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CHAPTER 8 ELECTRIC POWER

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CHAPTER 8.0 ELECTRIC POWER

8.1 INTRODUCTION

8.1.1 Utility Grid Description

The Entergy Mississippi, Inc./Entergy System grid system consists of interconnected hydro-plants, fossil fuel plants, and nuclear plants supplying electric energy over a 500/230/115 kV transmission system as shown in Figures 8.2-1 and 8.2-2.

Entergy Mississippi, Inc. is a member of Entergy Electric System. Other members are Entergy Arkansas, Inc., Entergy Louisiana, Inc., System Energy Resources, Inc. (SERI), New Orleans Public Services, Inc. (NOPSI), and Entergy Gulf States.

The Entergy Electric System is interconnected with the Southwestern Power Administration (SPA), Associated Electric Cooperatives, Inc. (AECI), Missouri Utilities (MU), Union Electric Company (UE), Tennessee Valley Authority (TVA), Mississippi Power Company (MPC), Central Louisiana Electric Company (CLECO), Southwestern Electric Power Company (SWEP), Oklahoma Gas and Electric Company (OG&E), Empire District Electric Company (EDE), and Arkansas Electric Cooperative Corporation (AECC).

8.1.2 Onsite Electric Systems

[HISTORICAL INFORMATION] [The station is supplied with ac power from the 500-kV switchyard and the 115-kV offsite circuit. From the switchyard, the voltage of the ac power is stepped down to 34.5 kV through two service transformers and fed to two sets of engineered safety features (ESF) and balance-of-plant transformers. The 115-kV offsite circuit feeds another ESF transformer with 4.16-kV output voltage. The ESF transformers supply the 4.16-kV ESF buses with ac power which feed ESF load groups at 4.16 and 0.48 kV. The balance- of-plant transformers provide ac power to balance-of-plant loads at 13.8, 6.9, 4.16, and 0.48 kV. An alternate source for the Class IE ac power system for each ESF bus is the associated diesel generator set.

The Class IE ac power system is divided into three independent divisions to provide ac power to the three divisions of ESF loads. The onsite ac power distribution system is shown on Figure 8.1-1.]

Each division of the Class IE ac power system is provided with an independent Class IE 125-volt dc system. The balance-of-plant loads have several 125-volt and 250-volt dc systems (see Figure 8.3-10).

Amendment 27 to the Facility Operating License for GGNS implemented transfer of control of licensed activities from MP&L, (since renamed Entergy Mississippi, Inc.) to SERI. At that time, as discussed in Section 8.2.1.2, MP&L and SERI entered into an agreement governing the conduct of activities involving interface between the two companies in the area of offsite power supply (Ref. 1). The division of ownership of the offsite power supply equipment occurs at the transformer bushings on the high voltage side of the two 500/34.5kV transformers. SERI owns the main unit output lines, through their main transformers (20.9/500kV); both 34.5kV substations and associated BOP and ESF transformers; and the 115/4.16kV ESF transformer, plus the cable and feeder breaker from the 115 kV substation. Entergy Mississippi, Inc. owns: the 115kV substation itself; and the 500kV lines downstream of the (20.9/500kV) main transformers. Maintenance activities and responsibilities for switchyard equipment are set forth in the MP&L/SERI agreement SERI maintains the main transformers, ESF and BOP Transformers. Entergy Mississippi, Inc. maintains other switchyard and transmission equipment.

8.1.3 Safety Loads

Safety loads are defined as those systems and devices that require electric power to perform their safety functions. Such loads are divided into the following classifications:

a. Engineered safety features (ESF)

   1. Emergency core cooling systems (ECCS)

      (a) Residual heat removal system (RHR) - low-pressure core injection (LPCI) mode

      (b) Low-pressure core spray system (LPCS)

      (c) High-pressure core spray system (HPCS)

      (d) Automatic depressurization system (ADS)

   2. Containment and reactor vessel isolation control system

3. Control room atmospheric control and isolation system

4. Standby service water system*

5. Combustible gas control system

6. Standby power and support systems*

7. Leakage control systems

   (a) Main steam isolation valve leakage control system (MSIV-LCS)

   (b) Feedwater isolation valve leakage control system (FIV-LCS)

8. Standby gas treatment system

9. Suppression pool makeup system

10. 10.RHR - Containment spray mode

11. 11.ESF area HVAC systems*

   (a) ECCS pump room HVAC

*Essential auxiliary supporting systems

   (b) Standby service water pumphouse HVAC

   (c) Emergency switchgear room HVAC

12. Auxiliary building isolation control system

b. Safe shutdown systems

1. Reactor protection system

2. Standby liquid control system

3. Control rod hydraulic system (scram system portion)

4. Nuclear steam supply shutoff system

5. Reactor core isolation cooling and room HVAC system

c. Spent fuel pool cooling system

All of the above loads utilize both ac and dc sources for motive or control power or both. In some cases the utilization is indirect. For example, dc control power in the logic provides an actuation signal to start the standby gas treatment system which is ac powered.

8.1.3.1 Division of Safety Loads

For detailed listings of safety division ac loads, see the site a/c electrical power and distribution calculations. Tables 8.3-6, 8.3-7, and 8.3-8 list the loads of Class IE 125-volt dc batteries.

Loads required for normal operation, normal shutdown, forced shutdown, and LOCA are documented in the site a/c electrical calculations.

Forced shutdown is defined as a shutdown following standard procedures but accomplished entirely with onsite power.

8.1.3.2 Reactor Protection System Power System Loads

Power supplies for the reactor protection system (RPS) have sufficient stored energy to remain available through switching transients. Power supplies are shown in Figure 8.3-14.

The safe failure characteristic of the RPS on a loss of power exempts the RPS power supplies from being classified essential. However, redundancy is provided to avoid an unnecessary plant shutdown on interruption of power to one RPS bus. The RPS

power system is grounded, which prevents unsafe failure that may occur from multiple grounds.

8.1.3.3 HPCS Power System Loads

The HPCS power system loads consist of the HPCS pump/motor and associated 460-volt ac auxiliaries, such as motor-operated valves, engine cooling water pump, and miscellaneous engine auxiliary loads. Table 8.3-8 lists the Division 3 loads of Class IE 125 V dc batteries. The applicable regulatory standards and guides implemented in the design of the controls are listed in Table 7.1-3.

8.1.4 Design Bases

8.1.4.1 Safety Design Bases - Offsite Power

a. Three offsite circuits from the Entergy Electric System provide the ac power requirements of the station.

b. Alternating current power from the 500 kV switchyard to the onsite electrical distribution is supplied by two physically independent circuits.

c. Each 500-34.5 kV service transformer has a rating capable of feeding the necessary power required for both BOP and safety loads of the unit.

d. The 500 kV switchyard is provided with two independent 125-volt dc systems and three auxiliary ac power supplies, one from Division 2 ESF 4.16 kV bus of Unit 1, one from 13.8 kV-480 V station service transformer, and one from ESF transformer No. 12.

e. Each 34.5-4.16 kV engineered safety feature transformer has a rating capable of supplying ac power to start and run ESF loads required due to a LOCA. The power comes from the 500-34.5 kV service transformers.

f. The 115-4.16 kV engineered safety features transformer has a single, independent offsite circuit. This transformer is capable of supplying ac power to start and run the ESF loads required as the result of a LOCA. Offsite grid analysis performed in 2000-2001 determined that the 115kV offsite circuit was not capable of supplying sufficient power to start and run the ESF loads required as the result of a LOCA. Transmission system upgrades, additional capacitor banks at the Port Gibson, South Vicksburg, and Fayette 115kV substations, were performed and the capability of the 115kV circuit has been restored.

g. Loss of Grand Gulf Nuclear Plant generating capability or its most critical offsite circuit will not cause system instability (see subsection 8.2.3).

8.1.4.2 Safety Design Bases - Onsite Power

8.1.4.2.1 Engineered Safeguard Features (ESF)

a. The safety-related load is divided into three division load groups. Each load group is fed by an independent Class IE electric system engineered safety features bus.

b. Three separate ac power feeds are provided for each engineered safety features bus, each of which origi- nates from an independent offsite source of power.

c. One diesel generator set and one independent 125-volt dc system are provided for each division load group.

d. An independent raceway system is provided to meet load group cable requirements for each ESF division.

8.1.4.2.2 Reactor Protection System (RPS)

The reactor protection system is a fail-safe system which requires no power in order to perform its safety function. However, it is afforded complete redundancy and separation to provide independence of its four sensor channels and four Class 1E uninterruptible power supplies.

8.1.4.2.3 High-Pressure Core Spray (HPCS) Power Supplies Design Basis

a. The HPCS power system loads consist of HPCS pump/motor and associated 460-volt ac auxiliaries such as motoroperated valves, engine cooling water pump, and miscellaneous engine auxiliary loads. Figures 8.3-12a and 8.3-12b show the basic one line diagram of the system.

b. The HPCS power system is self-contained except for access to the preferred source of offsite power, by connection through the plant ac power distribution system, and for the initiation signal source. It is an operable isolated system independent of electrical connection to any other system by use of the HPCS diesel-generator. Required standby auxiliary equipment such as heaters and battery charger are supplied from the same power source as the HPCS motor and are compatible with that available from the plant ac power system.

c. The HPCS diesel-generator has the capability to restore onsite power quickly to the HPCS pump motor in the event offsite power is unavailable and to provide all power for startup and operation of the HPCS pump motor compatible with safe shutdown of the plant. The HPCS diesel generator starts automatically on signal from the plant protection system or HPCS supply bus undervoltage and, when the plant preferred ac power supply is not available, is connected to the HPCS bus. A more detailed discussion is provided in subsection 8.3.1.1.4.2.1.

d. The HPCS electric system is capable of performing its function when subjected to the effects of design bases natural phenomena at its location. In particular, it is seismic Category I and it is housed in a seismic Category I structure.

e. The HPCS power system has its own fuel day tank and storage tank with sufficient capacity to operate the standby power source while supplying maximum post-accident HPCS power requirements for a time sufficient to put the plant in a safe condition. Tank size is consistent with availability of back-up fuel sources.

f. Manual controls are provided to permit the operator to select the most suitable distribution path from the power supply to the load. An automatic start signal overrides the test mode. Provision is made for diesel generator control from the control room or at the HPCS diesel generator control panel. The diesel generator can be controlled locally only when the "LOCAL/REMOTE" selector switch, located in the control room, is in the "LOCAL" position.

g. A separate dc power supply consisting of a battery and one battery charger exclusively provides the HPCS system dc power requirements for control and protection.

8.1.4.2.4 Reactor Protection System (RPS) Power System

a. The power for the reactor protection system is supplied by four Class 1E uninterruptible power supplies and two independent motor generator set sources, capable of sustaining output voltage and frequency where momentary loss of input power occurs due to switching.

b. Voltage regulation is provided so that the maximum voltage variation for a step loading of 50 percent rated load shall not be greater than 15 percent rated voltage.

c. The power supplies are capable of maintaining voltage and frequency within 5 percent of rated values for no less than 1.0 seconds following loss of input power.

d. The power supplies are nonessential since loss of output power due to open, short, or ground will cause reactor scram or isolation (safe).

8.1.4.3 Power Generation Design Bases

The unit is provided with eight BOP transformers which provide 13.8, 6.9, and 4.16 kV BOP ac power sources. See UFSAR Figure 8.1-001 for the transformers and ac power source configurations.

Four 125-volt dc systems, one 250-volt dc system, and two ±24-volt dc systems are provided for the BOP load groups. Two 125-volt dc systems are provided for the radial wells.

A separate raceway system is provided for the BOP power, control, and instrumentation cables.

The design of the BOP electric system is in accordance with the applicable ANSI, NEMA, and IPCEA standards.

These features are not directly related to the safety of the plant. Descriptions given in Section 8.3 are only in such depth and detail as to permit an understanding of the safety-related portions.

8.1.4.4 Design Criteria, Regulatory Guides, and IEEE Standards

8.1.4.4.1 Directly Applicable Criteria

The design of the offsite power and onsite Class IE electric systems is in accordance with the criteria, regulatory guides, and standards listed below. Table 8.1-1, "Identification of Safety-Related Criteria," contains a cross reference of FSAR sections and design criteria. Exceptions to the regulatory guides are summarized in Appendix 3A. A discussion of compliance to the General Design Criteria is included in Section 3.1.

a. General Design Criterion 17 - Electric Power Systems

b. General Design Criterion 18 - Inspection and Testing of Electric Power Systems

c. Regulatory Guide 1.6, (March 1971), "Independence Between Redundant Standby (Onsite) Power Sources and Between Their Distribution Systems"

d. Regulatory Guide 1.9, (July 1993), "Selection, Design, Qualification, and Testing of Diesel-Generator Units Used as Standby (Onsite) Electric Power Systems at Nuclear Power Plants"

e. Regulatory Guide 1.22, (February 1972), "Periodic Testing of Protection System Actuation Functions"

f. Regulatory Guide 1.29, (February 1976), "Seismic Design Classification"

g. Regulatory Guide 1.30, (August 1972), "Quality Assurance Requirements for the Installation, Inspection, and Testing of Instrumentation and Electric Equipment"

h. h.Regulatory Guide 1.32, (February 1977), "Criteria for Safety-Related Electric Power Systems for Nuclear Power Plants"

i. i.Regulatory Guide 1.40, (March 1973), "Qualification Tests of Continuous-Duty Motors Installed Inside the Containment of Water-Cooled Nuclear Power Plants"

j. Regulatory Guide 1.41, (March 1973), "Preoperational Testing of Redundant Onsite Electric Power Systems to Verify Proper Load Group Assignments"

k. Regulatory Guide 1.47, (May 1973), "Bypassed and Inoperable Status Indication for Nuclear Power Plant Safety Systems"

l. Regulatory Guide 1.53, (June 1973), "Application of the Single-Failure Criterion to Nuclear Power Plant Protection Systems"

m. Regulatory Guide 1.62, (October 1973), "Manual Initiation of Protective Actions"

n. Regulatory Guide 1.63, (October 1973), "Electric Penetration Assemblies in Containment Structures for Water-Cooled Nuclear Power Plants"

o. Regulatory Guide 1.73, (January 1974), "Qualification Tests of Electric Valve Operators Installed Inside the Containment of Nuclear Power Plants"

p. Regulatory Guide 1.75, (January 1975), "Physical Independence of Electric Systems"

q. Regulatory Guide 1.89, (November 1974), "Qualification of Class IE Equipment for Nuclear Power Plants"

r. Regulatory Guide 1.93, (December 1974), "Availability of Electric Power Sources"

s. IEEE Std 338-1975, "IEEE Standard Criteria for the Periodic Testing of Nuclear Power Generating Station Class IE Power and Protection Systems"

t. IEEE Std 344-1971/1975, "IEEE Recommended Practices for Seismic Qualification of Class IE Equipment for Nuclear Power Generating Stations" (Note: The Grand Gulf initial design conforms to the requirements of IEEE 344-1971 as modified by EICSB Branch Technical Position 10. SQRT review was subsequently performed against IEEE 344-1975. Qualification during the plant operating license stage is in accordance with IEEE 344-1975. See Section 3.10.)

u. IEEE Std 387-1972, "Criteria for Diesel Generator Units Applied as Standby Power Supplies for Nuclear Power Stations"

v. IEEE Std 387-1977, "IEEE Standard Criteria for Diesel-Generator Units Applied as Standby Power Supplies for Nuclear Power Generating Stations"

w. IEEE Std 387-1984, "IEEE Standard Criteria for Diesel-Generator Units Applied as Standby Power Supplies for Nuclear Power Generating Stations"

8.1.4.4.2 Indirectly Applicable Criteria

In addition to the criteria listed in subsection 8.1.4.4.1, there are other important criteria which appear at either a higher or lower level of application (for example, 8.1.4.4.1(n) Regulatory Guide 1.63 endorses IEEE 317-1972). Also in this class are industry and trade specifications included in material orders. Unless otherwise indicated, concurrence and implementation have been obtained.

a. IEEE Std 278-1967, "Guide for Classifying Electrical Insulating Materials Exposed to Neutron and Gamma Radiation"

b. IEEE Std 279-1971, "Class IE Electric Systems for Nuclear Power Stations"

c. IEEE Std 308-1974, "Class IE Power Systems for Nuclear Power Generating Stations"

d. IEEE Std 317-1972, "Electrical Penetration Assemblies in Containment Structures for Nuclear Power Generating Stations"

e. IEEE Std 323-1971, "General Guide for Qualifying Class IE Electric Equipment for Nuclear Power Generating Stations"

f. IEEE Std 334-1971, "Standard for Type Test of Continuous Duty Class IE Motors for Nuclear Power Generating Stations"

g. IEEE Std 336-1971, "Installation, Inspection, and Testing Requirements for Instrumentation and Electric Equipment During Construction of Nuclear Power Generating Stations"

h. IEEE Std 450-1975, "Recommended Practice for Maintenance Testing and Replacement of Large Stationary Type Power Plant and Substation Lead Storage Batteries"

   Later editions of this standard may apply to specific Technical Specification testing requirements.

i. IEEE Std 484-1975, "IEEE Recommended Practice for Installation Design and Installation of Large Lead Storage Batteries for Generating Stations and Substations"

j. ANSI, NEMA, and IPCEA standards with effective dates as of the issue of the material orders

TABLE 8.1-1: IDENTIFICATION OF SAFETY-RELATED CRITERIA

Criteria	Title	Applicable 8.1	SAR Sections 8.2	Discussing 8.3.1	Compliance 8.3.2	SAR Sections Discussing Compliance with Safety Criteria for Plant as a whole
10 CFR Part 50						
10 CFR 50.34	Contents of Applications: Technical Information	8.1.4.1 8.1.4.2.1	8.2.1.1	8.3.1.1	8.3.2.1.1	
10 CFR 50.36	Technical Specifications					See Technical Specifications
10 CFR 50.55a	Codes & Standards	8.1.4.4.2				
General Design Criteria (GDC), Appendix A to 10 CFR Part 50						
GDC-1	Quality Standards and Records		8.2.1.2			3.1.2.1.1
GDC-2	Design Basis for Protection Against Natural Phenomena			8.3.1.1.1		3.1.2.1.2
GDC-3	Fire Protection		8.2.1.2	8.3.1.4.1c 8.3.1.2.3d		3.1.2.1.3
GDC-4	Environmental and Missile Design Bases		8.2.1.2			3.1.2.1.4
GDC-5	Sharing of Structures, Systems and Components			8.3.1.1.2.5		3.1.2.1.5
GDC-13	Instrumentation and Control					3.1.2.2.4
GDC-17	Electric Power Systems	8.1.4.4.1	8.2.1.2	8.3.1.2.1	8.3.2.2 8.3.2.2.1	3.1.2.2.8

TABLE 8.1-1: IDENTIFICATION OF SAFETY-RELATED CRITERIA (CONTINUED)

Criteria	Title	Applicable 8.1	SAR Sections 8.2	Discussing 8.3.1	Compliance 8.3.2	SAR Sections Discussing Compliance with Safety Criteria for Plant as a whole
GDC-18	Inspection and Testing of Electric Power Systems	8.1.4.4.1	8.2.1.2	8.3.1.2.1	8.3.2.1.7.8 8.3.2.1.7.9	3.1.2.2.9
GDC-21	Protection System Reliability and Testability	8.1.4.2.4 8.1.4.2.2		8.3.1.1.5		3.1.2.3.2
GDC-22	Protection System Independence	8.1.4.2.2 8.1.4.2.4		8.3.1.4.1		3.1.2.3.3
GDC-33	Reactor Coolant Makeup					3.1.2.4.4
GDC-34	Residual Heat Removal					3.1.2.4.5
GDC-35	Emergency Core Cooling					3.1.2.4.6
GDC-38	Containment Heat Removal					3.1.2.4.9
GDC-41	Containment Atmosphere Cleanup					3.1.2.4.12
GDC-44	Cooling Water					3.1.2.4.15
Institute of Electrical and Electronics Engineers (IEEE) Standards:						
IEEE-279 1971	Criteria for Protection Systems for Nuclear Power Generating Stations	8.1.4.4.2		8.3.1.2.1.b.15		

TABLE 8.1-1: IDENTIFICATION OF SAFETY-RELATED CRITERIA (CONTINUED)

Criteria	Title	Applicable 8.1	SAR Sections 8.2	Discussing 8.3.1	Compliance 8.3.2	SAR Sections Discussing Compliance with Safety Criteria for Plant as a whole
IEEE-308 1971	Criteria for Class 1E Electric Systems for Nuclear Power Generating Stations	8.1.4.4.2		8.3.1.2.1.a.6		8.3.2.2.1
IEEE-317 1972	Electric Penetration Assemblies in Containment Structures	8.1.4.4.2		8.3.1.2.3.1		
IEEE-323 1971	Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations	8.1.4.4.2		8.3.1.2.1.a.7		
IEEE-334 1971	Standard for Type Test of Continuous Duty Class 1E Motors for Nuclear Power Generating Stations	8.1.4.4.2		8.3.1.1.6.1		
IEEE-336 1971	Installation, Inspection and Testing Requirements for Instrumentation and Electric Equipment During the Construction of Nuclear Power Generating Stations	8.1.4.4.2				
IEEE-338 1975	Criteria for Periodic Testing of Nuclear Power Generating Station Protection Systems	8.1.4.4.1				

TABLE 8.1-1: IDENTIFICATION OF SAFETY-RELATED CRITERIA (CONTINUED)

Criteria	Title	Applicable 8.1	SAR Sections 8.2	Discussing 8.3.1	Compliance 8.3.2	SAR Sections Discussing Compliance with Safety Criteria for Plant as a whole
IEEE-344 1971/1975	Guide for Seismic Qualification of Class I Electrical Equipment for Nuclear Power Generating Stations	8.1.4.4.1				
IEEE-379	Guide for the Application of the Single Failure Criterion to Nuclear Power Generating Station Protection Systems					See Compliance to RG 1.53
IEEE-382	Trial-Use Guide for the Type-Test of Class 1 Electric Valve Operators for Nuclear Power Generating Stations (ANSI N416)					See Compliance to RG 1.73
IEEE-383	Standard for Type-Test of Class 1E Electric Cable Field Splices, and Connections for Nuclear Power Generating Stations					8.3.3.1
IEEE-384	Criteria for Separation of Class 1E Equipment and Circuits					See Exceptions to RG 1.75, Appendix 3A
IEEE-387 1972	Criteria for Diesel-Generator Units Applied as Standby Power Supplies for Nuclear Power Stations					

TABLE 8.1-1: IDENTIFICATION OF SAFETY-RELATED CRITERIA (CONTINUED)

Criteria	Title	Applicable 8.1	SAR Sections 8.2	Discussing 8.3.1	Compliance 8.3.2	SAR Sections Discussing Compliance with Safety Criteria for Plant as a whole
IEEE-415	Planning of Pre-Operational Testing Programs for Class 1E Power Systems for Nuclear Power Generating Stations					See Technical Specifications
IEEE-420	Trial-Use Guide for Class 1E Control Switchboards for Nuclear Power Generating Stations (ANSI N41.7)					See Compliance to IEEE Standards 279, 323, 344, 336,338
IEEE-450 1975	Recommended Practice for Maintenance, Testing and Replacement of Large Stationary Type Power Plant and Substation Lead Storage Batteries	8.1.4.4.2			8.3.2.2.1	
IEEE-484 1975	Recommended Practice for Installation Design and Installation of Large Lead Storage Batteries for Nuclear Power Plants	8.1.4.4.2				
IEEE-387 1977	IEEE Standard Criteria for Diesel Generator Units Applied as Standby Power Supplies for Nuclear Power Generating Stations	8.1.4.4.1			8.3.1.2.1	

TABLE 8.1-1: IDENTIFICATION OF SAFETY-RELATED CRITERIA (CONTINUED)

Criteria	Title	Applicable 8.1	SAR Sections 8.2	Discussing 8.3.1	Compliance 8.3.2	SAR Sections Discussing Compliance with Safety Criteria for Plant as a whole
IEEE-387 1984	IEEE Standard Criteria for Diesel Generator Units Applied as Standby Power Supplies for Nuclear Power Generating Stations	8.1.4.4.1			8.3.1.2.1	
Regulatory Guide (RG)						
RG 1.6 Mar 1971	Independence Between Redundant Standby (Onsite) Power Sources and Between Their Distribution Systems	8.1.4.4.1		8.3.1.2.1.a.3		
RG 1.9 July 1993	Selection, Design, Qualification, and Testing of Emergency Diesel Generator Units Used as Class 1E Onsite Electric Power Systems at Nuclear Plants	8.1.4.4.1		8.3.1.1.4.1 8.3.1.1.4.2 8.3.1.2.1		See Appendix 3A for Exceptions See Technical Specifications
RG 1.29 Feb 1976	Seismic Design Classification	8.1.4.4.1				
RG 1.30 Aug 1972	Quality Assurance Requirements for the Installation, Inspection, and Testing of Instrumentation and Electric Equipment	8.1.4.4.1				See Appendix 3A for Compliance

TABLE 8.1-1: IDENTIFICATION OF SAFETY-RELATED CRITERIA (CONTINUED)

Criteria	Title	Applicable 8.1	SAR Sections 8.2	Discussing 8.3.1	Compliance 8.3.2	SAR Sections Discussing Compliance with Safety Criteria for Plant as a whole
RG 1.32 Feb 1977	Criteria for Class 1E Electric Systems for Nuclear Power Plants	8.1.4.4.1		8.3.1.2.1.a.5		
RG 1.40 Mar 1973	Qualification Tests for Continuous-Duty Motors Installed Inside the Containment of Water Cooled Nuclear Power Plants	8.1.4.4.1				
RG 1.41 Mar 1973	Preoperational Testing of Redundant Onsite Electric Power Systems to Verify Proper Load Group Assignments	8.1.4.4.1				14.2.12.1.44.c.5
RG 1.47 May 1973	Bypassed and Inoperable Status Indication for Nuclear Power Plant Safety Systems	8.1.4.4.1				
RG 1.53 June 1973	Application of the Single-Failure Criterion to Nuclear Power Plant Protection Systems	8.1.4.4.1				
RG 1.63 Oct 1973	Electric Penetration Assemblies in Containment Structures for Water-Cooled Nuclear Power Plants	8.1.4.4.1		8.3.1.2.3.1		

TABLE 8.1-1: IDENTIFICATION OF SAFETY-RELATED CRITERIA (CONTINUED)

Criteria	Title	Applicable 8.1	SAR Sections 8.2	Discussing 8.3.1	Compliance 8.3.2	SAR Sections Discussing Compliance with Safety Criteria for Plant as a whole
RG 1.68 Jan 1977	Preoperational and Initial Startup Test Programs for Water-Cooled Power Reactors					Refer to FSAR Section 14.2 for Compliance
RG 1.70 Sept. 1975	Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants					Refer to Entire FSAR for Compliance
RG 1.73 Jan 1974	Qualification Tests of Electric Valve Operators Installed Inside the Containment of Nuclear Power Plants	8.1.4.4.1				
RG 1.75 Jan 1975	Physical Independence of Electric Systems	8.1.4.4.1		8.3.1.4.1 8.3.1.4.2		
RG 1.81 Jan 1975	Shared Emergency and Shutdown Electric Systems for Multi-Unit Nuclear Power Plants	8.1.4.4.1		8.3.1.1.2.5		
RG 1.89 Nov 1974	Qualification of Class 1E Equipment for Nuclear Power Plants	8.1.4.4.1				See Appendix 3A for Exceptions
RG 1.93 Dec 1974	Availability of Electric Power Sources	8.1.4.4.1				See Appendix 3A For Exceptions
RG 1.100 Mar 1976	Seismic Qualification of Electric Equipment for Nuclear Power Plants					See Appendix 3A for Compliance

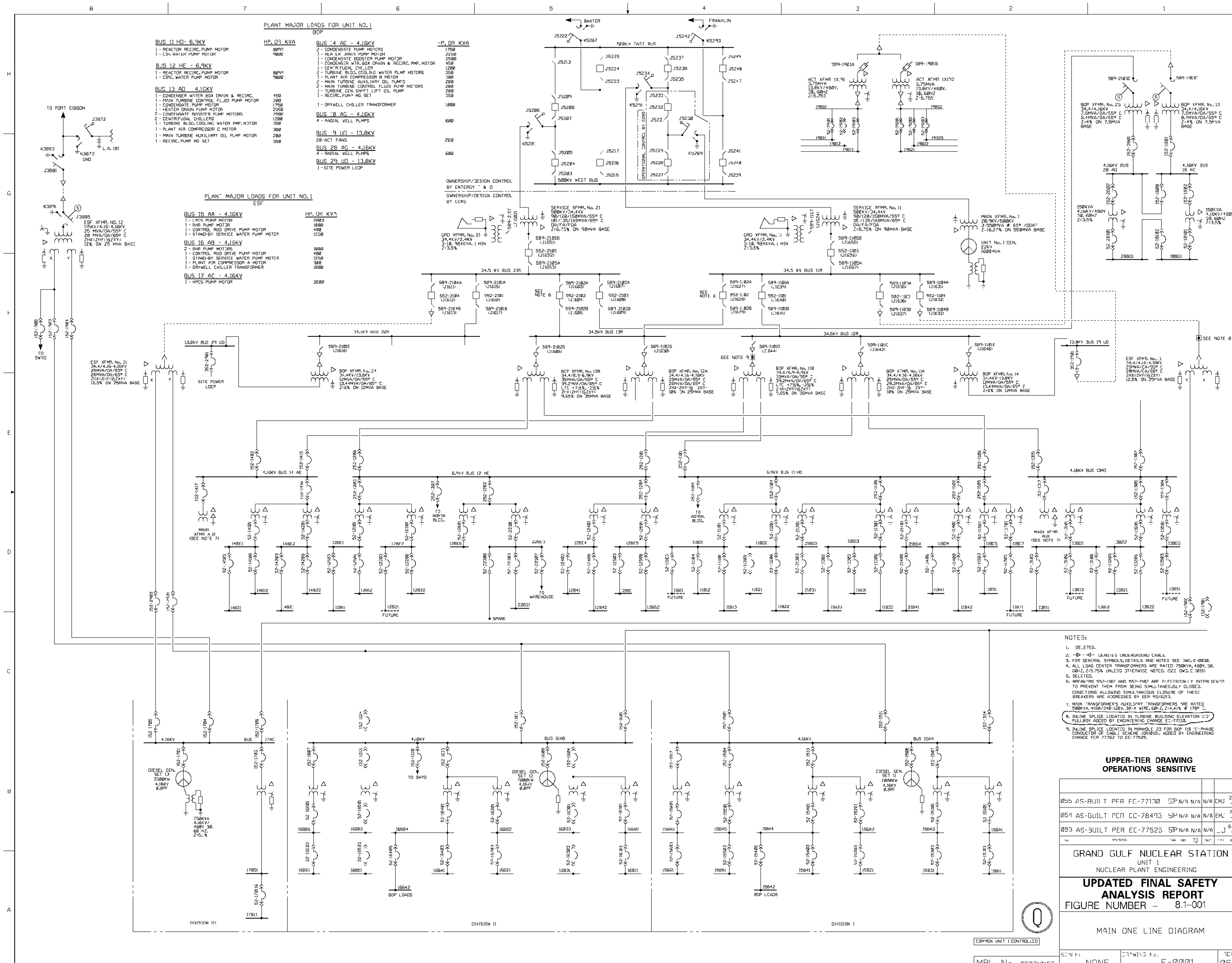
TABLE 8.1-1: IDENTIFICATION OF SAFETY-RELATED CRITERIA (CONTINUED)

Criteria	Title	Applicable 8.1	SAR Sections 8.2	Discussing 8.3.1	Compliance 8.3.2	SAR Sections Discussing Compliance with Safety Criteria for Plant as a whole
RG 1.106 Mar 1977	Thermal Overload Protection for Electric Motors on Motor-Operated Valves					7.1.2.6.22
RG 1.118	Periodic Testing of Electric Power and Protection Systems					See Note 1
RG 1.120	Fire Protection Guidelines for Nuclear Plants					See Note 1
RG 1.128	Installation Design and Installation of Large Lead Storage Batteries for Nuclear Power Plants					See Note 1
RG 1.129 April 1977	Maintenance, Testing and Replacement of Large Lead Storage Batteries for Nuclear Power Plants	8.1.4.4.2			8.3.2.2.1	
Branch Technical Positions (BTP) ICSB						
BTP ICSB 2	Diesel Generator Reliability Qualification Testing			8.3.1.1.4.1.1		
BTP ICSB 8	Use of Diesel Generator Sets for Peaking			8.3.1.1.4.1.b		
BTP ICSB 11	Stability of Offsite Power Systems	8.1.1 8.1.4.1.g	8.2.3			

TABLE 8.1-1: IDENTIFICATION OF SAFETY-RELATED CRITERIA (CONTINUED)

Criteria	Title	Applicable 8.1	SAR Sections 8.2	Discussing 8.3.1	Compliance 8.3.2	SAR Sections Discussing Compliance with Safety Criteria for Plant as a whole
BTP ICSB 15	Reactor Coolant Pump Breaker Qualification					Not Applicable to Boiling Water Reactors
BTP ICSB 17	Diesel Generator Protective Trip Circuit Bypasses			8.3.1.1.4.1.f		
BTP ICSB 18	Application of the Single Failure Criterion to Manually-Controlled Electrically-Operated Valves					See Compliance to RG 1.53
BTP ICSB 21	Guidance for Application of RG 1.47					7.5.1.3

Note 1: Not addressed in FSAR. Section D of Regulatory Guide indicates not applicable based on construction permit docket date.



LBDCR 2018033
LBDCR 2019004

8.2 OFFSITE POWER SYSTEM

8.2.1 Description

8.2.1.1 Transmission System

[HISTORICAL INFORMATION] [The Entergy Mississippi, Inc./Entergy Electric Systems, as shown in Figures 8.2-1 and 8.2-2 and described in subsection 8.1.1, supply the offsite ac power for starting, normal operation, and safe shutdown.

The offsite power system was designed and constructed with sufficient capacity and capability to assure that specified acceptable fuel design limits and conditions are not exceeded as a result of anticipated operational occurrences, that the core is cooled; and that the containment integrity, and other vital functions are maintained in the event of postulated accidents.]

The offsite power system consists of two independent systems, the 500 kV system and the 115 kV system as shown in Figures 8.2-2 and 8.2-3. The source of control power for all incoming circuit breakers (from the offsite power sources) associated with the 4.16 kV buses 15AA, 16AB, and 17AC is shown in Figure 8.2-6.

As discussed in Sections 8.1.2 and 8.2.1.2 the 1999 agreement between Entergy Mississippi and SERI (Ref. 1) addresses commitments and responsibilities regarding the GGNS switchyard and related transmission matters.

500 kV System

[HISTORICAL INFORMATION] [The 500 kV switchyard accommodates two 500 kV overhead lines: one terminating at the Baxter Wilson Substation and the other at the Franklin Substation. Layout of this switchyard is a breaker-and-a-half configuration on the GGNS Unit 1 Generator/Service Transformer 11 string and two-breaker-two-bus configuration on the Baxter Wilson, Franklin, and Service Transformer 21 strings. Power is provided to the ESF buses from two 500/34.5 kV service transformers located in the 500 kV switchyard This is shown in Figure 8.2-3 and fully described in subsection 8.2.1.2.

Offsite ac power source to the 500 kV switchyard is from two 500 kV lines, from the Franklin 500 kV Substation and the Baxter Wilson 500 kV Substation.

115 kV System

The 115 kV system consists of an overhead 115 kV line from the Port Gibson Substation terminated near the plant site to an underground 115 kV cable. The 115 kV cable feeds a 115 kV/4.16 kV ESF transformer located adjacent to the plant. This is shown in Figure 8.2-3.

The bulk power transmission and generation needs of the Entergy Electric System are planned on a system wide basis. In 1965 the basic 500 kV system now in operation was designed and put into operation. The system has proven to be highly reliable and has met the needs of the various companies.

The system is about 400 miles from north to south and 150 miles from east to west and serves approximately 22,000 megawatts of load on peak. This system interconnects to the east with the Tennessee Valley Authority; at West Memphis, Arkansas, and West Point, Mississippi. It interconnects to the southwest with Entergy Gulf States, Inc. at Willow Glen, Louisiana, and to the west with Oklahoma Gas and Electric at Fort Smith, Arkansas. Agreements with each of these utilities provide a most reliable and widely dispersed source of power, when connected at 500 kV over such relatively short distances. These interconnections serve to enhance the reliability of the 500 kV bulk power system of the Entergy Electric System. Other connections exist at 345, 230, 161, and 115 kV as shown in Figure 8.2-1. Direct generation connections to the 500 kV transmission are at Arkansas Nuclear Number One, Baxter Wilson, and Little Gypsy; other connections are made through step-up transformers at substations at West Memphis, Mabelvale, El Dorado, Baxter Wilson, Ray Braswell, Franklin, and Waterford, all in the Entergy System. Other connections are at O.G. & E., S.W.P.A., and T.V.A. These diverse power inputs provide a highly reliable source of power for the grid that supplies offsite power for Grand Gulf.]

Although the overall 500 kV system has been highly reliable, equipment failures in the Baxter Wilson Switchyard in 2000 and 2001 caused load loss at GGNS due to actuation of the Load Rejection Relay.

[HISTORICAL INFORMATION] [The offsite preferred power sources are the two 500 kV lines discussed in subsection 8.2.1 above and the 115 kV line from the Port Gibson 115 kV Substation serving the 115/4.16 kV ESF 12 transformer. This 115 kV power source is

completely independent from any one of the 500 kV lines for offsite power. The 115 kV line is on a completely different right-of-way from any of the 500 kV lines, in its routing to the Port Gibson Substation. The Port Gibson Substation is connected on the north to the Baxter Wilson 115 kV Substation, via the South Vicksburg Substation, where the Baxter Wilson Unit Number One is connected to the 115 kV bus. Port Gibson is connected on the south at the Natchez Generating Station 115 kV Substation, via the Fayette Substation, where a 73 MW unit is connected to the 115 kV system.

The Baxter Wilson 500 kV line is approximately 21.47 miles long, the Franklin 500 kV line is approximately 43.6 miles long, and the 115 kV line from Port Gibson is approximately 5.48 miles long. The Grand Gulf to Port Gibson 115 kV line does not cross over or under any of the 500 kV offsite power supply lines except on the east side of the 500 kV switchyard at Grand Gulf. At this point the 115 kV line is installed underground at the crossing point of the Grand Gulf-Franklin 500 kV line so that the failure of the 500 kV line cannot cause failure of the 115 kV power line. Neither of the two Grand Gulf 500 kV lines or the Grand Gulf to Port Gibson 115 kV line are on any common towers or common right-of-way.

These considerations dictated the divergence of the lines as they emanated from the 500 kV substation. The lines are widely dispersed to minimize the probability of multiple concurrent line damage by tornadoes.] |

The 500 kV grid transmission lines are designed with lattice steel towers. Foundations are reinforced, poured-in-place concrete with embedded stub angles. The conductors are 954 MCM ACSR with three conductors per phase arranged in a delta configuration. Conductor spacers are provided at about 240 feet spacing. Each span is provided with dampers on each conductor. The line is designed to meet the National Electrical Safety Code in all respects with the lines from Grand Gulf designed to meet the edition of the code in effect at the time of construction. Design loading conditions are one half inch of ice, 105 miles per hour wind.

Because of these design parameters, there have been no problems with aeolian vibration or galloping of the conductors. In all applications, this design has proven adequate for the conditions of this area.

Recent design changes and modifications of the light tangent 500 kV towers has increased the withstand capability of these towers in high winds. These towers were suspected to be weak in the longitudinal direction and test proved this to be so on towers having 25-foot and 30-foot leg extensions. These towers have been modified and are by test, capable of withstanding 110 mph wind loads. Although tornadoes are damaging and the destruction can be substantial, there has only been an average loss of two towers per year in the first 12 years of operation of the Entergy Mississippi, Inc. portion of the grid.

The 500 kV line from the Baxter Wilson substation has a nominal rating of 2598 MVA and the 500 kV line from the Franklin substation has a nominal rating of 1732 MVA. Additional 216 MVAR capacitor banks were installed in various 5000kV substations to meet EPU conditions (Ref. 3). This will meet the requirements under any expected contingencies.

The nominal voltage of the 500 kV grid is 510 kV. The maximum voltage of the grid is 525 kV. The minimum allowable voltage of the 500 kV grid is 491 kV. Recorded grid voltages in the past years indicate no voltage outside these limits.

8.2.1.2 Switchyard

[HISTORICAL INFORMATION] [The two 500 kV and one 115 kV lines described in subsection
8.2.1.1 provide three physically independent sources of preferred power to the three independent and redundant ESF load groups within the station.]

In Figure 8.1-1, which shows switchyard design responsibility, demarcation lines are similar for equipment ownership with Entergy Mississippi, Inc. owning equipment with Entergy Mississippi, Inc. design responsibility and SERI owning equipment with original design shown by Bechtel. Under the 1999 Entergy Mississippi/SERI agreement on switchyard and transmission interface (Reference 1) issues addressed and defined are:

- Exclusion Area Control, Switchyard Access and Security
- Operation of Equipment and Activities Performed in the Switchyard
- Maintenance of Switchyard Equipment
- Coordination of Planned Plant Outages and Activities Directly Affecting Power Supply to GGNS

- Review and Approval of Changes Which Might Affect Compliance with Regulatory Requirements and Commitments Which Could Affect Offsite Power Supply to GGNS and
- Procedures and Training on the Critical Need for Power at GGNS During Emergencies

SERI has transferred its maintenance and any related operational responsibilities to Entergy Operations, Inc.

In the manner stated in subsection 8.2.1.1, the 115 kV line approaches the 115 kV switchyard at the east end outside of the 500 kV switchyard. From that point the 115 kV power is brought into the station by underground duct and overhead lines as shown in Figure 8.2-3. The 500 kV switchyard is constructed on the east side of Grand Gulf; the 500 kV lines emanate to the east and to the north as shown in Figure 8.2-3. Included within its boundaries are the 500/34.5 kV service transformers and 34 kV oil breakers referred to as the “34.5kV switchyard” which provide two redundant offsite sources to the 34.5/4.16 kV ESF transformers as shown in Figure 8.1-1.

The station is constructed with rigid aluminum tubing supported on insulators and galvanized towers and pedestals. The breakers are 500 kV dead tank, arc suppressing. The layout of the substation is shown in Figure 8.2-3. The buses are constructed at 30 feet and 55 feet heights above ground. The buses are designed to withstand a maximum fault on any section. This is the maximum force-loading that the buses will be subjected to. Similar designs have been used in the past at the Baxter Wilson, Ray Braswell and Franklin 500 kV Substations and have proven to be adequate under all electrical fault and environmental conditions. [HISTORICAL INFORMATION] [The breaker switching configuration provides for the isolation of any faulted line without affecting the operation of any other line. This scheme also provides for the isolation of any one breaker in the 500 kV bus for inspection or maintenance without affecting the operation of any of the connecting lines or any other connection to the buses. The buses have adequate capacity to carry its load under any postulated switching sequences. The design provides for the isolation of any breaker, connecting the unit to the substation buses, without limiting the operation of the unit or any line connecting to the 500 kV power grid. Also either 500/34.5 kV service transformer breaker can be isolated and inspected or maintained as needed without affecting any line

or unit input. Either of the 500/34.5 kV service transformers can be taken out of service for inspection or maintenance without jeopardizing the operation for the other service transformer.

A fault of any section of 500 kV bus will be cleared by the adjacent breakers and will not interrupt operation of any of the remaining part of the 500 kV switchyard bus. Only that element connected to the faulted section will be interrupted.

The 500 kV substation is supplied with a breaker failure protective scheme in accordance with the North American Power Systems Interconnection Committee (NAPSIC) rules.

The switchyard is designed with a completely redundant protective scheme. There are three sources of ac auxiliary power with independent sets of power cables in physically separated raceways. There are two completely separate sets of dc batteries for dc supply with cables also separated physically in raceways.]

The two 4.16 kV auxiliary ac supplies originate at sources as shown on Figure 8.1-1. The other supply originates from the 13.8 kV bus in the 115 kV switchyard. Each is rated for 1000 kVA, and its design load is 225 kW when servicing a single system in the switchyard. The arrangement for the distribution of the ac power in the switchyard is shown in Figure 8.2-4.

The system is designed with adequate auxiliary equipment, standby power, and protection to provide maximum continuity of service, to thus insure operation of the essential switchyard auxiliary equipment during normal and emergency operating conditions, both during and after plant construction.

Of the three auxiliary ac power sources provided, one functions for normal switchyard service. The other two sources operate as standby sources for the normal operating system. The system shall automatically switch to a standby source on loss of the normal operating system.

An electrical interlock on breakers T01-2 and T02-2 prevents simultaneous operation of both systems on emergency supply T0-3). Manual override allows both systems to operate simultaneously on emergency supply.

The switchyard service power system will be aligned as shown on Figure 8.2-4.

The transfer switch shall automatically transfer its load circuit to an emergency or alternate power supply upon failure of its normal or original supply. Upon restoration of the normal supply, the transfer switch shall automatically retransfer its load circuits to the normal supply.

To avoid retransfer to an unstable normal supply, a retransfer delay of 0-5 minutes (adjustable) is provided. Time delay retransfer shall be bypassed on loss of emergency supply.

The transfer switch is a mechanically held device utilizing two circuit breakers. Circuit breakers are adjustable thermal magnetic breakers complete with wiring terminals. Circuit breaker lockout is provided to prevent transfer to emergency supply in case the normal breaker trips on overcurrent. The breaker handles are operated by a common transfer mechanism to provide fast-transfer, double throw switching action.

The transfer switch is mechanically and electrically interlocked so that a neutral position shall not be possible when under electrical operation. Nor shall it be possible for load circuits to be connected to normal and emergency sources simultaneously, regardless of whether the switch is electrically or manually operated.

The switch, however, has a manual neutral position for ease of load circuit maintenance. Manual operation may be accomplished by one person.

For complete protection, switches which close differential voltage sensing relays are provided to monitor each phase of the normal supply. A drop in voltage in any phase below the predetermined dropout value of the relay shall initiate load transfer. The relay(s) shall initiate retransfer of the load to the normal supply as soon as the voltage is restored in all phases beyond the predetermined pickup value of the relay.

Voltage sensing relays are electro-mechanical type. These relays are nominally set for 70 percent dropout and 90 percent pick-up.

The transfer switch obtains its operating current from the source to which the load is being transferred. Control power is separately fused for 120 V ac.

A key interlock on breakers P1-1, P1-2, P2-1, and P2-2 allows only three out of four breakers to be closed simultaneously.

The switchyard general alarm, signaled by the Balance-of-Plant (BOP) Process Computer, alerts the control room operator of abnormal or alarm conditions in switchyard components. The conditions which result in a switchyard general alarm are listed in Table 8.2-2. The switchyard annunciator panel provides the alarm signal to the process computer. The computer signals the alarm only. It does not identify the switchyard source. Upon receipt of the general alarm, the control room operator dispatches personnel to the switchyard control house to identify the source alarm point at the switchyard annunciator panel. Further operator action is dictated by the appropriate alarm response instruction or the Entergy Mississippi, Inc. dispatcher. Further detailed information regarding the alarm condition is obtained locally at the alarming switchyard component.

[HISTORICAL INFORMATION] [The dc requirements for the switchyard relay and control systems are provided by two independent sets of 125 volt batteries. Each of these dc systems is supported by its own charger which has redundant ac power supplies. The distribution systems for the two battery systems are physically separated in so far as possible in all areas. This separation extends to dual cable tray systems in the control building and dual cable trenches in the switchyard. The communications facilities and power line carrier are also supplied by the 125 volt batteries.

All of the protective relay systems in the 500 kV switchyard are redundant. These schemes are overlapping so that each switchyard high-voltage component is covered by at least two sets of protective relays. Where the relay systems are redundant, each scheme is supplied with separate current inputs, operates on a separate battery system, and is connected to separate trip coils of the power circuit breakers. The potentials for these schemes are provided from one set of potential transformers on each 500 kV bus. The secondary potentials are separated into two systems at the junction box in the switchyard and are treated as redundant systems from this point with separation by cable trenches and trays. In addition, a potential transfer scheme is provided between the primary potentials of each bus to the opposite bus and the redundant potentials of each bus to the opposite bus.

Batteries are physically separated by being installed in separate battery rooms within the control room. All cables leaving the control room exit through terminal cabinets associated with either the primary or redundant cable trench system. All breaker closing functions are associated with the backup dc system.

The physical separation between the preferred power sources from the service transformers and ESF transformers to the onsite Class IE power system is shown pictorially in Figure 8.2-3 to the point where the voltage is transformed down to 4.16 kV. This occurs at the three ESF transformers. Figure 8.2-5 expands and details Figure 8.2-3, for clarity, and provides additional detail on separation of the three divisions from the point described to the ESF load groups shown in Figure 8.3-3.

The preferred power sources are not Class IE and are not manufactured and purchased under a quality assurance program as described in Chapter 17. However, all material is the highest grade of commercial equipment manufactured to the industrial standard listed in subsection 8.2.1.4. The design has been made in the same fashion as Class 1 systems and subjected to essentially the same reviews, checks, and calculation methods. This design is considered to meet the requirements of General Design Criterion 1 as evoked for the offsite (preferred) power system.]

In satisfaction of General Design Criterion 3, the three offsite power systems have spatial separation and/or totally enclosed raceways over their entire length. Fire protection and detection is provided as discussed in subsections 9.5.1 and 9.5.1.2.2.4.

In satisfaction of General Design Criterion 4, two of the offsite power sources are routed in duct banks and trenches below grade in exterior areas, and the third source is routed overhead in cable trays. There is great spatial distance between the cable tray route and the below grade routes as physically depicted in Figure 8.3-5.

Thus all features of the offsite (preferred) power supply are designed to provide maximum practical reliability and total redundancy in servicing the station safety load groups. Compliance with General Design Criterion 17, “Electric Power System,” is demonstrated by supplying the switchyard with offsite ac power by means of two 500 kV and one 115 kV physically independent circuits. Furthermore, the offsite power sources to the engineered safety features (ESF) buses are then brought in by

three physically independent circuits from this switchyard and the 115 kV transformer through ESF transformers. Physical separation, the breaker switching configuration, redundant switchyard protection systems, and transmission system are designed on load flow and stability studies so as to minimize simultaneous failure of all offsite power sources.

Station Service Transformers ST11 and ST21 and Engineered Safety Features Transformer ESF12 are monitored with an Open Phase Detection System. NRC Bulletin 2012-01 discusses that an Open Phase Condition, with or without accompanying ground faults, located on the high voltage side of a transformer connecting a GDC-17 offsite power circuit to the plant electric system, could result in a degraded condition in the onsite power system. Redundant Open Phase Detection Systems are installed on ST11, ST21, and ESF12 to monitor for an Open Phase Condition. Upon detection of an Open Phase Condition, the system provides an alarm to the Main Control Room.

Compliance with General Design Criterion 18 is achieved by designing testability and inspection capability into the system and then implementing a comprehensive testing and surveillance program. Surveillance and monitoring is further discussed in subsection 8.2.1.3. As previously stated in this subsection, the inspection and testing of the 500 kV, 115 kV, and 34.5 kV breakers, disconnects, and the transmission line protective relaying can be done on a routine basis, without removing the service and engineered safety features transformers and most transmission lines (offsite circuits) from service.

Compliance with General Design Criteria 17 and 18 at the onsite power interface is additionally addressed in subsection 8.3.1.2.

8.2.1.3 Offsite Power System Monitoring and Surveillance

The transmission lines of Entergy Mississippi, Inc. are routinely inspected by an aerial observer and those lines employing wooden poles are periodically inspected by walking patrol. These inspections are done in accordance with Entergy Transmission Maintenance Standards to ensure continued reliable operation of the transmission lines.

Routine maintenance on power circuit breakers will be performed as required to verify that all design criteria for operation are not exceeded.

As discussed in Sections 8.1.2 and 8.2.1.2, the Entergy Mississippi/SERI switchyard agreement addresses maintenance of offsite power supply equipment.

Control and protective breakers are separated to the maximum extent possible to ensure that failure of any item will not impair system protection.

Calibration checks of the protective relay systems in the switchyard will be performed on a routine interval not to exceed two fuel cycles. Functional checks of relay and control equipment will also be made on a two-fuel cycle interval.

Protective relay operation is annunciated locally and/or in the control room (PGCC) and may be simultaneously inputed to the balance-of-plant computer. The computer acts as a data logger with or without additional alarm, dependent on the nature of the protective action. A tabulation of these alarms is given in Table 8.2-2.

[HISTORICAL INFORMATION] [The Entergy Mississippi, Inc. system dispatcher has control of all 500 kV switchyard components except for the synchronizing breakers, which are under control of the plant operator.
Information transmitted back to the system dispatcher includes watt and var loadings of all lines, transformers, and generators, as well as status of all controlled devices. Various switchyard alarms are also transmitted to the system dispatcher to enable him to take necessary steps to have problems corrected before they become serious. In addition to the SCADA system that reports to the Entergy Mississippi, Inc. system dispatcher, a separate remote supervisory is in operation. This unit will report to the Entergy System Operating Center in Pine Bluff, Arkansas for input to the Entergy generation control, Fossil Energy Management Organization in Houston, Texas, and Cooperative Energy control center. Quantities transmitted include watt and var loadings watt accumulator points.] The events involving switchyard components requiring plant operator information or action are annunciated in similar fashion as the protective devices, and are tabulated in Table 8.2-2.

8.2.1.4 Standards and Guides

In addition to the NRC Design Criteria and NAPSIC document addressed in subsection 8.2.1.2, the following listed industry guides and standards, and references thereto, have been used in the design and procurement of the offsite power system:

a. IEEE Standard 450-1972, IEEE Recommended Practice for Maintenance, Testing and Replacement of Large Stationary Type Power Plant and Substation Lead Storage Batteries

b. ANSI C37.010-1969, Application Guide for AC High Voltage Circuit Breakers

c. ANSI C37.90-1971, IEEE Standard for Relays and Relay Systems Associated with Electric Power Apparatus

d. ANSI C57.12.00-1968, General Requirements for Distribution, Power, Regulating Transformers and Shunt Reactors

e. IPCEA Standard SS-66-524-1971, Cross-Linked-Thermosetting Polyethylene Insulated Wire and Cable for Transmission and Distribution of Electrical Energy

8.2.2 Analysis

8.2.2.1 Availability Considerations

As discussed in Subsection 8.2.1.2, the Entergy Mississippi/SERI switchyard agreement addresses coordination of activities directly affecting power supply to GGNS and procedures and training on the critical need for power at GGNS during emergencies.

[HISTORICAL INFORMATION] [The 500 kV and 115 kV transmission lines and their associated structures, interconnecting the switchyard with the system, are designed to withstand the loading conditions for environmental conditions prevalent in the area in regard to wind, temperature, lightning, and flood so as to minimize failure.

The transmission lines approach the switchyard on separate rights-of-way on the east side of the switchyard. Due to this separation, failure of one line will not cause failure of another line.

Constructively, three independent and redundant transmission lines are provided as initial offsite (preferred) power sources to the safety load groups. Upon merging in the switchyard, independence of one 500 kV line is lost, but three completely independent offsite sources are made available for the safety load groups which, as is shown in Section 8.3, remain independent down to the lowest voltage level of distribution.] These sources are the two 34.5-4.16 kV and one 115-4.16 kV ESF transformers as shown in Figure 8.1-1.

The 500 kV switchyard utilizes both “breaker-and-a-half” and “two-breaker-two-bus” configuration for its inter-bus circuits, along with breaker failure backup protection. With this configuration, reliability, and operating flexibility:

a. Any transmission line can be cleared under normal or fault conditions without affecting any other transmission line

b. Any system circuit breaker can be isolated for maintenance without interrupting the power or protection to any circuit.

c. Short circuits on a section of a bus are isolated without interrupting service to any circuit other than that connected to the faulty bus section.

[HISTORICAL INFORMATION] [The 500 kV switchyard is provided with two independent dc power systems which provide a highly reliable and continuously available source of dc power. Also three physically independent auxiliary ac power circuits are provided. Two of the three ac sources are derived from separate ESF buses which can be fed from the diesel generator. These provisions minimize the possibilities of losing ac and dc power sources in the switchyard.

The two 34.5 kV switchyards are independent of each other. Each 34.5 kV switchyard receives an independent auxiliary ac power feed from the 500 kV switchyard, and two independent dc control power feeds from the plant BOP dc batteries. Each 34.5 kV switchyard has a main incoming breaker and several feeder breakers. Each 34.5-4.16 kV ESF transformer is controlled by a 34.5 kV breaker. The main incoming breakers are provided with two trip coils, each controlled from a different battery.

The three independent circuits from the switchyard to the engineered safety features transformers are routed separately as shown in Figure 8.2-3. Due to this separation, a failure of one circuit will not cause the failure of the other circuits. Therefore, and as previously stated, these three transformers provide separate and redundant sources to safety load groups.

While it is improbable that all transmission lines could be out of service simultaneously, such an event would not jeopardize a safe shutdown of the station because the onsite standby diesel generators would be able to supply the necessary power to systems required for safe shutdown or LOCA.]

With any single line in service under its design condition of operation, sufficient offsite power would be available to handle a LOCA and subsequent safe shutdown of the unit.

8.2.3 Stability

[HISTORICAL INFORMATION] [Entergy Corporation is a member of the Southeastern Electric Reliability Council (SERC). Guidelines of the SERC provide assurance that transmission systems that are part of the interconnected network are planned, designed, and constructed to operate reliably within thermal, voltage, and stability limits. Through membership in the SERC, GGNS ensures grid stability such that there is reasonable assurance that the ability of the Entergy grid to provide offsite power to the Grand Gulf Nuclear Station will not be impaired by the loss of the largest external single supply to the grid, the loss of the most critical transmission line, or the loss of the Grand Gulf Unit itself. Standard stability studies, updated periodically, confirm that the offsite network performs in a stable, reliable manner in response to system perturbations.] To ensure stability after the Extended Power Uprate (EPU), capacitor banks were added to several substations (see Ref. 3).

A listing of contingencies, as conducted for 2014 thru 2018 peak and off-peak cases for Unit No. 1 at Grand Gulf, is attached in Table 8.2-3. This list indicates that there are no overloads or unacceptable bus voltages during these contingencies. These studies also indicate that the system is adequate to maintain the offsite sources during any postulated accidents.

The attached Table 8.2-4 indicates that the system is stable under all conditions that were studied. Stability studies have been conducted in recent years for each major addition to the system and each study has indicated the system to be stable for each contingency.

8.2.4 Operating Limits

The continuous operating limits that were utilized in the design of the auxiliary electrical distribution system for Grand Gulf are as follows:

1. System Voltage

    a. 500 kV system - nominal: 510 kV

    minimum: 491 kV

    maximum: 525 kV

b. 115 kV system - nominal: 115 kV

minimum: 112.125 kV

maximum: 120.75 kV

2. System Frequency - nominal: 60 Hz

minimum: 58.5 Hz

maximum: 61.8 Hz

3. System Capacity

a. 500 kV system - minimum: 6004 MVA

b. 115 kV system - minimum: 481 MVA

The basis for the selection of the operating limits is as follows:

1. System Voltage: The system voltage limits are dictated in part by the following considerations:

   a. The ability to start and operate electrically driven equipment for all conditions of system voltage extremes without exceeding the voltage tolerances of the motors (± 10%)

   b. The ability to operate the turbine generator within its continuous operation, extreme voltage limits (± 5%) while maintaining rated output

The limit for minimum 500 kV system voltage is established by analysis of the Class 1E ESF buses (Ref.2) to be ≥ 487.5 kV or 0.975 per unit. An allowable value of ≥ 491 kV includes an allowance for instrument uncertainty associated with the voltage measurement in the switchyard. Surveillance procedures check that adequate electrical voltage and frequency levels exist on the offsite power sources. Indicated voltage and frequency values from the switchyard are checked against the continuous operating limits for system voltage and system frequency.

2. System Frequency: The system frequency limits are dictated in part by the following considerations:

   a. The ability to maintain continuous operation of the electrically driven equipment without exceeding the frequency tolerances of the motors (± 5%)

   b. The ability to operate the turbine generator within its continuous operation, extreme frequency limits (- 5%, + 3%) while maintaining rated output

3. System Capacity: The system capacity limits are a function of the transmission system configuration and its effect on the minimum available short circuit level. For the 500 kV switchyard, the system capacity figure of 6004 MVA is equivalent to the minimum short circuit level available from the transmission system with only one EHV line in service (Baxter Wilson line). The 115kV Port Gibson line minimum short circuit system capability is 481 MVA with only the transmission line from Baxter Wilson to

Port Gibson in service. The 115kV line integrity and load flows are monitored by Entergy Mississippi, Inc. dispatchers, while capacity is not. Switching performed on the 115kV line is cleared with the GGNS operator and the operator is verbally informed by the Entergy Mississippi, Inc. dispatchers as to the status of the line.

Power within the Entergy Electric System will be distributed by the Entergy System operator in Pine Bluff, Arkansas, through the Entergy Mississippi, Inc. dispatcher in Jackson, Mississippi. Entergy Corporation is a member of the Southeastern Electric Reliability Council and adheres to the rules set by the North American Electric Reliability Council (NERC). The Entergy System operator follows the recommendations of the NERC Operating Guides in maintaining voltage and frequency throughout the system and coordinates the distribution of real and reactive power.

8.2.5 REFERENCES

1. Letter, M. R. Kansler to W. A. Eaton, “Switchyard and Transmission Interface Agreements,” March 31, 1999 (CEO-99/00088)

2. Calculation EC-Q1111-90028, AC Power Systems Analysis

3. Letter, A. B. Wang, NRC to Vice President, Operations, Entergy Operations, Inc., Grand Gulf Nuclear Station, “Grand Gulf Nuclear Station Unit 1 - Issuance of Amendment RE: Extended Power Uprate (TAC No. ME4679),” July 18, 2012

TABLE 8.2-1: DELETED

TABLE 8.2-1A: DELETED

TABLE 8.2-2: SWITCHYARD ALARMS AND ANNUNCIATION

	SOE	PGCC Annun	LOC Annun	Computer W/o Alm	Computer W/Alm
Service Trans ST11 Alarm					
Ser. Trans. ST11 PRI L/O Trip	X	X		X	
Loss of Cont Volt		X		X	
Serv. Trans Sec L/O Trip	X	X		X	
Winding Temp HI			X	X	
Oil Temp HI			X	X	
PRD Operate			X	X	
Oil Flow LO			X	X	
Cooler Power U/V			X	X	
Gas Detector Oper.			X	X	
Low Oil Level			X	X	
Sudden Press Trip	X	X			
Sudden Press Oper			X		X
Serv XFMR Trouble		X			
Cooler Power Auto Transfer			X	X	
ST11 XFMR Primary Diff. Relay	X				
Grnd. XFMR 11 Overcurrent Relay	X				
Grnd. XFMR 11 Neutral O/C Relay	X				
ST11 XFMR BU Diff. Relay	X				
ST11 XFMR O/C Relay	X				
ST11 XFMR Neutral O/C Relay	X				
Grndg XFMR 11 OV. Volt Relay	X				

TABLE 8.2-2: SWITCHYARD ALARMS AND ANNUNCIATION (CONTINUED)

	SOE	PGCC Annun	LOC Annun	Computer W/o Alm	Computer W/Alm
Service Trans ST21 Alarm					
Ser. Trans. ST21 PRI Lockout Trip	X	X	X		
Loss of Cont Volt		X	X		
Ser. Trans. ST21 Sec L/O Trip	X	X		X	
Open Phase Detection			x		
Winding Temp HI			X	X	
Oil Temp HI			X	X	
PRD Operate			X	X	
Oil Flow LO			X	X	
Cooler Power U/V			X	X	
Gas Detector Oper.			X	X	
Low Oil Level			X	X	
Sudden Press Trip	X	X			
Sudden Press Oper			X		X
Serv XFMR Trouble		X			
Cooler Power Auto Transfer			X	X	
ST21 XFMR PRI Diff. Rly	X				
Grndg XFMR 21 O/C Diff. Rly	X				
Grndg XFMR 21 Neutral O/C Rly	X				
ST21 XFMR BU Diff. Rly	X				
Open Phase Detection				X	
ST21 O/C Relay	X				
ST21 Neutral O/C Rly	X				
Grndg XFMR 21 OV. Volt Relay	X				

TABLE 8.2-2: SWITCHYARD ALARMS AND ANNUNCIATION (CONTINUED)

Alarm Description	SOE	PGCC Annun	LOC Annun	Computer W/o Alm	Computer W/Alm
GCB J5204 Position					X
GCB J5208 Position					X
GCB J5216 Position					X
GCB J5224 Position					X
GCB J5228 Position					X
GCB J5232 Position				X	
GCB J5236 Position				X	
GCB J5240 Position				X	
GCB J5248 Position				X	
DISC J5222 Position				X	
DISC J5242 Position				X	
DISC J5230 Position				X	
DISC J5234 Position				X	
DISC J5206 Position				X	
Bkr J5228 Failure Trip	X				X
Bkr J5232 Failure Trip	X				X
34kV Bus 21R Lockout Trip		X		X	

TABLE 8.2-2: SWITCHYARD ALARMS AND ANNUNCIATION (CONTINUED)

Alarm Description	SOE	PGCC Annun	LOC Annun	Computer W/o Alm	Computer W/Alm
Bus 21R Loss of Cont Volt					X
34kV Bus 11R Lockout Trip		X		X	
Bus 11R Loss of Cont Volt					X
Generator Brkr Auto Trip J5228	X				X
Generator Brkr Auto Trip J5232	X				X
Bkr J1656 Trip		X		X	
Bkr J1632 Trip		X		X	
Bkr J1636 Trip		X		X	
Bkr J1628 Trip		X		X	
Bkr J1640 Trip		X		X	
Comp Press Low J1656					X
Comp Press Low J1632					X
Comp Press Low J1636					X
Comp Press Low J1628					X
Comp Press Low J1640					X
Brkr J1652 Trip		X		X	
Brkr J1612 Trip		X		X	
Brkr J1608 Trip		X		X	
Brkr J1604 Trip		X		X	
Brkr J1616 Trip		X		X	
Comp Press Low Brkr J1652					X

TABLE 8.2-2: SWITCHYARD ALARMS AND ANNUNCIATION (CONTINUED)

Alarm Description	SOE	PGCC Annun	LOC Annun	Computer W/o Alm	Computer W/Alm
Comp Press Low Brkr J1612					X
Comp Press Low Brkr J1608					X
Comp Press Low Brkr J1604					X
Comp Press Low Brkr J1616					X
Brkr J1652 Failure L/O Trip					X
Brkr J1656 Failure L/O Trip					X
GCB J5204 Trouble Alarm					X
GCB J5208 Trouble Alarm					X
GCB J5216 Trouble Alarm					X
GCB J5224 Trouble Alarm					X
GCB J5228 Trouble Alarm					X
GCB J5232 Trouble Alarm					X
GCB J5236 Trouble Alarm					X
GCB J5240 Trouble Alarm					X
GCB J5248 Trouble Alarm					X

TABLE 8.2-2: SWITCHYARD ALARMS AND ANNUNCIATION (CONTINUED)

Switchyard General Alarm (Consists of the Following)

Relay Potential Failure West Bus Backup

Relay Potential Failure East Bus Backup

Low Battery "D"-125 V dc-Primary

Low Battery "D"-48 V dc-Primary

Loss of Station ac No.1 Primary

Low Battery "E" 125 V dc-Backup

Low Battery "E" 48 V dc-Backup

Loss of Station ac No. 2 – Backup

Relay Potential Failure-West 500 kV Bus Primary

Relay Potential Failure-East 500 kV Bus Backup

Loss of ac Source No. 1-Unit 1 ESF

Station Power Switch-T01-Emergency Position

Station Power Switch-TO2-Emergency Position

Station Power Switch-T03-Emergency Position

TABLE 8.2-3: GRAND GULF LOAD FLOW STUDIES

Case	Contingency Description	Result (See Note 1)
1	Base Case - Normal Conditions	No Problems
2	Port Gibson Capacitor Bank Out of Service & GGNS Online	No Problems
3	Port Gibson Capacitor Bank Out of Service & GGNS Online	No Problems
4	Swartz To Alto 115kV Out Of Service & GGNS Offline	No Problems
5	Winnsboro To Gilbert 115 kV Out Of Service & GGNS Offline	No Problems
6	Franklin To Meadville 115 kV Out Of Service	No Problems
7	Natchez to Washington Out of Service & GGNS Offline	No Problems
8	Baxter Wilson To So. Vicksburg 115 kV Out Of Service & GGNS Offline	No Problems
9	Port Gibson To So. Vicksburg 115 kV Line Out of Service & GGNS Offline	No Problems
10	Port Gibson To Lorman 115 kV Out of Service & GGNS Offline	No Problems
11	Natchez To Fayette 115 kV Out Of Service & GGNS Offline	No Problems
12	Ray Braswell To Baxter Wilson 500kV Out Of Service & GGNS Offline	No Problems
13	Baxter Wilson To Perryville 500kV Out Of Service & GGNS Offline	No Problems

TABLE 8.2-3: GRAND GULF LOAD FLOW STUDIES (CONTINUED)

Case	Contingency Description	Result (See Note 1)
14	Franklin To Ray Braswell 500kV Out Of Service & GGNS Offline	No Problems
15	Franklin To McKnight 500 kV Out Of Service & GGNS Offline	No Problems
16	Franklin To GGNS 500 kV Out Of Service & GGNS Offline	No Problems
17	Baxter Wilson To GGNS 500 kV Out Of Service & GGNS Offline	No Problems
18	Franklin To Adams Creek 500 kV Out Of Service & GGNS Offline	No Problems
19	Baxter Wilson Unit 1 Out Of Service & GGNS Offline	No Problems
20	Baxter Wilson Unit 2 Out Of Service & GGNS Offline	No Problems
21	Baxter Wilson 500/11 kV Auto Transformer Out Of Service & GGNS Offline	No Problems

Note 1

The Load Flow Studies for the Transmission Grid were performed using the latest power flow models of the Entergy Transmission System including peak and off-peak cases for the years 2014 through 2018. The results of the analysis indicate that the contingencies in the area around Grand Gulf (GGNS) will produce voltages at the GGNS 500KV and 115KV buses that are within the limits given in ENS-DC-199.

TABLE 8.2-4: SYSTEM STABILITY STUDIES

Fault Cases in this Study: 3 Phase faults simulated for stability analysis					
CASE	**LOCATION**	**TYPE**	**CLEARING TIME (cycles)**	**BREAKER TRIP #**	**TRIPPED FACILITIES ?**
Fault 1	G. Gulf - B. Wilson 500 kV	3 PH	5	J5224, J5216, J2240, J2244	G. Gulf - B. Wilson 500kV
Fault 2	G. Gulf - Franklin 500 kV	3 PH	5	J2425, J2420, J5248, J5240	G. Gulf - Franklin 500kV
Fault 3	B. Wilson - Perryville 500 kV	3 PH	5	R7372, R9872, J2233, J2218	B. Wilson - Perryville 500kV
Fault 4	B. Wilson - Ray Bras-well	3 PH	5	J4928, J4920, J2230, J2233	B. Wilson - Ray Bras-well
Fault 5	B. Wilson 500/115kV transformer #1	3 PH	5	J2214, J2222	B. Wilson 500/115kV transformer #1
Fault 6	Ray Braswell -Franklin 500 kV	3 PH	5	J2404, J2408, J4914, J4944	Ray Braswell -Franklin 500kV
Fault 7	Ray Braswell -Lakeover 500 kV	3 PH	5	J4928, J4908, J9218, J9234	Ray Braswell -Lakeover 500kV
Fault 8	Ray Braswell - B. Wilson 500 kV	3 PH	5	J4928, J4920, J2230, J2233	Ray Braswell - B. Wilson 500kV
Fault 9	Ray Braswell 500/230kV Transformer #1	3 PH	5	J4904, J4917	Ray Braswell 500/115kV Transformer #1
Fault 10	Ray Braswell 500/230kV Transformer #1	3 PH	5	J4914, J4952	Ray Braswell 500/230kV Transformer #1

TABLE 8.2-4: SYSTEM STABILITY STUDIES (CONTINUED)

Fault Cases in this Study: 3 Phase faults simulated for stability analysis					
CASE	**LOCATION**	**TYPE**	**CLEARING TIME (cycles)**	**BREAKER TRIP #**	**TRIPPED FACILITIES ?**
Fault 11	Franklin - McKnight 500kV	3 PH	5	BRK#21105, BRK#21110, J2416, J2412	Franklin - McKnight 500kV
Fault 12	Franklin - Bogal USA - Adams Creek 500kV	3 PH	5	S4402, S4405,S7569 J2416, J2420	Franklin - Bogal USA - Adams Creek 500kV
Fault 13	Franklin - Ray Braswell 500kV	3 PH	5	J2404, J2408, J4914, J4944	Franklin - Ray Braswell 500kV
Fault 14	Franklin - G. Gulf 500kV	3 PH	5	J2425, J2420, J5248, J5240	Franklin - G. Gulf 500kV
Fault 15	Franklin 500/115kV transformer #1	3 PH	5	J2425, J2404	Franklin 500/115kV transformer #1

TABLE 8.2-4: SYSTEM STABILITY STUDIES (CONTINUED)

List of 3 Phase Stuck Breaker (IPO: 3PH-1PH) faults simulated for stability analysis									
CASE	**LOCATION**	**TYPE**	**CLEARING TIME (cycles)**		**SLG FAULT IMPEDANCE (MVA)**	**STUCK BREAKER #**	**PRIMARY BREAKER TRIP**	**SECONDARY BREAKER TRIP**	**TRIPPED FACILITIES**
			PRIMARY	**Backup**					
FAULT 1a	G. Gulf - B. Wilson 500kV	3PH/ SLG	5	9	640.02-j8505.34	J5224	J5216, J2240, J2244	J5208, J5236, J5248	G. Gulf - B. Wilson 500kV
FAULT 2b	G. Gulf - Franklin 500kV	3PH/ SLG	5	9	640.02-j8505.34	J5248	J2425, J2420, J5240	J5208, J5236, J5224	G. Gulf - Franklin 500kV
FAULT 3a	B. Wilson - Perryville 500kV	3PH/ SLG	5	9	779.96-j8641.41	J2233	R7372, R9872, J2218	J2230, J4928, J4920	B. Wilson - Perryville 500kV; B. Wilson Ray Braswell 500kV
FAULT 3b	B. Wilson - Perryville 500kV	3PH/ SLG	5	9	779.96-j8641.41	J2218	R7372, R9872, J2233	J2214, J2252, J2225	B. Wilson - Perryville 500kV; B. Wilson 500/115kV Transformer #1
FAULT 4a	B. Wilson - Ray Braswell 500kV	3PH/ SLG	5	9	779.96-j8641.41	J2233	J4928, J4920, J2230	R7372, R9872, J2218	B. Wilson - Ray Braswell 500kV; B. Wilson - Perryville 500kV
FAULT 4b	B. Wilson - Ray Braswell 500kV	3PH/ SLG	5	9	779.96-j8641.41	J2230	J4928, J4920, J2233	J2240, J2236, J2222	B. Wilson - Ray Braswell 500kV
FAULT 5a	B. Wilson 500/115kV transformer #1	3PH/ SLG	5	9	779.96-j8641.41	J2214	J2222	J2218, j2252, J2225	B. Wilson 500/115kV transformer #1
FAULT 6a	Ray Braswell - Franklin 500kV	3PH/ SLG	5	9	643.2-j6126.3	J4908	J2404, J2408, J4914	J4904, J4908, J4914	Ray Braswell - Franklin 500kV; Ray Braswell - Lakeover 500kV

TABLE 8.2-4: SYSTEM STABILITY STUDIES (CONTINUED)

List of 3 Phase Stuck Breaker (IPO: 3PH-1PH) faults simulated for stability analysis

CASE	LOCATION	TYPE	CLEARING TIME (cycles)		SLG FAULT IMPEDANCE (MVA)	STUCK BREAKER #	PRIMARY BREAKER TRIP	SECONDARY BREAKER TRIP	TRIPPED FACILITIES
			PRIMARY	Backup					
FAULT 6b	Ray Braswell - Franklin 500kV	3PH/ SLG	5	9	643.2-j6126.3	J4914	J2404, J2408, J4944	J4908, J4904, J4932	Ray Braswell - Franklin 500kV; Ray Braswell 500/230kV transformer #2
FAULT 7a	Ray Braswell - Lakeover 500kV	3PH/ SLG	5	9	635.0-j6100.6	J4928	J4908, J9218, J9234	J2230, J2233, J4920	Ray Braswell - Lakeover 500kV; Ray Braswell - B Wilson 500kV
FAULT 7b	Ray Braswell - Lakeover 500kV	3PH/ SLG	5	9	635.0-j6100.6	J4908	J4928, J9218, J9234	J4904, J2404, J4944, J4932	Ray Braswell - Lakeover 500kV
FAULT 8a	Ray Braswell - B. Wilson 500kV	3PH/ SLG	5	9	548.2-j5599.2	J4928	J4920, J2230, J2233	J4908, J9218, J9234	Ray Braswell - B. Wilson 500kV; Ray Braswell - Lakeover 500kV
FAULT 8b	Ray Braswell - B. Wilson 500kV	3PH/ SLG	5	9	548.2-j5599.2	J4920	J4928, J2230, J2233	J4936, J4917	Ray Braswell - B. Wilson 500kV
FAULT 9a	Ray Braswell 500/115kV Transformer #1	3PH/ SLG	5	9	737.2-j6899.6	J4904	J4917	J4908, J4944, J4932	Ray Braswell 500/115kV Transformer #1
FAULT 9b	Ray Braswell 500/115kV Transformer #1	3PH/ SLG	5	9	796.4-j6899.6	J4917	J4904	J4952, J4936	Ray Braswell 500/115kV Transformer #1
FAULT 10a	Ray Braswell 500/230kV Transformer #2	3PH/ SLG	5	9	769.4-j6899.6	J4914	J4952	J2404, J2408, J4944	Ray Braswell 500/230kV Transformer #2; Ray Braswell - Franklin 500kV

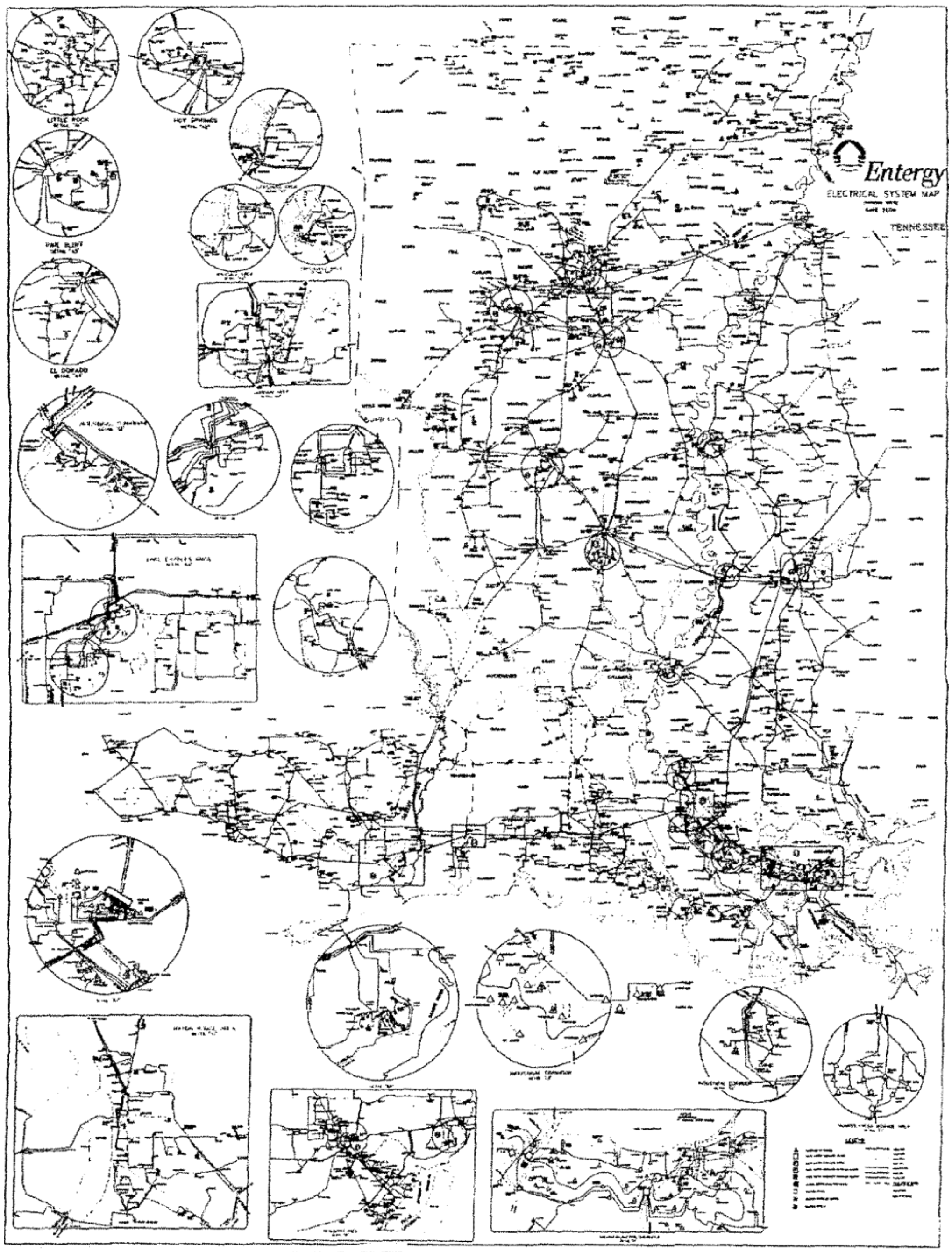
TABLE 8.2-4: SYSTEM STABILITY STUDIES (CONTINUED)

List of 3 Phase Stuck Breaker (IPO: 3PH-1PH) faults simulated for stability analysis									
CASE	**LOCATION**	**TYPE**	**CLEARING TIME (cycles)**		**SLG FAULT IMPEDANCE (MVA)**	**STUCK BREAKER #**	**PRIMARY BREAKER TRIP**	**SECONDARY BREAKER TRIP**	**TRIPPED FACILITIES**
			PRIMARY	**Backup**					
FAULT 10b	Ray Braswell 500/230kV Transformer #2	3PH/ SLG	5	9	796.4-j6899.6	J4952	J4914	J4920, J4917, J4936	Ray Braswell 500/230kV Transformer #2
FAULT 11a	Franklin - McKnight 500kV	3PH/ SLG	5	9	542.5-j4751.5	J2416	BRK#21105, BRK#21110, J2412	J2420, S4402, S4405	Franklin - McKnight 500kV; Franklin - Bogal USA - Adams Creek 500kV
FAULT 11b	Franklin - McKnight 500kV	3PH/ SLG	5	9	542.5-j4751.5	J2412	BRK#21105, BRK#21110, J2416	J2408	Franklin - McKnight 500kV; Franklin 500/115kV transformer #1
FAULT 12a	Franklin - Bogal USA - Adams Creek 500kV	3PH/ SLG	5	9	682.8-j5671.9	J2416	S4402, S4405, J2420	BRK#21105, BRK#21110, J2412	Franklin - Bogal USA - Adams Creek 500kV; Franklin - McKnight 500kV
FAULT 12b	Franklin - Bogal USA - Adams Creek 500kV	3PH/ SLG	5	9	682.8-j5671.9	J2420	S4402, S4405, J2416	J2425, J5248, J5240	Franklin - Bogal USA - Adams Creek 500kV; Franklin - G. Gulf 500kV
FAULT 13a	Franklin - Ray Braswell 500kV	3PH/ SLG	5	9	623.3-j5117.6	J2404	J2408, J4914, J4944	J2425	Franklin - Ray Braswell 500kV; Franklin 500/115kV transformer #1

TABLE 8.2-4: SYSTEM STABILITY STUDIES (CONTINUED)

List of 3 Phase Stuck Breaker (IPO: 3PH-1PH) faults simulated for stability analysis

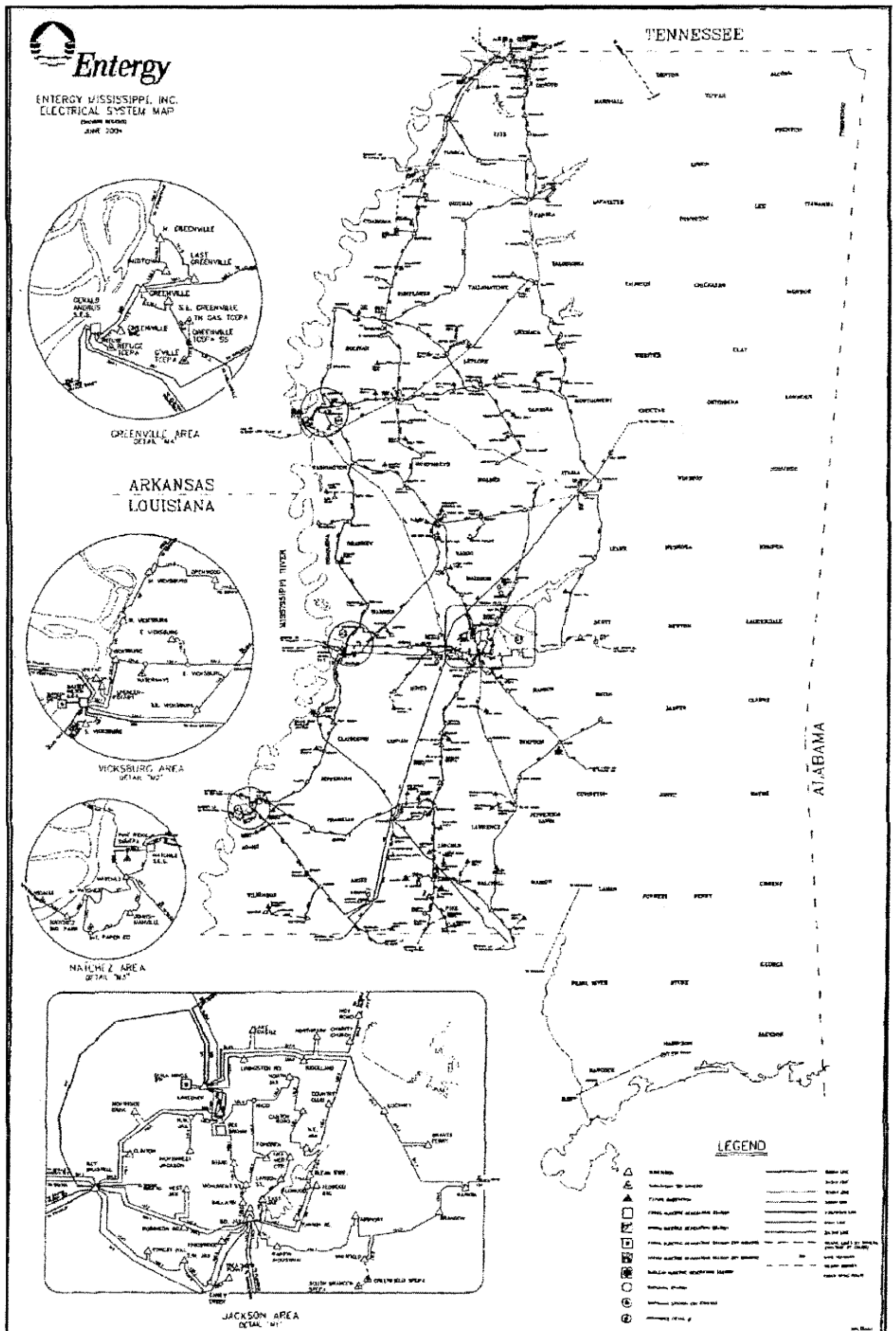
CASE	LOCATION	TYPE	CLEARING TIME (cycles)		SLG FAULT IMPEDANCE (MVA)	STUCK BREAKER #	PRIMARY BREAKER TRIP	SECONDARY BREAKER TRIP	TRIPPED FACILITIES
			PRIMARY	Backup					
FAULT 13b	Franklin - Ray Braswell 500kV	3PH/ SLG	5	9	623.3-j5117.6	J2408	J2404, J4914, J4944	J2412	Franklin - Ray Braswell 500kV; Franklin 500/115kV transformer #2
FAULT 14a	Franklin - G. Gulf 500kV	3PH/ SLG	5	9	582.6-j4696.7	J2425	J2420, J5248, J5240	J2404	Franklin - G. Gulf 500kV; Franklin 500/115kV transformer #1
FAULT 14b	Franklin - G. Gulf 500kV	3PH/ SLG	5	9	582.8-j4696.7	J2420	J5248, J5240, J2425	J2416, S4402, S4405	Franklin - G. Gulf 500kV; Franklin - Bogal USA - Adams Creek 500kV
FAULT 15a	Franklin 500/115kV transformer	3PH/ SLG	5	9	797.5-j6141.8	J2404	J2425	J2408, J4904, J4908	Franklin 500/115kV transformer; Franklin - Ray Braswell 500kV
FAULT 15b	Franklin 500/115kV transformer #1	3PH/ SLG	5	9	797.5-j6141.8	J2425	J2404	J2420, J5248, J5240	Franklin 500/115kV transformer #1; Franklin - G. Gulf 500kV



GRAND GULF NUCLEAR STATION
UNIT 1
UPDATED FINAL SAFETY ANALYSIS REPORT

ENTERGY ELECTRICAL SYSTEM

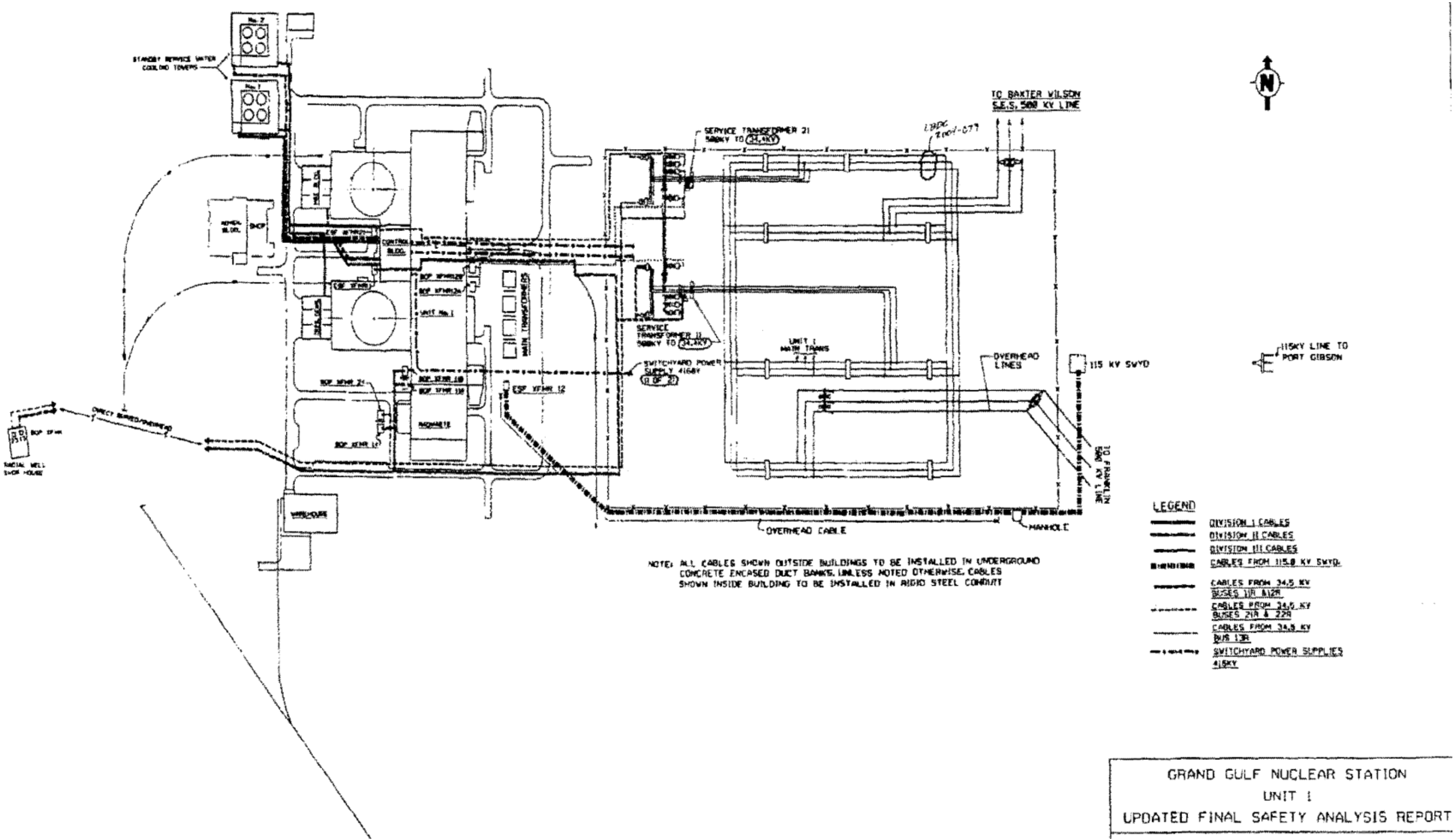
FIGURE 8.2-001



GRAND GULF NUCLEAR STATION
UNIT 1
UPDATED FINAL SAFETY ANALYSIS REPORT

MISSISSIPPI POWER & LIGHT
ELECTRICAL SYSTEM MAP

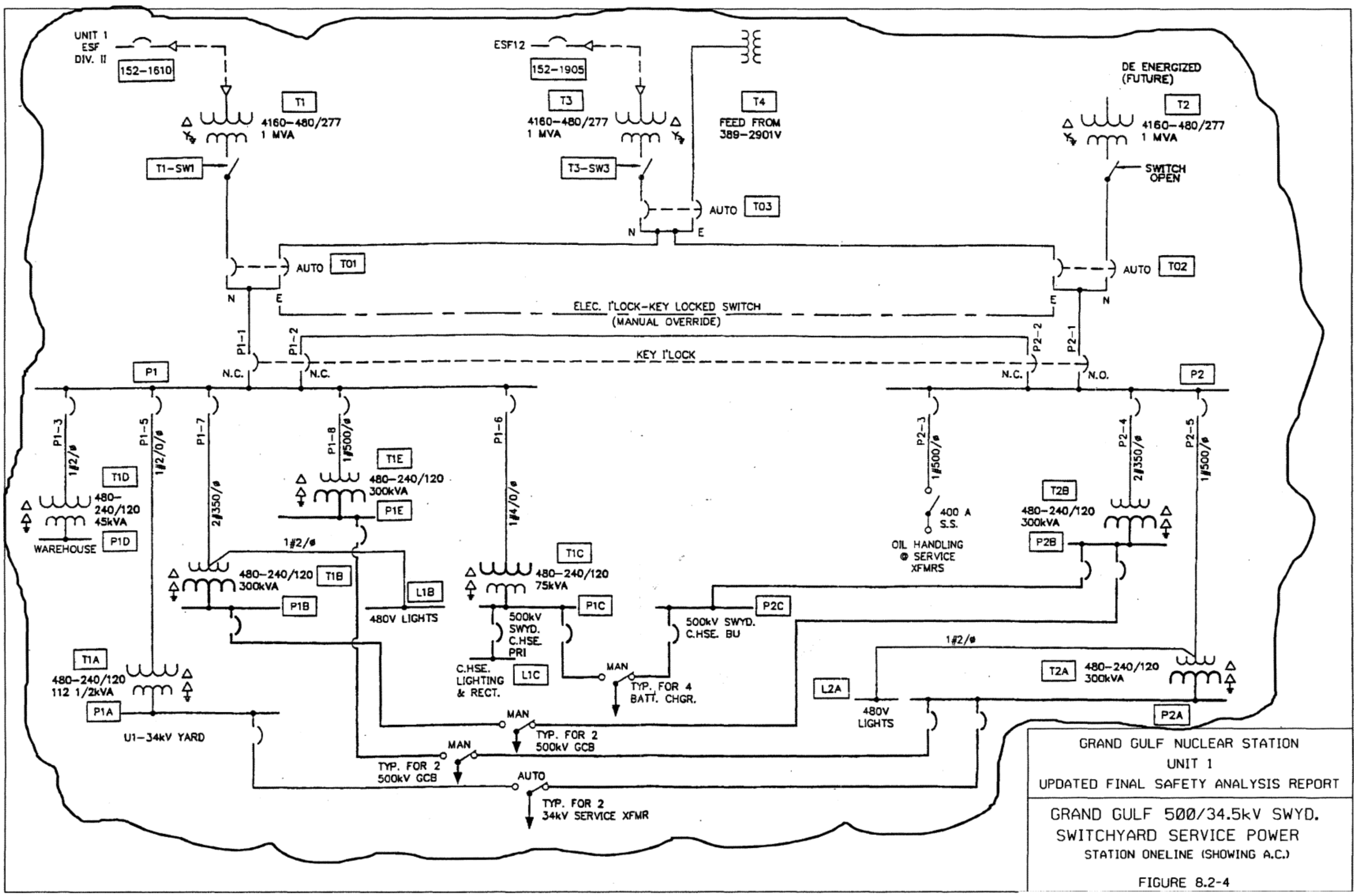
FIGURE 8.2-002



GRAND GULF NUCLEAR STATION
UNIT 1
UPDATED FINAL SAFETY ANALYSIS REPORT

POWER SUPPLY ROUTING-PLANT TO SWITCHYARD & RADIAL WELL SWITCHGEAR HOUSE

FIGURE 8.2-3



GRAND GULF NUCLEAR STATION
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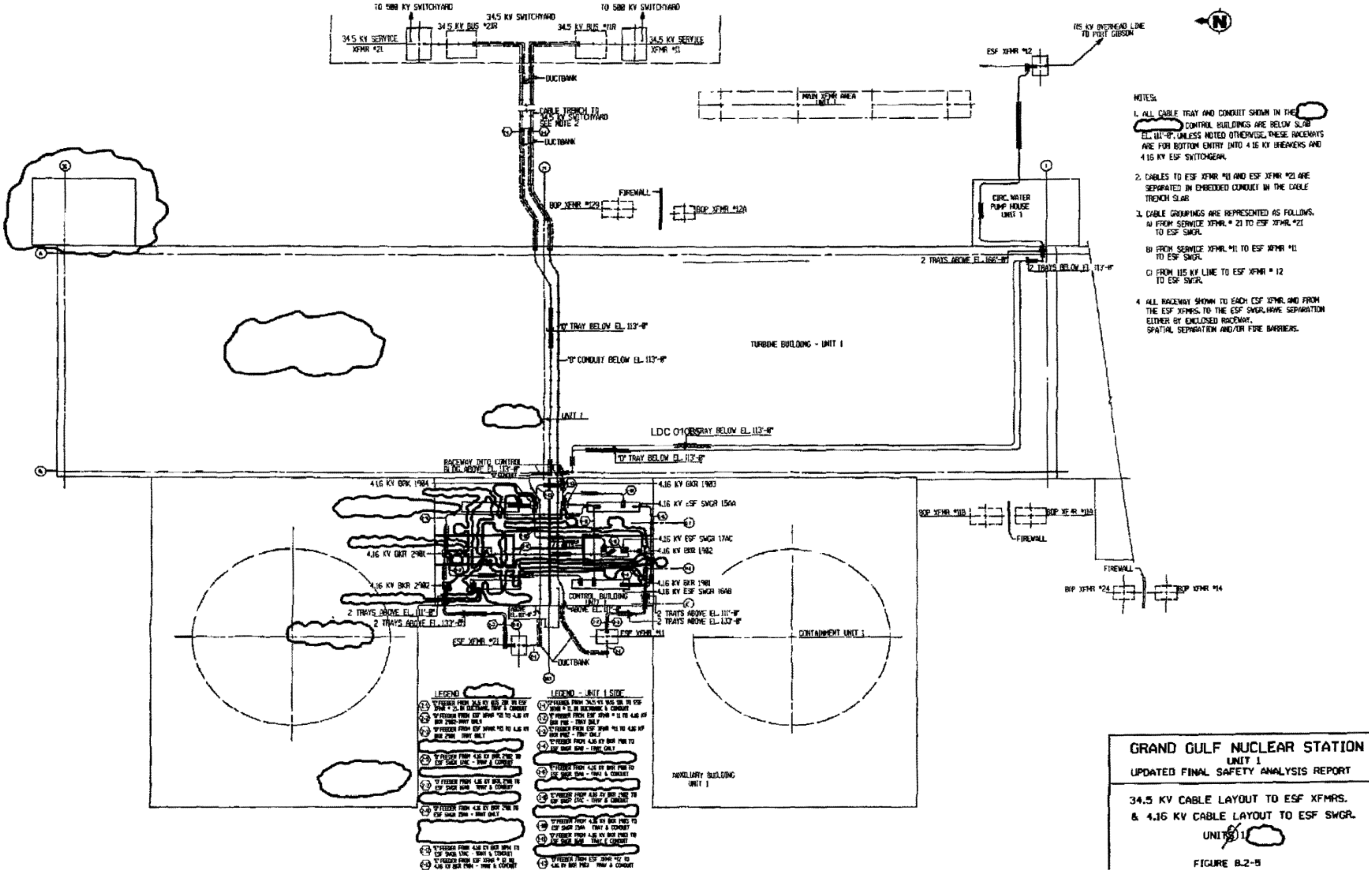
GRAND GULF 500/34.5kV SWYD.
SWITCHYARD SERVICE POWER
STATION ONELINE (SHOWING A.C.)

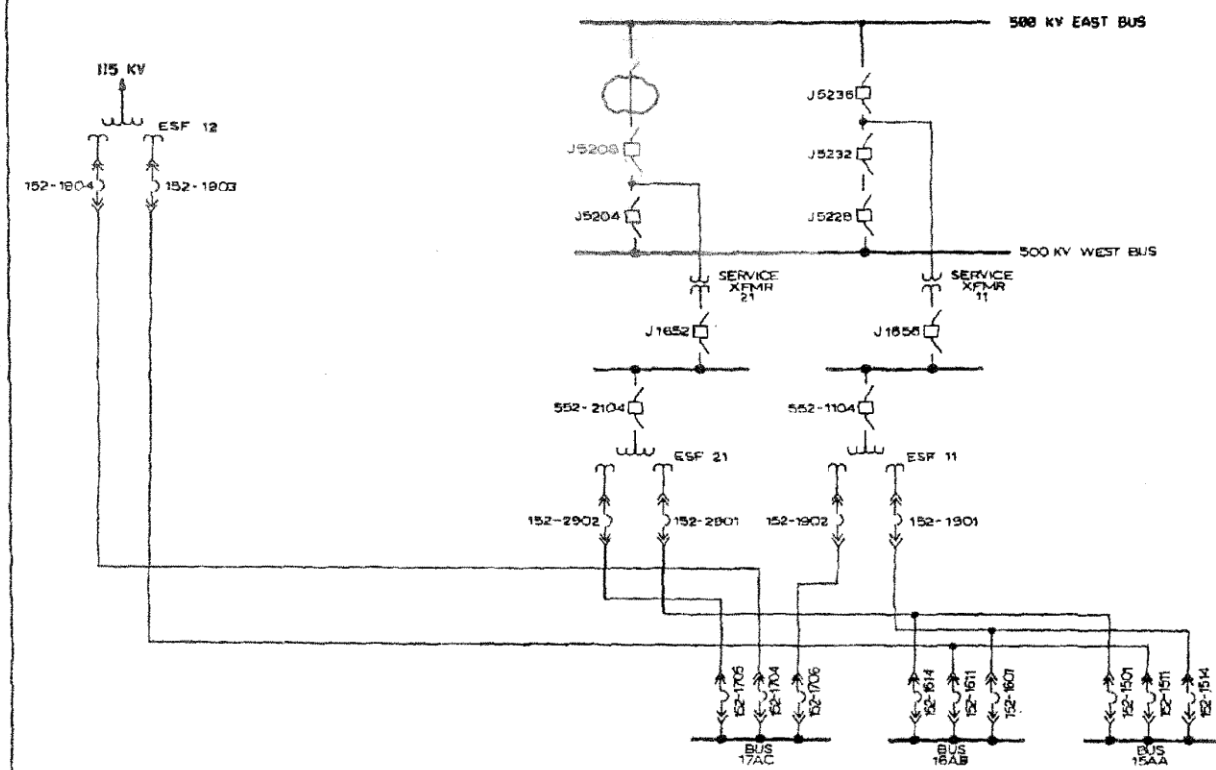
FIGURE 8.2-4



GRAND GULF NUCLEAR STATION
UNIT 1
UPDATED FINAL SAFETY ANALYSIS REPORT

34.5 KV CABLE LAYOUT TO ESF XFMRS. & 4.16 KV CABLE LAYOUT TO ESF SWGR.
UNIT 1

FIGURE 8.2-5



BREAKER NUMBER	CONTROL PWR		REMARKS
	BAT.	UNIT	
J5204	D, E	SWYD	SWYD BAT D USED FOR PRIMARY PROTECTION SWYD BAT E USED FOR BACKUP PROTECTION AND CLOSING
J5208	D, E	SWYD	
J5228	D, E	SWYD	
J5232	D, E	SWYD	
J5236	D, E	SWYD	
J1656	D	1	ALTERNATE FEED FROM SWITCHYARD BAT D (UNIT 1)
J1652	D	1	
552-1104	D	1	
552-2104	D	1	
152-1901	E	1	
152-1902	E	1	
152-1903	D	1	
152-1904	E	1	
152-2901	D	1	
152-2902	D	1	
152-1501	A	1	
152-1511	A	1	
152-1514	A	1	
152-1601	B	1	
152-1611	B	1	
152-1614	B	1	
152-1704	C	1	
152-1705	C	1	
152-1706	C	1	

GRAND GULF NUCLEAR STATION

UPDATED FINAL SAFETY ANALYSIS REPORT

OFFSITE POWER SOURCE
CONTROL POWER

FIGURE 8.2-8

CHAPTER 8.0 ELECTRIC POWER

8.1 INTRODUCTION

8.1.1 Utility Grid Description

The Entergy Mississippi, Inc./Entergy System grid system consists of interconnected hydro-plants, fossil fuel plants, and nuclear plants supplying electric energy over a 500/230/115 kV transmission system as shown in Figures 8.2-1 and 8.2-2.

Entergy Mississippi, Inc. is a member of Entergy Electric System. Other members are Entergy Arkansas, Inc., Entergy Louisiana, Inc., System Energy Resources, Inc. (SERI), New Orleans Public Services, Inc. (NOPSI), and Entergy Gulf States.

The Entergy Electric System is interconnected with the Southwestern Power Administration (SPA), Associated Electric Cooperatives, Inc. (AECI), Missouri Utilities (MU), Union Electric Company (UE), Tennessee Valley Authority (TVA), Mississippi Power Company (MPC), Central Louisiana Electric Company (CLECO), Southwestern Electric Power Company (SWEP), Oklahoma Gas and Electric Company (OG&E), Empire District Electric Company (EDE), and Arkansas Electric Cooperative Corporation (AECC).

8.1.2 Onsite Electric Systems

[HISTORICAL INFORMATION] [The station is supplied with ac power from the 500-kV switchyard and the 115-kV offsite circuit. From the switchyard, the voltage of the ac power is stepped down to 34.5 kV through two service transformers and fed to two sets of engineered safety features (ESF) and balance-of-plant transformers. The 115-kV offsite circuit feeds another ESF transformer with 4.16-kV output voltage. The ESF transformers supply the 4.16-kV ESF buses with ac power which feed ESF load groups at 4.16 and 0.48 kV. The balance- of-plant transformers provide ac power to balance-of-plant loads at 13.8, 6.9, 4.16, and 0.48 kV. An alternate source for the Class IE ac power system for each ESF bus is the associated diesel generator set.

The Class IE ac power system is divided into three independent divisions to provide ac power to the three divisions of ESF loads. The onsite ac power distribution system is shown on Figure 8.1-1.]

Each division of the Class IE ac power system is provided with an independent Class IE 125-volt dc system. The balance-of-plant loads have several 125-volt and 250-volt dc systems (see Figure 8.3-10).

Amendment 27 to the Facility Operating License for GGNS implemented transfer of control of licensed activities from MP&L, (since renamed Entergy Mississippi, Inc.) to SERI. At that time, as discussed in Section 8.2.1.2, MP&L and SERI entered into an agreement governing the conduct of activities involving interface between the two companies in the area of offsite power supply (Ref. 1). The division of ownership of the offsite power supply equipment occurs at the transformer bushings on the high voltage side of the two 500/34.5kV transformers. SERI owns the main unit output lines, through their main transformers (20.9/500kV); both 34.5kV substations and associated BOP and ESF transformers; and the 115/4.16kV ESF transformer, plus the cable and feeder breaker from the 115 kV substation. Entergy Mississippi, Inc. owns: the 115kV substation itself; and the 500kV lines downstream of the (20.9/500kV) main transformers. Maintenance activities and responsibilities for switchyard equipment are set forth in the MP&L/SERI agreement SERI maintains the main transformers, ESF and BOP Transformers. Entergy Mississippi, Inc. maintains other switchyard and transmission equipment.

8.1.3 Safety Loads

Safety loads are defined as those systems and devices that require electric power to perform their safety functions. Such loads are divided into the following classifications:

a. Engineered safety features (ESF)

   1. Emergency core cooling systems (ECCS)

      (a) Residual heat removal system (RHR) - low-pressure core injection (LPCI) mode

      (b) Low-pressure core spray system (LPCS)

      (c) High-pressure core spray system (HPCS)

      (d) Automatic depressurization system (ADS)

   2. Containment and reactor vessel isolation control system

3. Control room atmospheric control and isolation system

4. Standby service water system*

5. Combustible gas control system

6. Standby power and support systems*

7. Leakage control systems

   (a) Main steam isolation valve leakage control system (MSIV-LCS)

   (b) Feedwater isolation valve leakage control system (FIV-LCS)

8. Standby gas treatment system

9. Suppression pool makeup system

10. 10.RHR - Containment spray mode

11. 11.ESF area HVAC systems*

   (a) ECCS pump room HVAC

*Essential auxiliary supporting systems

   (b) Standby service water pumphouse HVAC

   (c) Emergency switchgear room HVAC

12. Auxiliary building isolation control system

b. Safe shutdown systems

1. Reactor protection system

2. Standby liquid control system

3. Control rod hydraulic system (scram system portion)

4. Nuclear steam supply shutoff system

5. Reactor core isolation cooling and room HVAC system

c. Spent fuel pool cooling system

All of the above loads utilize both ac and dc sources for motive or control power or both. In some cases the utilization is indirect. For example, dc control power in the logic provides an actuation signal to start the standby gas treatment system which is ac powered.

8.1.3.1 Division of Safety Loads

For detailed listings of safety division ac loads, see the site a/c electrical power and distribution calculations. Tables 8.3-6, 8.3-7, and 8.3-8 list the loads of Class IE 125-volt dc batteries.

Loads required for normal operation, normal shutdown, forced shutdown, and LOCA are documented in the site a/c electrical calculations.

Forced shutdown is defined as a shutdown following standard procedures but accomplished entirely with onsite power.

8.1.3.2 Reactor Protection System Power System Loads

Power supplies for the reactor protection system (RPS) have sufficient stored energy to remain available through switching transients. Power supplies are shown in Figure 8.3-14.

The safe failure characteristic of the RPS on a loss of power exempts the RPS power supplies from being classified essential. However, redundancy is provided to avoid an unnecessary plant shutdown on interruption of power to one RPS bus. The RPS

power system is grounded, which prevents unsafe failure that may occur from multiple grounds.

8.1.3.3 HPCS Power System Loads

The HPCS power system loads consist of the HPCS pump/motor and associated 460-volt ac auxiliaries, such as motor-operated valves, engine cooling water pump, and miscellaneous engine auxiliary loads. Table 8.3-8 lists the Division 3 loads of Class IE 125 V dc batteries. The applicable regulatory standards and guides implemented in the design of the controls are listed in Table 7.1-3.

8.1.4 Design Bases

8.1.4.1 Safety Design Bases - Offsite Power

a. Three offsite circuits from the Entergy Electric System provide the ac power requirements of the station.

b. Alternating current power from the 500 kV switchyard to the onsite electrical distribution is supplied by two physically independent circuits.

c. Each 500-34.5 kV service transformer has a rating capable of feeding the necessary power required for both BOP and safety loads of the unit.

d. The 500 kV switchyard is provided with two independent 125-volt dc systems and three auxiliary ac power supplies, one from Division 2 ESF 4.16 kV bus of Unit 1, one from 13.8 kV-480 V station service transformer, and one from ESF transformer No. 12.

e. Each 34.5-4.16 kV engineered safety feature transformer has a rating capable of supplying ac power to start and run ESF loads required due to a LOCA. The power comes from the 500-34.5 kV service transformers.

f. The 115-4.16 kV engineered safety features transformer has a single, independent offsite circuit. This transformer is capable of supplying ac power to start and run the ESF loads required as the result of a LOCA. Offsite grid analysis performed in 2000-2001 determined that the 115kV offsite circuit was not capable of supplying sufficient power to start and run the ESF loads required as the result of a LOCA. Transmission system upgrades, additional capacitor banks at the Port Gibson, South Vicksburg, and Fayette 115kV substations, were performed and the capability of the 115kV circuit has been restored.

g. Loss of Grand Gulf Nuclear Plant generating capability or its most critical offsite circuit will not cause system instability (see subsection 8.2.3).

8.1.4.2 Safety Design Bases - Onsite Power

8.1.4.2.1 Engineered Safeguard Features (ESF)

a. The safety-related load is divided into three division load groups. Each load group is fed by an independent Class IE electric system engineered safety features bus.

b. Three separate ac power feeds are provided for each engineered safety features bus, each of which origi- nates from an independent offsite source of power.

c. One diesel generator set and one independent 125-volt dc system are provided for each division load group.

d. An independent raceway system is provided to meet load group cable requirements for each ESF division.

8.1.4.2.2 Reactor Protection System (RPS)

The reactor protection system is a fail-safe system which requires no power in order to perform its safety function. However, it is afforded complete redundancy and separation to provide independence of its four sensor channels and four Class 1E uninterruptible power supplies.

8.1.4.2.3 High-Pressure Core Spray (HPCS) Power Supplies Design Basis

a. The HPCS power system loads consist of HPCS pump/motor and associated 460-volt ac auxiliaries such as motoroperated valves, engine cooling water pump, and miscellaneous engine auxiliary loads. Figures 8.3-12a and 8.3-12b show the basic one line diagram of the system.

b. The HPCS power system is self-contained except for access to the preferred source of offsite power, by connection through the plant ac power distribution system, and for the initiation signal source. It is an operable isolated system independent of electrical connection to any other system by use of the HPCS diesel-generator. Required standby auxiliary equipment such as heaters and battery charger are supplied from the same power source as the HPCS motor and are compatible with that available from the plant ac power system.

c. The HPCS diesel-generator has the capability to restore onsite power quickly to the HPCS pump motor in the event offsite power is unavailable and to provide all power for startup and operation of the HPCS pump motor compatible with safe shutdown of the plant. The HPCS diesel generator starts automatically on signal from the plant protection system or HPCS supply bus undervoltage and, when the plant preferred ac power supply is not available, is connected to the HPCS bus. A more detailed discussion is provided in subsection 8.3.1.1.4.2.1.

d. The HPCS electric system is capable of performing its function when subjected to the effects of design bases natural phenomena at its location. In particular, it is seismic Category I and it is housed in a seismic Category I structure.

e. The HPCS power system has its own fuel day tank and storage tank with sufficient capacity to operate the standby power source while supplying maximum post-accident HPCS power requirements for a time sufficient to put the plant in a safe condition. Tank size is consistent with availability of back-up fuel sources.

f. Manual controls are provided to permit the operator to select the most suitable distribution path from the power supply to the load. An automatic start signal overrides the test mode. Provision is made for diesel generator control from the control room or at the HPCS diesel generator control panel. The diesel generator can be controlled locally only when the "LOCAL/REMOTE" selector switch, located in the control room, is in the "LOCAL" position.

g. A separate dc power supply consisting of a battery and one battery charger exclusively provides the HPCS system dc power requirements for control and protection.

8.1.4.2.4 Reactor Protection System (RPS) Power System

a. The power for the reactor protection system is supplied by four Class 1E uninterruptible power supplies and two independent motor generator set sources, capable of sustaining output voltage and frequency where momentary loss of input power occurs due to switching.

b. Voltage regulation is provided so that the maximum voltage variation for a step loading of 50 percent rated load shall not be greater than 15 percent rated voltage.

c. The power supplies are capable of maintaining voltage and frequency within 5 percent of rated values for no less than 1.0 seconds following loss of input power.

d. The power supplies are nonessential since loss of output power due to open, short, or ground will cause reactor scram or isolation (safe).

8.1.4.3 Power Generation Design Bases

The unit is provided with eight BOP transformers which provide 13.8, 6.9, and 4.16 kV BOP ac power sources. See UFSAR Figure 8.1-001 for the transformers and ac power source configurations.

Four 125-volt dc systems, one 250-volt dc system, and two ±24-volt dc systems are provided for the BOP load groups. Two 125-volt dc systems are provided for the radial wells.

A separate raceway system is provided for the BOP power, control, and instrumentation cables.

The design of the BOP electric system is in accordance with the applicable ANSI, NEMA, and IPCEA standards.

These features are not directly related to the safety of the plant. Descriptions given in Section 8.3 are only in such depth and detail as to permit an understanding of the safety-related portions.

8.1.4.4 Design Criteria, Regulatory Guides, and IEEE Standards

8.1.4.4.1 Directly Applicable Criteria

The design of the offsite power and onsite Class IE electric systems is in accordance with the criteria, regulatory guides, and standards listed below. Table 8.1-1, "Identification of Safety-Related Criteria," contains a cross reference of FSAR sections and design criteria. Exceptions to the regulatory guides are summarized in Appendix 3A. A discussion of compliance to the General Design Criteria is included in Section 3.1.

a. General Design Criterion 17 - Electric Power Systems

b. General Design Criterion 18 - Inspection and Testing of Electric Power Systems

c. Regulatory Guide 1.6, (March 1971), "Independence Between Redundant Standby (Onsite) Power Sources and Between Their Distribution Systems"

d. Regulatory Guide 1.9, (July 1993), "Selection, Design, Qualification, and Testing of Diesel-Generator Units Used as Standby (Onsite) Electric Power Systems at Nuclear Power Plants"

e. Regulatory Guide 1.22, (February 1972), "Periodic Testing of Protection System Actuation Functions"

f. Regulatory Guide 1.29, (February 1976), "Seismic Design Classification"

g. Regulatory Guide 1.30, (August 1972), "Quality Assurance Requirements for the Installation, Inspection, and Testing of Instrumentation and Electric Equipment"

h. h.Regulatory Guide 1.32, (February 1977), "Criteria for Safety-Related Electric Power Systems for Nuclear Power Plants"

i. i.Regulatory Guide 1.40, (March 1973), "Qualification Tests of Continuous-Duty Motors Installed Inside the Containment of Water-Cooled Nuclear Power Plants"

j. Regulatory Guide 1.41, (March 1973), "Preoperational Testing of Redundant Onsite Electric Power Systems to Verify Proper Load Group Assignments"

k. Regulatory Guide 1.47, (May 1973), "Bypassed and Inoperable Status Indication for Nuclear Power Plant Safety Systems"

l. Regulatory Guide 1.53, (June 1973), "Application of the Single-Failure Criterion to Nuclear Power Plant Protection Systems"

m. Regulatory Guide 1.62, (October 1973), "Manual Initiation of Protective Actions"

n. Regulatory Guide 1.63, (October 1973), "Electric Penetration Assemblies in Containment Structures for Water-Cooled Nuclear Power Plants"

o. Regulatory Guide 1.73, (January 1974), "Qualification Tests of Electric Valve Operators Installed Inside the Containment of Nuclear Power Plants"

p. Regulatory Guide 1.75, (January 1975), "Physical Independence of Electric Systems"

q. Regulatory Guide 1.89, (November 1974), "Qualification of Class IE Equipment for Nuclear Power Plants"

r. Regulatory Guide 1.93, (December 1974), "Availability of Electric Power Sources"

s. IEEE Std 338-1975, "IEEE Standard Criteria for the Periodic Testing of Nuclear Power Generating Station Class IE Power and Protection Systems"

t. IEEE Std 344-1971/1975, "IEEE Recommended Practices for Seismic Qualification of Class IE Equipment for Nuclear Power Generating Stations" (Note: The Grand Gulf initial design conforms to the requirements of IEEE 344-1971 as modified by EICSB Branch Technical Position 10. SQRT review was subsequently performed against IEEE 344-1975. Qualification during the plant operating license stage is in accordance with IEEE 344-1975. See Section 3.10.)

u. IEEE Std 387-1972, "Criteria for Diesel Generator Units Applied as Standby Power Supplies for Nuclear Power Stations"

v. IEEE Std 387-1977, "IEEE Standard Criteria for Diesel-Generator Units Applied as Standby Power Supplies for Nuclear Power Generating Stations"

w. IEEE Std 387-1984, "IEEE Standard Criteria for Diesel-Generator Units Applied as Standby Power Supplies for Nuclear Power Generating Stations"

8.1.4.4.2 Indirectly Applicable Criteria

In addition to the criteria listed in subsection 8.1.4.4.1, there are other important criteria which appear at either a higher or lower level of application (for example, 8.1.4.4.1(n) Regulatory Guide 1.63 endorses IEEE 317-1972). Also in this class are industry and trade specifications included in material orders. Unless otherwise indicated, concurrence and implementation have been obtained.

a. IEEE Std 278-1967, "Guide for Classifying Electrical Insulating Materials Exposed to Neutron and Gamma Radiation"

b. IEEE Std 279-1971, "Class IE Electric Systems for Nuclear Power Stations"

c. IEEE Std 308-1974, "Class IE Power Systems for Nuclear Power Generating Stations"

d. IEEE Std 317-1972, "Electrical Penetration Assemblies in Containment Structures for Nuclear Power Generating Stations"

e. IEEE Std 323-1971, "General Guide for Qualifying Class IE Electric Equipment for Nuclear Power Generating Stations"

f. IEEE Std 334-1971, "Standard for Type Test of Continuous Duty Class IE Motors for Nuclear Power Generating Stations"

g. IEEE Std 336-1971, "Installation, Inspection, and Testing Requirements for Instrumentation and Electric Equipment During Construction of Nuclear Power Generating Stations"

h. IEEE Std 450-1975, "Recommended Practice for Maintenance Testing and Replacement of Large Stationary Type Power Plant and Substation Lead Storage Batteries"

   Later editions of this standard may apply to specific Technical Specification testing requirements.

i. IEEE Std 484-1975, "IEEE Recommended Practice for Installation Design and Installation of Large Lead Storage Batteries for Generating Stations and Substations"

j. ANSI, NEMA, and IPCEA standards with effective dates as of the issue of the material orders

TABLE 8.1-1: IDENTIFICATION OF SAFETY-RELATED CRITERIA

Criteria	Title	Applicable 8.1	SAR Sections 8.2	Discussing 8.3.1	Compliance 8.3.2	SAR Sections Discussing Compliance with Safety Criteria for Plant as a whole
10 CFR Part 50						
10 CFR 50.34	Contents of Applications: Technical Information	8.1.4.1 8.1.4.2.1	8.2.1.1	8.3.1.1	8.3.2.1.1	
10 CFR 50.36	Technical Specifications					See Technical Specifications
10 CFR 50.55a	Codes & Standards	8.1.4.4.2				
General Design Criteria (GDC), Appendix A to 10 CFR Part 50						
GDC-1	Quality Standards and Records		8.2.1.2			3.1.2.1.1
GDC-2	Design Basis for Protection Against Natural Phenomena			8.3.1.1.1		3.1.2.1.2
GDC-3	Fire Protection		8.2.1.2	8.3.1.4.1c 8.3.1.2.3d		3.1.2.1.3
GDC-4	Environmental and Missile Design Bases		8.2.1.2			3.1.2.1.4
GDC-5	Sharing of Structures, Systems and Components			8.3.1.1.2.5		3.1.2.1.5
GDC-13	Instrumentation and Control					3.1.2.2.4
GDC-17	Electric Power Systems	8.1.4.4.1	8.2.1.2	8.3.1.2.1	8.3.2.2 8.3.2.2.1	3.1.2.2.8

TABLE 8.1-1: IDENTIFICATION OF SAFETY-RELATED CRITERIA (CONTINUED)

Criteria	Title	Applicable 8.1	SAR Sections 8.2	Discussing 8.3.1	Compliance 8.3.2	SAR Sections Discussing Compliance with Safety Criteria for Plant as a whole
GDC-18	Inspection and Testing of Electric Power Systems	8.1.4.4.1	8.2.1.2	8.3.1.2.1	8.3.2.1.7.8 8.3.2.1.7.9	3.1.2.2.9
GDC-21	Protection System Reliability and Testability	8.1.4.2.4 8.1.4.2.2		8.3.1.1.5		3.1.2.3.2
GDC-22	Protection System Independence	8.1.4.2.2 8.1.4.2.4		8.3.1.4.1		3.1.2.3.3
GDC-33	Reactor Coolant Makeup					3.1.2.4.4
GDC-34	Residual Heat Removal					3.1.2.4.5
GDC-35	Emergency Core Cooling					3.1.2.4.6
GDC-38	Containment Heat Removal					3.1.2.4.9
GDC-41	Containment Atmosphere Cleanup					3.1.2.4.12
GDC-44	Cooling Water					3.1.2.4.15
Institute of Electrical and Electronics Engineers (IEEE) Standards:						
IEEE-279 1971	Criteria for Protection Systems for Nuclear Power Generating Stations	8.1.4.4.2		8.3.1.2.1.b.15		

TABLE 8.1-1: IDENTIFICATION OF SAFETY-RELATED CRITERIA (CONTINUED)

Criteria	Title	Applicable 8.1	SAR Sections 8.2	Discussing 8.3.1	Compliance 8.3.2	SAR Sections Discussing Compliance with Safety Criteria for Plant as a whole
IEEE-308 1971	Criteria for Class 1E Electric Systems for Nuclear Power Generating Stations	8.1.4.4.2		8.3.1.2.1.a.6		8.3.2.2.1
IEEE-317 1972	Electric Penetration Assemblies in Containment Structures	8.1.4.4.2		8.3.1.2.3.1		
IEEE-323 1971	Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations	8.1.4.4.2		8.3.1.2.1.a.7		
IEEE-334 1971	Standard for Type Test of Continuous Duty Class 1E Motors for Nuclear Power Generating Stations	8.1.4.4.2		8.3.1.1.6.1		
IEEE-336 1971	Installation, Inspection and Testing Requirements for Instrumentation and Electric Equipment During the Construction of Nuclear Power Generating Stations	8.1.4.4.2				
IEEE-338 1975	Criteria for Periodic Testing of Nuclear Power Generating Station Protection Systems	8.1.4.4.1				

TABLE 8.1-1: IDENTIFICATION OF SAFETY-RELATED CRITERIA (CONTINUED)

Criteria	Title	Applicable 8.1	SAR Sections 8.2	Discussing 8.3.1	Compliance 8.3.2	SAR Sections Discussing Compliance with Safety Criteria for Plant as a whole
IEEE-344 1971/1975	Guide for Seismic Qualification of Class I Electrical Equipment for Nuclear Power Generating Stations	8.1.4.4.1				
IEEE-379	Guide for the Application of the Single Failure Criterion to Nuclear Power Generating Station Protection Systems					See Compliance to RG 1.53
IEEE-382	Trial-Use Guide for the Type-Test of Class 1 Electric Valve Operators for Nuclear Power Generating Stations (ANSI N416)					See Compliance to RG 1.73
IEEE-383	Standard for Type-Test of Class 1E Electric Cable Field Splices, and Connections for Nuclear Power Generating Stations					8.3.3.1
IEEE-384	Criteria for Separation of Class 1E Equipment and Circuits					See Exceptions to RG 1.75, Appendix 3A
IEEE-387 1972	Criteria for Diesel-Generator Units Applied as Standby Power Supplies for Nuclear Power Stations					

TABLE 8.1-1: IDENTIFICATION OF SAFETY-RELATED CRITERIA (CONTINUED)

Criteria	Title	Applicable 8.1	SAR Sections 8.2	Discussing 8.3.1	Compliance 8.3.2	SAR Sections Discussing Compliance with Safety Criteria for Plant as a whole
IEEE-415	Planning of Pre-Operational Testing Programs for Class 1E Power Systems for Nuclear Power Generating Stations					See Technical Specifications
IEEE-420	Trial-Use Guide for Class 1E Control Switchboards for Nuclear Power Generating Stations (ANSI N41.7)					See Compliance to IEEE Standards 279, 323, 344, 336,338
IEEE-450 1975	Recommended Practice for Maintenance, Testing and Replacement of Large Stationary Type Power Plant and Substation Lead Storage Batteries	8.1.4.4.2			8.3.2.2.1	
IEEE-484 1975	Recommended Practice for Installation Design and Installation of Large Lead Storage Batteries for Nuclear Power Plants	8.1.4.4.2				
IEEE-387 1977	IEEE Standard Criteria for Diesel Generator Units Applied as Standby Power Supplies for Nuclear Power Generating Stations	8.1.4.4.1			8.3.1.2.1	

TABLE 8.1-1: IDENTIFICATION OF SAFETY-RELATED CRITERIA (CONTINUED)

Criteria	Title	Applicable 8.1	SAR Sections 8.2	Discussing 8.3.1	Compliance 8.3.2	SAR Sections Discussing Compliance with Safety Criteria for Plant as a whole
IEEE-387 1984	IEEE Standard Criteria for Diesel Generator Units Applied as Standby Power Supplies for Nuclear Power Generating Stations	8.1.4.4.1			8.3.1.2.1	
Regulatory Guide (RG)						
RG 1.6 Mar 1971	Independence Between Redundant Standby (Onsite) Power Sources and Between Their Distribution Systems	8.1.4.4.1		8.3.1.2.1.a.3		
RG 1.9 July 1993	Selection, Design, Qualification, and Testing of Emergency Diesel Generator Units Used as Class 1E Onsite Electric Power Systems at Nuclear Plants	8.1.4.4.1		8.3.1.1.4.1 8.3.1.1.4.2 8.3.1.2.1		See Appendix 3A for Exceptions See Technical Specifications
RG 1.29 Feb 1976	Seismic Design Classification	8.1.4.4.1				
RG 1.30 Aug 1972	Quality Assurance Requirements for the Installation, Inspection, and Testing of Instrumentation and Electric Equipment	8.1.4.4.1				See Appendix 3A for Compliance

TABLE 8.1-1: IDENTIFICATION OF SAFETY-RELATED CRITERIA (CONTINUED)

Criteria	Title	Applicable 8.1	SAR Sections 8.2	Discussing 8.3.1	Compliance 8.3.2	SAR Sections Discussing Compliance with Safety Criteria for Plant as a whole
RG 1.32 Feb 1977	Criteria for Class 1E Electric Systems for Nuclear Power Plants	8.1.4.4.1		8.3.1.2.1.a.5		
RG 1.40 Mar 1973	Qualification Tests for Continuous-Duty Motors Installed Inside the Containment of Water Cooled Nuclear Power Plants	8.1.4.4.1				
RG 1.41 Mar 1973	Preoperational Testing of Redundant Onsite Electric Power Systems to Verify Proper Load Group Assignments	8.1.4.4.1				14.2.12.1.44.c.5
RG 1.47 May 1973	Bypassed and Inoperable Status Indication for Nuclear Power Plant Safety Systems	8.1.4.4.1				
RG 1.53 June 1973	Application of the Single-Failure Criterion to Nuclear Power Plant Protection Systems	8.1.4.4.1				
RG 1.63 Oct 1973	Electric Penetration Assemblies in Containment Structures for Water-Cooled Nuclear Power Plants	8.1.4.4.1		8.3.1.2.3.1		

TABLE 8.1-1: IDENTIFICATION OF SAFETY-RELATED CRITERIA (CONTINUED)

Criteria	Title	Applicable 8.1	SAR Sections 8.2	Discussing 8.3.1	Compliance 8.3.2	SAR Sections Discussing Compliance with Safety Criteria for Plant as a whole
RG 1.68 Jan 1977	Preoperational and Initial Startup Test Programs for Water-Cooled Power Reactors					Refer to FSAR Section 14.2 for Compliance
RG 1.70 Sept. 1975	Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants					Refer to Entire FSAR for Compliance
RG 1.73 Jan 1974	Qualification Tests of Electric Valve Operators Installed Inside the Containment of Nuclear Power Plants	8.1.4.4.1				
RG 1.75 Jan 1975	Physical Independence of Electric Systems	8.1.4.4.1		8.3.1.4.1 8.3.1.4.2		
RG 1.81 Jan 1975	Shared Emergency and Shutdown Electric Systems for Multi-Unit Nuclear Power Plants	8.1.4.4.1		8.3.1.1.2.5		
RG 1.89 Nov 1974	Qualification of Class 1E Equipment for Nuclear Power Plants	8.1.4.4.1				See Appendix 3A for Exceptions
RG 1.93 Dec 1974	Availability of Electric Power Sources	8.1.4.4.1				See Appendix 3A For Exceptions
RG 1.100 Mar 1976	Seismic Qualification of Electric Equipment for Nuclear Power Plants					See Appendix 3A for Compliance

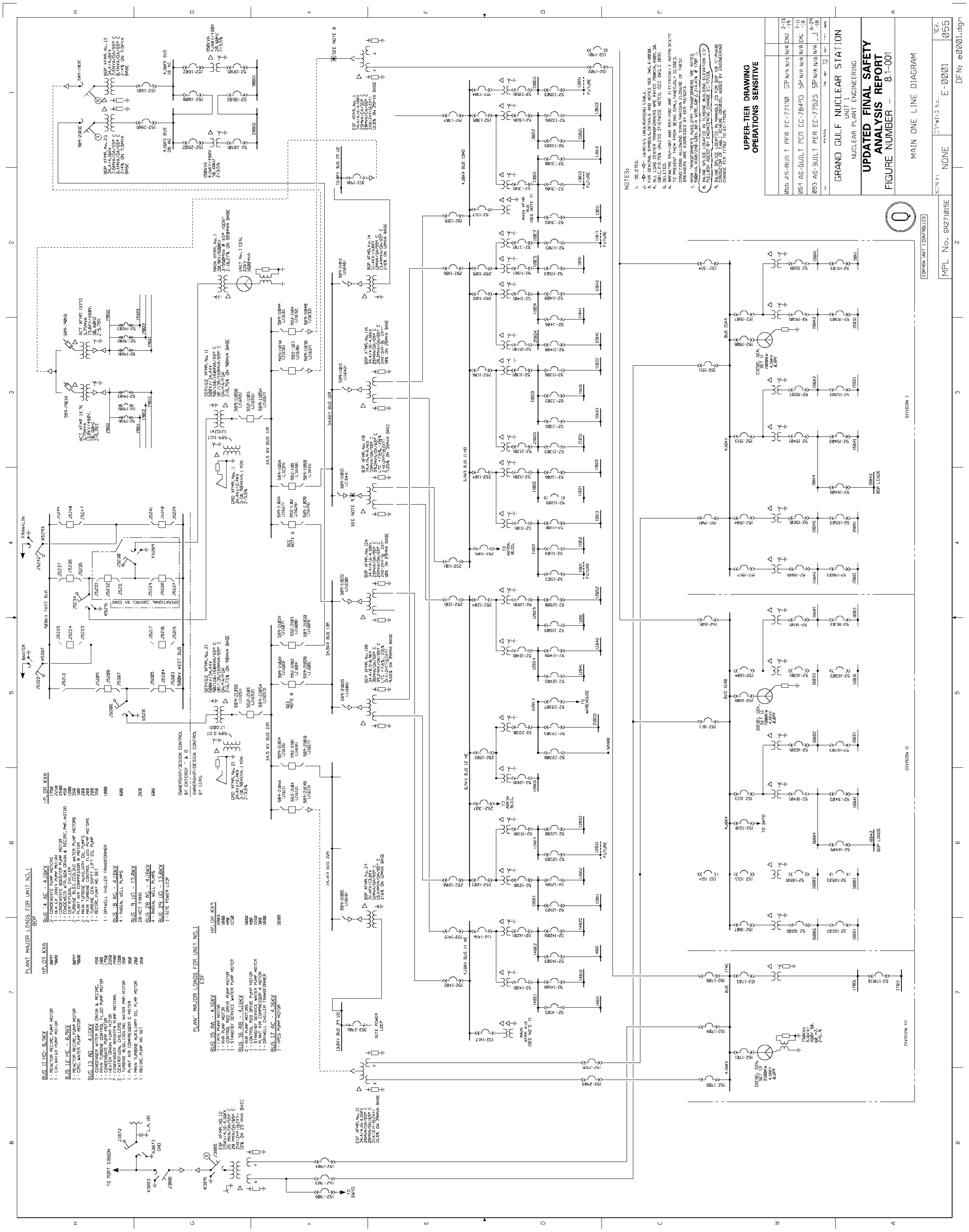
TABLE 8.1-1: IDENTIFICATION OF SAFETY-RELATED CRITERIA (CONTINUED)

Criteria	Title	Applicable 8.1	SAR Sections 8.2	Discussing 8.3.1	Compliance 8.3.2	SAR Sections Discussing Compliance with Safety Criteria for Plant as a whole
RG 1.106 Mar 1977	Thermal Overload Protection for Electric Motors on Motor-Operated Valves					7.1.2.6.22
RG 1.118	Periodic Testing of Electric Power and Protection Systems					See Note 1
RG 1.120	Fire Protection Guidelines for Nuclear Plants					See Note 1
RG 1.128	Installation Design and Installation of Large Lead Storage Batteries for Nuclear Power Plants					See Note 1
RG 1.129 April 1977	Maintenance, Testing and Replacement of Large Lead Storage Batteries for Nuclear Power Plants	8.1.4.4.2			8.3.2.2.1	
Branch Technical Positions (BTP) ICSB						
BTP ICSB 2	Diesel Generator Reliability Qualification Testing			8.3.1.1.4.1.1		
BTP ICSB 8	Use of Diesel Generator Sets for Peaking			8.3.1.1.4.1.b		
BTP ICSB 11	Stability of Offsite Power Systems	8.1.1 8.1.4.1.g	8.2.3			

TABLE 8.1-1: IDENTIFICATION OF SAFETY-RELATED CRITERIA (CONTINUED)

Criteria	Title	Applicable 8.1	SAR Sections 8.2	Discussing 8.3.1	Compliance 8.3.2	SAR Sections Discussing Compliance with Safety Criteria for Plant as a whole
BTP ICSB 15	Reactor Coolant Pump Breaker Qualification					Not Applicable to Boiling Water Reactors
BTP ICSB 17	Diesel Generator Protective Trip Circuit Bypasses			8.3.1.1.4.1.f		
BTP ICSB 18	Application of the Single Failure Criterion to Manually-Controlled Electrically-Operated Valves					See Compliance to RG 1.53
BTP ICSB 21	Guidance for Application of RG 1.47					7.5.1.3

Note 1: Not addressed in FSAR. Section D of Regulatory Guide indicates not applicable based on construction permit docket date.


UPPER-TIER DRAWING
OPERATIONS SENSITIVE
GRAND GULF NUCLEAR STATION
UNIT 1
NUCLEAR PLANT ENGINEERING
UPDATED FINAL SAFETY
ANALYSIS REPORT
FIGURE NUMBER – 8.1-001
MAIN ONE LINE DIAGRAM
E-0001
055
NONE
DFN: e0001.dgn