PRESSURE SIGNAL IS PRESENT DURING THE PERIOD 0-29 SEC.

(5) FOR CONTAINMENT PRESSURE SIGNALS BETWEEN 29-60 SEC. CSP'S WILL START AT 60 SEC. (OR LATER UPON RECEIPT OF HI-HI CONTAINMENT PRESSURE SIGNAL WITH SAFETY INJECTION SIGNAL (SIS) OR LOOP NOT RESET).

(6) IF CERTAIN SINGLE FAILURES ASSOCIATED WITH LOAD CENTER 3H OR 4H OCCUR AFTER 21.5 SEC. AFFECTED LOAD CENTERS ARE PREVENTED FROM TRANSFERRING DURING THE PERIOD 21.5-55 SEC.

(7) LOAD BLOCK TOTAL ELASPED TIMES MAY BE DELAYED BY UP TO 1.0 SEC. BEYOND THAT SHOWN ABOVE TO ACCOUNT FOR THE MANUAL TESTING RESET TIME OF THE SEQUENCERS AND LOAD BLOCK TOLERANCES. MANUAL TEST RESET TIMES ARE DOCUMENTED IN VENDOR MANUAL V00506E.

Revised 02/14/2013

FLORIDA POWER & LIGHT
COMPANY
TURKEY POINT PLANT UNITS 3 & 4

ONSITE AC POWER SYSTEM
AUTOMATIC SEQUENCER
LOADING SCHEME
FOR SIS WITH A CONCURRENT
LOOP
FIGURE 8.2-19b

8.3 RELIABILITY ASSURANCE

The electrical system is arranged so that no single failure can inactivate enough safeguards equipment to jeopardize either unit's safety.

The safety related 4.16 kV system comprises two electrically trained buses and a swing bus per unit. The safety related 480V system is served by four load center buses and a swing bus for each unit, which feed seven safety related Motor Control Centers (MCCs) for Unit 3 and eight safety related MCCs for Unit 4.

The startup transformer of each unit, connected to the 240 kV switchyard, supplies offsite power to the units during startup, shutdown and after unit trip. The switchyard, as described before, interconnects Turkey Point Units 1, 2, 3 and 4 with the Florida Power & Light Company 240 kV system through nine C26 transmission lines. Therefore, station service power is supplied to the units by multiple sources.

The unit auxiliary equipment is arranged electrically so that multiple equipment receives power from two different sources. The 4.16 kV and the 480V bus arrangements ensure that power is available to an adequate number of safeguards auxiliaries. Fuses are not used for the protection of any power feeders.

Assuming any credible single failure, the EDGs are capable of powering a set of engineered safeguard equipment necessary for controlling an MHA in one unit, as well as the equipment necessary to maintain the other unit in Hot Standby.

A minimum of one battery charger per battery bank is in service continuously, so that the batteries will always be at full charge in anticipation of a loss of power event.

Failure Modes and Effects Analyses (FMEA)

The design of the Emergency Power System was subjected to a rigorous analysis of failure modes during system operation, to demonstrate that the system safety function can be accomplished with any credible single failure. The design was subjected to a comprehensive FMEA, the key elements of which are summarized below, from which it is concluded that the Emergency Power System can perform its safety functions for all modes of plant operation.

The detailed FMEA, documented as Ebasco Report 53-205.5008, Revision 1, is very lengthy, and is not included for the sake of brevity. The FMEA for the electrical system components and individual loads was used to identify potential failure modes from proposed relocation (repowering) of the shared, or common loads. Based on the results of the FMEA, the loads were assigned to the proper MCC, such that, an MHA and a single failure does not result in the loss of the minimum required safety equipment.

The FMEA also considered the scenario of one unit at power and the other unit in MODEs 5 or 6 with one train out-of-service. An accident (LOCA) plus a single failure was assumed on the unit at power. The FMEA was used to confirm that the Turkey Point Technical Specifications, as amended by Operating License Amendments 133 and 138 for Units 3 and 4, respectively, were appropriate for potential Emergency Power System configurations during plant operation, including equipment out-of-service conditions (e.g., a unit in MODEs 5 or 6 with only one EDG required to be Operable). The FMEA shows that no credible single failure of the onsite Emergency Power System (i.e., sequencers, EDG and AC electrical distribution system components) will preclude meeting the enhanced Emergency Power System design bases for a loss of offsite power coincident with a LOCA, or for a loss of offsite power event only.

Also, circuit and/or component failure effects analyses were performed for selected major control circuits of the Emergency Power System, as documented in the various Plant Change/Modification packages. These analyses assure that the modified design control logic and its implementation meet the single-failure criterion.

FMEA of the 125V DC Enhancements

A review of various failure modes and their effect on the 125V DC safety function was performed assuming a loss of offsite power occurring coincident with the accidents discussed above (i.e., assuming that both units are at power, an accident occurs coincident with a dual unit loss of offsite power). This scenario is the worst-case condition from an EDG loading standpoint. This analysis is documented in Bechtel correspondence SFB-7673, dated March 2, 1990.

8.4 MINIMUM OPERATING CONDITIONS, EACH UNIT

The requirements for the availability of electrical power to meet minimum operating conditions are given in the Technical Specifications.

Table 8.4-1 indicates the power source for safeguards equipment.

TABLE 8.4-1

SAFEGUARD COMPONENT POWER SUPPLIES

		POWER SUPPLY BUS																
	QTY (BOTH UNITS)	4160V						LC 480V (Each Unit)					MCC 480v					
SAFEGUARD COMPONENT		3A	3B	3D	4A	4B	4D	A	B	C	D	H	3B	3C	3D	4A	4B	4D
Safety Injection Pump	4	1	1		1	1												
Residual Heat Removal Pump	4	1	1		1	1												
Component Cooling Pump	6	1	1	1	1	1	1											
Intake Cooling Water Pump	6	1	1	1	1	1	1											
Charging Pump	6							1	1			1						
Containment Spray Pump	4							1			1							
Emergency Containment Filter Fan[(1)]	0												0	0	0	0	0	0
Emergency Containment Cooler Fan	6												1	1	1	1	1	1

(1) The Unit 3 and 4 ECF units, fans and related SSCs and design features were disconnected, removed and/or abandoned in place by EC 246930 (PC/M 08-181) and 246931 (PC/M 08-182).

8.5 TESTS AND INSPECTIONS

The tests specified are designed to demonstrate that the diesel-generators will provide adequate power for operation of equipment. They also assure that the emergency generator control systems for safeguard equipment will function automatically in the event of a loss of all normal 4160 volt offsite power.

Frequent tests are conducted to identify and correct any mechanical or electrical deficiency before it can result in a system failure. The control components are in dust tight enclosures having space heaters for humidity control. The fuel supply and starting circuits and controls are continuously monitored and any faults are annunciated. An abnormal condition in these systems will be signaled without having to place the diesel-generators on test.

In accordance with Technical Specification Amendments 215/209 (Ref. 8.5-1), the diesel generators will be inspected in accordance with a licensee-controlled maintenance program. This program will require inspection in accordance with procedures prepared in conjunction with the manufacturer’s recommendations for this class of standby service. Changes to the maintenance program will be controlled under 10CFR50.59.

To verify that the emergency power system will properly respond within the required time limit when required, the following tests are performed.

a. Manually initiated demonstration of the ability of the diesel-generators to start, synchronize and deliver power up to nameplate rating, when operating in parallel with other power sources. Normal unit operation will not be affected.

b. Demonstration of the readiness of the generator system and the control systems of vital equipment to automatically start, or restore to operation, the vital equipment by initiating an actual loss of all normal AC station service power. This testing approach requires the simultaneous loss of offsite power to one 4160V train while simulating a safety injection on the shutdown unit. This integrated safeguards test is performed on each train of each unit individually for the two conditions of a loss of offsite power and a loss of offsite power coincident with a safety injection signal. This test is conducted during each refueling interval.

c. Demonstration of the automatic sequencing equipment during normal unit operation. This test exercises the control and indication devices, and may be performed any time, the sequencing equipment being redundant to normal operations. If a safety injection signal occurs while the test is underway, it takes precedence and immediately cancels the test. The equipment then responds to the safety injection signal.

REFERENCES

8.5-1 Turkey Point Units 3 and 4 Technical Specifications, Amendments 215/209, effective August 8, 2001.

APPENDIX 8A

ENVIRONMENTAL QUALIFICATION

8A.1 INTRODUCTION

Equipment required to mitigate or monitor the consequences of a design basis accident must be capable of maintaining functional operability under conditions postulated to occur during its installed life. This requirement is embodied in 10CFR50.49, "Environmental Qualification of Electrical Equipment Important to Safety for Nuclear Power Plants," 10CFR50 Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," and 10CFR50 Appendix A, "General Design Criteria for Nuclear Power Plants," Criteria 1, 2, 4, 23 and 50.

When Turkey Point Units 3 and 4 construction permits were issued, environmental qualification was performed on a generic basis in documents such as Westinghouse's WCAPs and in the normal design and procurement of equipment required for safety. Safety related capability was assured by conservative design. Wherever possible, all active components required for safe shutdown of the plant were located outside containment and away from post accident harsh environments.

In response to NRC IE Bulletin 79-01B, FPL developed a program to document the qualification of electrical equipment in accordance with Enclosure 4 to IEB 79-01B, the DOR Guidelines - "Guidelines for Evaluating Environmental Qualification of Class 1E Electrical Equipment in Operating Reactors."

The NRC has subsequently issued NUREG-0588, "Interim Staff Position on Environmental Qualification (EQ) of Safety-Related Electrical Equipment," and other guideline documents including Regulatory Guide 1.89, "Environmental Qualification of certain Electric Equipment Important to Safety for Nuclear Power Plants."

The documents issued required that replacement equipment installed subsequent to February 22, 1983, must be qualified in accordance with the criteria provided in NUREG-0588 Category I unless there are sound reasons to the contrary. These reasons are delineated in Section C6 of Regulatory Guide 1.89.

8A.2 CRITERIA

8A.2.1CODE OF FEDERAL REGULATIONS

The US Code of Federal Regulations, Part 10, Section 50.49 (10CFR50.49) requires that each holder of a license to operate a nuclear power plant establish a program for qualifying equipment within the rules scope. To satisfy this requirement FPL has developed a list of equipment which meets the criteria of 10CFR50.49. For each of these components separate documentation packages exist which support its qualification. Environmental Qualification requires commitment to various sections of 10 CFR. These sections include 10CFR21, "Reporting of Defects and Non Compliances," 10CFR50, "Domestic Licensing of Production and New Utilization Facilities." For identification of other documents Turkey Point is committed to refer to the Equipment Qualification Documentation Package (Doc Pac) 1001, "Environmental Qualification Generic Approach and Treatment of Issues."

8A.3 IDENTIFICATION OF COMPONENTS

Electric equipment covered in 10CFR50.49 is characterized as follows:

a) Safety-related electric equipment that is relied upon to remain functional during and following design basis events to ensure (i) the integrity of the reactor coolant pressure boundary, (ii) the capability to shut down the reactor and maintain it in a safe shutdown condition, and (iii) the capability to prevent or mitigate the consequences of accidents that could result in potential offsite exposures comparable to the 10CFR100 guidelines. Design Basis Events are defined as conditions of normal operation, including anticipated operational occurrences, design basis accidents, external events, and natural phenomena for which the plant must be designed to ensure functions (i) through (iii) of this paragraph.

b) Non safety electric equipment whose failure under postulated environmental conditions could prevent satisfactory accomplishment of safety functions specified previously.

c) Certain post-accident monitoring equipment (Refer to Regulatory Guide 1.97, Revision 3, "Instrumentation for Light Water Cooled Nuclear Power Plants to Assess Plant and Environs During and Following an Accident."

These components are identified on the Environmental Qualification (EQ) List for 10CFR50.49.

8A.4 QUALIFICATION OF COMPONENTS

If the equipment in question meets the requirement found in Subsection 8A.3 and is located in a harsh environment, it must be qualified to 10CFR50.49. The Equipment Qualification Documentation Package 1001 (Doc Pac 1001), "Environmental Qualification Generic Approach and Treatment of Issues," provides the information required to properly identify the environment to which the specific equipment must be qualified. Operability requirements associated with the component are discussed along with the required temperature, pressure, humidity, radiation, aging and submergence.

Harsh environments are characterized by abnormally high temperatures, pressures, radiation doses, exposure to chemical spray, high relative humidity or submergence which are postulated to result from a Design Basis Event.

A mild environment is an environment that would at no time be significantly more severe than the environment which would occur during normal operation, including operational occurrences. Mild environment operability is assured by: (a) engineering requirements during specification development for purchasing equipment; (b) periodic maintenance, inspection and/or a replacement program based on sound engineering judgement or manufacturer's recommendations.

Environments in which radiation is the only parameter of concern are considered to be mild if the total radiation dose (includes 60-year normal dose plus the post accident dose) is 1.0E5 rads or less. This value is the threshold for evaluation and consideration based on EPRI NP-2129. However, certain solid state electronic components and components that utilize teflon are considered to be in a mild environment only if total radiation dose is 1.0E3 rads or less.

For additional detail on the identification of environmental conditions refer to Equipment Qualification Documentation Package (Doc Pac) 1001, "Generic Approach and Treatment of Issues."

8A.5 MAINTENANCE

The purpose of the Turkey Point Equipment Qualification Maintenance Program is the preservation of the qualification of systems, structures and components. In order to accomplish this task, the plants have developed approved Design Control, Procurement and Maintenance Procedures. In addition, the component specific documentation package contains the equipment's qualified life. The qualified life is developed based upon the qualification test report reviewed in conjunction with the environmental parameters associated with the area. After this review is completed a qualified life is established. Maintenance activities to be performed in addition to the vendor recommended maintenance are determined to ensure that qualification of each piece of equipment is maintained throughout its qualified life.

8A.6 RECORDS/QUALITY ASSURANCE

A documentation package is prepared for the qualification of each manufacturer's piece of equipment under the auspices of 10CFR50.49. This package contains the information, analysis and justifications necessary to demonstrate that the equipment is properly and validly qualified as defined in 10CFR50.49 for the environmental effects of 60 years of service plus a design basis accident.

This documentation package is developed from the criteria stipulated in Doc Pac 1001.

A complete listing of equipment under the auspices of 10CFR50.49 is maintained.

The 10CFR50.49 list of equipment and the Documentation Packages are developed and controlled under the procedures involving drawing preparation, vendor manual control updating and storage as specified in the FPL Quality Assurance Program.

8A.7 CONCLUSIONS

Doc Pac 1001, together with Qualification Documentation Packages for specific equipment and the 10CFR50.49 list of equipment have been developed for the purpose of documenting the environmental qualification of safety related equipment located in a harsh environment. Equipment installed prior to February 22, 1983, may be qualified to either the DOR guidelines or NUREG-0588 criteria. However, equipment installed after this date must be qualified to NUREG-0588 Category I criteria. This program has ensured the systems selected for qualification are complete, the environmental conditions resulting from the design basis accident are identified and the methods used for qualification are appropriate.