11.0 PLANT SYSTEMS

11.5 ELECTRICAL SYSTEMS

11.5.1 CONDUCT OF REVIEW

This chapter of the draft Safety Evaluation Report (DSER) contains the staff's review of electrical systems described by the applicant in Chapter 11 of the Construction Authorization Request (CAR). The objective of this review is to determine whether the electrical principal structures, systems, and components (PSSCs) and their design bases identified by the applicant provide reasonable assurance of protection against natural phenomena and the consequences of potential accidents. The staff evaluated the information provided by the applicant for electrical systems by reviewing Chapter 11 of the CAR, other sections of the CAR, supplementary information provided by the applicant, and relevant documents available at the applicant's offices but not submitted by the applicant. The review of electrical systems design bases and strategies was closely coordinated with the review of the instrumentation and control and electrical aspects of accident sequences described in the Safety Assessment of the Design Bases (see Chapter 5.0 of this DSER), and the review of other plant systems.

The staff reviewed how the information in the CAR addresses the following regulations:

- Section 70.23(b) of 10 CFR states, as a prerequisite to construction approval, that the design bases of the PSSCs and the quality assurance program be found to provide reasonable assurance of protection against natural phenomena and the consequences of potential accidents.

- Section 70.64 of 10 CFR requires that baseline design criteria (BDC) and defense-in-depth practices be incorporated into the design of new facilities. With respect to electrical, 10 CFR 70.64(a)(7) requires that the MFFF design "provide for continued operation of essential utility services," which includes electrical power.

The review for this construction approval focused on the design basis of electrical systems, their components, and other related information. For each electrical system, the staff reviewed information provided by the applicant for the safety function, system description, and safety analysis. The review also encompassed proposed design basis considerations such as redundancy, independence, reliability, and quality. The staff used Chapter 11.0 in NUREG-1718, "Standard Review Plan for the Review of an Application for a Mixed Oxide Fuel Fabrication Facility," as guidance in performing the review.

11.5.1.1 System Description

The Mixed Oxide Fuel Fabrication Facility (MFFF) electrical systems include the normal power, standby alternating current (ac) power, and emergency power systems. The facility communications system, although not an electrical system, is briefly described herein.

11.5.1.1.1 Function

The electrical systems (as described in Section 11.5, "Electrical Systems," of the CAR) are to provide reliable electrical power for normal operation and safe shutdown and monitoring when normal electrical power is lost. Specifically, electrical systems provide support to and are essential for the operation of PSSCs such as the high and very high depressurization exhaust systems, emergency control room air-conditioning system, C4 confinement system, emergency control system, emergency diesel generator fuel oil system, and emergency generator ventilation system.

11.5.1.1.2 Major Components

11.5.1.1.2.1 Normal Power System

The normal power system distributes both ac and direct current (dc) power throughout the MFFF but is not a PSSC. Control of the breakers for the normal power system is provided from the utility control system or locally.

Normal AC Power System: The normal ac power system consists of two separate 13.8 kv feeds from the F-Area substation. Each feeder with a separate 13.8 kv/4.16 kv transformer and an associated distribution switchgear bus is capable of supplying 100 percent of the facility's loads. Each 4.16 kv switchgear bus supplies power to five 4.16 kv/480 v load center transformers, one emergency bus, and various 4.16 kv motors. Small loads are supplied power from 480 v to 120/240 v transformers and associated distribution panels throughout the facility.

Normally, the two 4.16 kv switchgear buses are isolated from each other by two series breakers. If an offsite feed is lost and the other feeder is available, an automatic delayed transfer connects the two switchgear buses together to supply power from the one remaining offsite feeder. Additional crossties utilizing series breakers are provided between the corresponding buses of most 480 v load center and are operated manually to facilitate maintenance.

Normal DC Power System: The normal dc system supplies power for the trip/close coils of low and medium-voltage circuit breakers in the normal power distribution system and other dc loads. The ungrounded system consists of two 125 vdc lead-acid batteries each with an associated charger and distribution panel. Each battery has sufficient capacity to supply its loads for one hour and each charger can supply its loads plus recharge its associated battery to fully charged within 24 hours. Annunciators for low battery voltage, low charging current, and battery charger failure along battery voltage indication are provided in the utilities control rooms.

11.5.1.1.2.2 Standby AC Power System

The standby ac power system supplies power to loads that are required for safe shutdown of the process on the loss of normal power but is not a PSSC. The system also provides for a quick resumption of production to minimize the economic impact to the facility. Upon loss of an offsite feeder and failure of the automatic bus transfer, loads are shed for the de-energized 4.16 kv switchgear bus and power is supplied to standby loads by the standby ac power system. The system consists of two separate diesel generators with associated auxiliary equipment and two 120/208 v uninterruptible power supplies (UPSs).

Standby Diesel Generators: Each generator is connected, when required, to one of the normal 4.16 kv switchgear buses and is sized to carry all the facility life-safety loads (critical loads {non-items relied on for safety [IROFS]} and loads on the associated emergency bus) plus other loads that are important to facility production. The standby diesel generators are automatically started in about 10 seconds and loads are sequenced on the bus based on standby power requirements. The diesel generators can be stopped and/or started locally or from the utilities and remote utilities control rooms. Synchronizing capability is provided for full-load testing. Each diesel is provided with its own fuel oil day tank which stores fuel for 8 hours of operation. An additional fuel oil supply tank is provided with enough fuel for both standby diesel generator to operate for 24 hours. Starting capability is provided by redundant 125 vdc batteries sized for five cranking cycles each with a charger capable of recharging their associated battery within 12 hours following a duty-cycle discharge.

Uninterruptible Power Supplies: The two 120/208 vac UPSs provide power to the programmable logic controllers (PLCs) used for process control. Each UPS feeds an associated essential bus by a battery/charger through a static inverter. When a static inverter is unavailable, the corresponding essential bus is fed from a 480 v normal bus via a regulating transformer. Also a maintenance bypass is provided.

11.5.1.1.2.3 Emergency Power System

The emergency power system distributes both ac and dc power to PSSCs and is itself also a PSSC. Control of the breakers for the emergency power system is provided in the emergency control room or locally.

11.5.1.1.2.3.1 Emergency AC Power System

The emergency ac power system supplies power to redundant PSSCs when an offsite power source is lost, the bus transfer fails, and the associated standby diesel generator does not start. Under those conditions or a degraded voltage condition, the 4.16 kv emergency bus is isolated from the normal 4.16 bus, loads are stripped from the bus, the associated emergency diesel generator is started, and emergency loads are automatically sequenced onto the emergency bus. The system consists of two redundant and independent emergency diesel generators (including their support systems) with their associated 4.16 kv emergency bus, a 480 v emergency system, 480 v UPSs, and 120 v vital ac power system. The system's equipment is qualified for the design basis seismic event and for the expected normal, off-normal, and design basis accident environmental conditions.

Emergency Diesel Generators: Each emergency diesel generator is connected, when required, to its associated separate and independent 4.16 kv emergency bus to provide emergency power to large PSSC loads, such as the high depressurization (HD) exhaust fans, and to lower voltage levels for other PSSC loads, such as the UPSs for the very high depressurization (VHD) exhaust fans and the vital 120 vac power system. Each diesel generator is automatically started on loss of normal and standby power to its associated emergency bus and accepts loads in approximately 10 seconds. They can be stopped and/or started locally or from the emergency control room. Synchronizing capability is provided for full-load testing. Each diesel is sized to start and accelerate its connected loads and is provided with its own fuel oil day tank which stores fuel for 8 hours of operation. A separate fuel oil supply tank is provided for each diesel generator with enough fuel for 7 days. The emergency diesel generators are the same type as the standby diesel generators. Starting capability is provided by redundant 125 vdc batteries sized for five cranking cycles each with a charger capable of recharging their associated battery within 12 hours following a duty-cycle discharge. An emergency diesel generator can be taken out of service for maintenance while the standby diesel generators and the redundant emergency ac power system (including the redundant emergency diesel generator) remain available.

Emergency 480 V System: The 480 v emergency system supplies power to small 480 v loads and to emergency motor control centers (MCCs). The system consists of two redundant 4.16 kv/480 v transformers each connected to a separate and independent 480 v emergency bus for power distribution. Redundant buses and MCCs permits maintenance of one train's equipment with the opposite train in service.

Emergency 480 V UPS: A dedicated 480 v UPS (two per each train of 4.16 kv emergency ac power) provides uninterruptible power to one of the four VHD exhaust glovebox extraction fans. Each UPS consists of a rectifier and an inverter with a battery bank capable of carrying a VHD fan for 1 hour. Power is assumed to be restored to the UPS from either the associated emergency or standby diesel generator in an hour or less.

Vital 120 VAC Power System: The 120 v vital ac power system provides instrumentation and control power to PSSC loads. The system consists of two independent and redundant UPSs each supplying an associated vital bus by a battery/charger (part of the emergency dc power system) through a static inverter. When the static inverter is unavailable, the corresponding vital bus is fed from an associated 480 v emergency bus via a regulating transformer. A maintenance bypass is also provided. Each UPS battery has a one-hour capacity and is located in a separate emergency battery room. The remaining 120 v vital ac power system components for each UPS are located in separate rooms.

11.5.1.1.2.3.2 Emergency DC Power System

The emergency dc system supplies power for the trip/close coils of low and medium-voltage circuit breakers in the emergency power distribution system, for emergency lighting, and for other PSSC dc loads. The ungrounded system consists of two redundant and independent 125 vdc lead-acid batteries each with an associated charger and distribution panel. Each battery has sufficient capacity to supply its loads for one hour and each charger can supply its loads plus recharge its associated battery to fully charged from a minimum charged state within 24 hours. Physical separation and electrical isolation prevent a fault in one train from affecting the opposite train. Annunciators for low battery voltage, low charging current, and battery charger failure along battery voltage indication are provided in the utilities control rooms.

11.5.1.1.2.4 Communication Systems

Communication systems provide voice and data communications for normal operations, emergency response, and security and are supplied power from the essential 120/208 vac buses. The applicant has stated that the communications systems are not PSSCs because communication systems are not required to perform safety functions during design basis events.

Normal Communication System: Part of the normal communication system consists of the telephone voice systems, including the public switched telephone system and dedicated non-public branch exchange (PBX) telephone lines, that are installed throughout the MFFF site. A public address system, consisting of central amplifiers and electronics, remote microphones, and building speakers, will be installed to provide intra-site and F Area public address announcements. A wireless trunk system will be used for communication between operations and maintenance personnel and a fiber optic data highway will be provided throughout the facility.

Emergency Communication System: The emergency communication system consists of dedicated, non-PBX telephone lines between:

- MFFF Operations Support Center and Savanna River Site (SRS) Area Emergency Coordinators.
- MFFF Fire Alarm System and SRS Operations Center.
- MFFF Operations Support Center and SRS Safety System/Alarm Public Announcement System.
- MFFF Operations Support Center and SRS Operations Center, Emergency Operations Center, and Technical Support Center.

Also each safe haven location is provided with telephone, intercom, and public address systems.

11.5.1.2 System Interfaces

The normal, standby, and emergency power systems provided electrical power to equipment throughout the MFFF and thus interface with most facility systems and components especially PSSCs such as the HD exhaust fans and systems listed in DSER Section 11.5.1.1.1. Environmental conditions for proper operation of the electrical systems are maintained by the heating, ventilation, and air-conditioning (HVAC) systems and protection against fires is provided by the fire protection systems. The electrical systems and their components are controlled by various manual and automatic controls in the process, utility, and emergency control systems. Also fuel oil is provided to the diesel generators in the electrical systems via interfaces with the emergency and standby diesel generator fuel oil systems.

11.5.1.3 Design Bases of the PSSCs

For design basis requirements, the electrical systems designated as PSSCs are to be available and provide reliable electrical power for normal operation and safe shutdown and monitoring during credible external events. The electrical systems designated as PSSCs should remain functional when subjected to severe natural phenomena, environmental and dynamic effects, consistent with the baseline design criteria in 10 CFR 70.64(a)(2) and (a)(4), respectively and be adequately protected from fires. Additionally, the electrical systems must support continued operation of essential utility services, consistent with the baseline criterion in 10 CFR 70.64(a)(7).

The electrical systems should also be designed with instrumentation and controls for monitoring and controlling each bus and major component, consistent with the baseline criterion in 10 CFR 70.64(a)(10). Pursuant to 10 CFR 70.64(b), the electrical systems should be designed using defense-in-depth practices, with a preference for engineered controls over administrative controls.

To ensure that the design basis requirements are met, the applicant has committed to specific industry standards and staff guidance as discussed in the following sections.

11.5.1.3.1 Emergency AC Power System

The emergency ac power system (as a PSSC) will be designed with redundancy, independence, physical separation, no single failure vulnerability, and fail safe performance with sufficient capacity, capability, periodic testing and maintenance, and adequate protective relaying to perform its safety function. It will also be designed using guidance (to the extend described in the CAR and the applicant's letters dated August 31, 2001, and December 5, 2001) from the following:

- For overall system design:
  - Institute of Electrical and Electronics Engineers (IEEE). IEEE Std 308-1991, "IEEE Standard Criteria for Class 1E Power Systems for Nuclear Generating Stations."
  - Nuclear Regulatory Commission (U.S.)(NRC). Regulatory Guide 1.32, Revision 2, "Criteria for Safety-Related Electric Power Systems for Nuclear Power Plants." NRC: Washington, D.C. February 1977.
- For equipment environmental and seismic qualification:
  - American National Standards Institute/American Institute of Steel Construction (ANSI/AISC). ANSI/AISC N690-1994, "Specification for the Design, Fabrication, and Erection of Steel Safety-Related Structures for Nuclear Facilities (SC-I)."
  - American Society of Civil Engineers (ASCE). ASCE 4-98, "Standard Seismic Analysis of Safety-Related Nuclear Structures."
  - Institute of Electrical and Electronics Engineers (IEEE). IEEE Std 323-1983, "IEEE Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations."
  - ————. IEEE Std 344-1987, "IEEE Recommended Practices for Seismic Qualification of Class 1E Equipment for Nuclear Generating Stations."
  - Nuclear Regulatory Commission (U.S.)(NRC). Regulatory Guide 1.61, "Damping Values for Seismic Design of Nuclear Power Plants." NRC: Washington, D.C. October 1973.
  - ————. Regulatory Guide 1.100, Revision 2, "Seismic Qualification of Electric and Mechanical Equipment for Nuclear Power Plants." NRC: Washington, D.C. June 1988.
- For periodic testing:
  - Institute of Electrical and Electronics Engineers (IEEE). IEEE Std 338-1987, "IEEE Standard Criteria for Periodic Testing of Nuclear Power Generating Station Class 1E Power and Protection Systems."
  - Nuclear Regulatory Commission (U.S.)(NRC). Regulatory Guide 1.118, Revision 3, "Periodic Testing of Electric Power and Protection Systems." NRC: Washington, D.C.

- For single failure:

  - Institute of Electrical and Electronics Engineers (IEEE). IEEE Std 379-1994, "IEEE Standard Application of the Single Failure Criterion to Nuclear Power Generation Station Safety Systems."

- For qualification of cables installed in open trays:

  - Institute of Electrical and Electronics Engineers (IEEE). IEEE Std 383-1974, "IEEE Standard for Type Test of Class 1E Electric Cables, Field Splices and Connections for Nuclear Power Generating Stations."

- For electrical independence and separation:

  - Institute of Electrical and Electronics Engineers (IEEE). IEEE Std 384-1992, "Standard Criteria for Independence of Class 1E Equipment and Circuits."

  - Nuclear Regulatory Commission (U.S.)(NRC). Regulatory Guide 1.75, Revision 2, "Physical Independence of Electric Systems." NRC: Washington, D.C. September 1978.

- For equipment protection:

  – Institute of Electrical and Electronics Engineers (IEEE). IEEE Std 741-1997, "IEEE Standard Criteria for the Protection of Class 1E Power Systems and Equipment in Nuclear Power Generating Stations."

- For design and installation of batteries:

  – Institute of Electrical and Electronics Engineers (IEEE). IEEE Std 484-1996, "IEEE Recommended Practice for Installation Design and Installation of Vented Lead-Acid Batteries for Stationary Applications."

The emergency diesel generators will be designed using guidance (to the extend described in the CAR and the applicant's letters dated August 31, 2001, and December 5, 2001 -- References 11.5.3.5 and 11.5.3.6) from the following:

- For fuel oil quality:

  – American National Standards Institute/American Society for Testing Materials (ANSI/ASTM). ANSI/ASTM D975-94, "Standard Specification for Diesel Fuel Oils."

- For overall design and qualification:

  - Institute of Electrical and Electronics Engineers (IEEE). IEEE Std 387-1995, "IEEE Standard Criteria for Diesel Generator Units Applied as Standby Power Supplies for Nuclear Power Generating Stations."

  - Nuclear Regulatory Commission (U.S.)(NRC). Regulatory Guide 1.9, Revision 3, "Selection, Design, Qualification, and Testing of Emergency Diesel Generator Units

Used as Class 1E Onsite Electric Power Systems at Nuclear Power Plants." NRC: Washington, D.C. July 1993.

The emergency 480 v UPS and 120 v vital ac power system will be designed using guidance (to the extend described in the CAR and the applicant's letter dated August 31, 2001- Reference 11.5.3.5) from the following:

- For overall design:

  – Institute of Electrical and Electronics Engineers (IEEE). IEEE Std 944-1986, "IEEE Recommended Practice for the Application and Testing of Uninterruptible Power Supplies for Power Generating Stations."

11.5.1.3.2 Emergency DC Power System

The emergency dc power system (as a PSSC) will be designed with redundancy, independence, physical separation, no single failure vulnerability, and fail safe performance with sufficient capacity, capability, periodic testing and maintenance, and adequate protective relaying to perform its safety function. It will also be designed using guidance (to the extend described in the CAR and the applicant's letters dated August 31, 2001, December 5, 2001, January 7, 2002, and March 8, 2002 - References 11.5.3.5, 11.5.3.6, 11.5.3.7, and 11.5.3.8) from the following:

- For overall system design:

  - Institute of Electrical and Electronics Engineers (IEEE). IEEE Std 308-1991, "IEEE Standard Criteria for Class 1E Power Systems for Nuclear Generating Stations."

  - —————. IEEE Std 946-1992, "IEEE Recommended Practice for the Design of Safety-Related DC Auxiliary Power Systems for Nuclear Power Generating Stations."

  - Nuclear Regulatory Commission (U.S.)(NRC). Regulatory Guide 1.32, Revision 2, "Criteria for Safety-Related Electric Power Systems for Nuclear Power Plants." NRC: Washington, D.C. February 1977.

- For equipment environmental and seismic qualification:

  - American National Standards Institute/American Institute of Steel Construction (ANSI/AISC). ANSI/AISC N690-1994, "Specification for the Design, Fabrication, and Erection of Steel Safety-Related Structures for Nuclear Facilities (SC-I)."

  - American Society of Civil Engineers (ASCE). ASCE 4-98, "Standard Seismic Analysis of Safety-Related Nuclear Structures."

  - Institute of Electrical and Electronics Engineers (IEEE). IEEE Std 323-1983, "IEEE Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations."

  - —————. IEEE Std 344-1987, "IEEE Recommended Practices for Seismic Qualification of Class 1E Equipment for Nuclear Generating Stations."

- ————. IEEE Std 383-1974, “IEEE Standard for Type Test of Class 1E Electric Cables, Field Splices and Connections for Nuclear Power Generating Stations.”

- Nuclear Regulatory Commission (U.S.)(NRC). Regulatory Guide 1.61, “Damping Values for Seismic Design of Nuclear Power Plants.” NRC: Washington, D.C. October 1973.

- ————. Regulatory Guide 1.100, Revision 2, “Seismic Qualification of Electric and Mechanical Equipment for Nuclear Power Plants.” NRC: Washington, D.C. June 1988.

- For periodic testing:

  - Institute of Electrical and Electronics Engineers (IEEE). IEEE Std 338-1987, “IEEE Standard Criteria for Periodic Testing of Nuclear Power Generating Station Class 1E Power and Protection Systems.”

  - ————. IEEE Std 450-1995, “IEEE Recommended Practice for Maintenance, Testing, and Replacement of Vented Lead-Acid Batteries for Stationary Applications.”

  - Nuclear Regulatory Commission (U.S.)(NRC). Regulatory Guide 1.118, Revision 3, “Periodic Testing of Electric Power and Protection Systems.” NRC: Washington, D.C.

- For single failure:

  Institute of Electrical and Electronics Engineers (IEEE). IEEE Std 379-1994, “IEEE Standard Application of the Single Failure Criterion to Nuclear Power Generation Station Safety Systems.”

- For electrical independence and separation:

  - Institute of Electrical and Electronics Engineers (IEEE). IEEE Std 384-1992, “Standard Criteria for Independence of Class 1E Equipment and Circuits.”

  - Nuclear Regulatory Commission (U.S.)(NRC). Regulatory Guide 1.75, Revision 2, “Physical Independence of Electric Systems.” NRC: Washington, D.C. September 1978.

- For design and installation of batteries:

  - Institute of Electrical and Electronics Engineers (IEEE). IEEE Std 484-1996, “IEEE Recommended Practice for Installation Design and Installation of Vented Lead-Acid Batteries for Stationary Applications.”

  - ————. IEEE Std 485-1997, “IEEE Recommended Practice for Sizing Lead-Acid Batteries for Stationary Applications.”

  - National Fire Protection Association, Inc. (NFPA). NFPA 111, “Standard for Stored Electrical Energy Emergency and Standby Power Systems.”

In Section 5.5.5 of the CAR, the applicant describes its general design philosophy used in formulating the preliminary design of the MFFF. Pursuant to 10 CFR 70.64(b), in order to ensure that engineered controls are relied upon over administrative controls, to the extent practicable, DCS has established a hierarchy of controls. In further adherence to 10 CFR 70.64(b), DCS states that it has incorporated defense-in-depth practices at new facilities in its preliminary MFFF design. Defense-in-depth is defined in the 10 CFR 70.64 footnote. In Section 5.5.5.2 of the CAR, DCS states that it has incorporated defense-in-depth practices through use of the single failure criterion. Under this criterion, PSSCs are required to be capable of carrying out their functions in the event that any single active component fails, whether such failure occurs within the applicable system, or in an associated system that supports the components's operation.

Accordingly, the MFFF electrical systems should be designed using defense-in-depth practices using the single failure criterion including redundancy, independence, separation, and fail safe for electrical systems identified as PSSCs through the use of industry standards listed above. For example the emergency AC power system, which provides power if offsite power is lost, is designed with redundant and independent emergency diesel generators that are physically separated from each other. This is discussed in Sections 11.5.1.3.1 and 11.5.1.3.2.

11.5.2 EVALUATION FINDINGS

In Section 11.5.7 of the CAR, DCS provided design basis information for electrical systems that it identified as PSSCs for the MFFF. Based on that the staff's review of the CAR and supporting information provided by the applicant and the applicant's commitments to the industry standards and guidance discussed in the sections above for electrical systems, the staff finds that DCS has met the BDC set forth in 10 CFR 70.64(a)(7). The staff concludes, pursuant to 10 CFR 70.23(b), that the design bases of the PSSCs evaluated in this DSER section will provide reasonable assurance of protection against natural phenomena and the consequences of potential accidents. The staff further concludes, from its review of the CAR and supporting information submitted by DCS, that the preliminary design of the MFFF electrical systems meet the defense-in-depth provisions and the preference to engineered controls over administrative controls stated in 10 CFR 70.64(b).

11.5.3 REFERENCES

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11.5.3.2 American National Standards Institute/American Society for Testing Materials (ANSI/ASTM). D975-94, "Standard Specification for Diesel Fuel Oils." ANSI/ASTM: Philadelphia, Pennsylvania, October 10, 1995.

11.5.3.3 American Society of Civil Engineers (ASCE). 4-98, "Standard Seismic Analysis of Safety-Related Nuclear Structures." ASCE: Reston, Virginia.

11.5.3.4 Hastings, P., Duke Cogema Stone & Webster, letter to U.S. Nuclear Regulatory Commission, RE MOX Fuel Fabrication Facility Site Geotechnical Report (DCS01–WRS–DS–NTE–G–0005–C), August 10, 2001.

11.5.3.5 Hastings, P., Duke Cogema Stone & Webster, letter to U.S. Nuclear Regulatory Commission, RE Response to Request for Additional Information (DCS-NRC-000059), August 31, 2001.

11.5.3.6 Hastings, P., Duke Cogema Stone & Webster, letter to U.S. Nuclear Regulatory Commission, RE Clarification of Responses to NRC Request for Additional Information (DCS–NRC–000074), December 5, 2001.

8.11.3.7 Hastings, P., Duke Cogema Stone & Webster, letter to U.S. Nuclear Regulatory Commission, RE Clarification of Responses to NRC Request for Additional Information, January 7, 2002.

11.5.3.8 Hastings, P., Duke Cogema Stone & Webster, letter to U.S. Nuclear Regulatory Commission, RE Clarification of Responses to NRC Request for Additional Information (DCS–NRC–000085), March 8, 2002.

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11.5.3.13 —————. Std 344-1987, “IEEE Recommended Practices for Seismic Qualification of Class 1E Equipment for Nuclear Generating Stations.” IEEE:New York, New York, August 3, 1987.

11.5.3.14 —————. Std 379-1994, “IEEE Standard Application of the Single Failure Criterion to Nuclear Power Generation Station Safety Systems.” IEEE: New York, New York, December 16, 1994.

11.5.3.15 —————. Std 383-1974, “IEEE Standard for Type Test of Class 1E Electric Cables, Field Splices and Connections for Nuclear Power Generating Stations. IEEE: New York, New York, April 15, 1974.

11.5.3.16 —————. Std 384-1992, “Standard Criteria for Independence of Class 1E Equipment and Circuits.” IEEE: New York, New York, December 1, 1992.

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