8.0 Electric Power

8.1 Introduction

8.1.1 Offsite Power Description

Offsite power to the U.S. EPR is provided by at least two utility transmission lines connected to the station switchyard. The power plant interfaces with the switchyard at the output of the main generator via the main step-up transformers and at the station auxiliary transformers.

The utility transmission system, location of rights-of-way, transmission lines and towers, and switchyard design and interconnections are site-specific. A COL applicant that references the U.S. EPR design certification will provide site-specific information describing the interface between the offsite transmission system and the nuclear unit, including switchyard interconnections.

During normal operation, the main generator connects to the switchyard via three single-phase step-up transformers to supply power to the transmission system. The plant electrical distribution system receives offsite power during normal plant operating modes, anticipated operational occurrences, and postulated accidents via four auxiliary transformers connected to the switchyard. The U.S. EPR design does not include the traditional unit auxiliary transformer that connects the plant electrical distribution system directly to the main generator output as the normal source during power operation. The preferred power supply (PPS) is the power supply from the transmission system to the Class 1E emergency power supply system (EPSS) which is preferred to provide power under accident and post-accident conditions. Two emergency auxiliary transformers (EAT) provide the PPS from the switchyard to the EPSS with no intervening non-Class 1E switchgear. Two normal auxiliary transformers (NAT) provide power from the switchyard to the non-Class 1E normal power supply system (NPSS).

Offsite power is described in depth in Section 8.2.

8.1.2 Onsite Power System Description

The EPSS distributes 6.9 kV and 480 Vac power to safety-related and select non-safety-related plant loads. There are four divisions of switchgear, load centers, motor control centers (MCC), standby power sources, and distribution system transformers that make up the EPSS as shown in Figure 8.3-2—Emergency Power Supply System Single Line Drawing. Each division includes a Class 1E emergency diesel generator (EDG), which is the standby power source to its particular division in the event of a power loss. Each division has the ability to connect to one of two non-safety-related station blackout diesel generators (SBODG) used as the alternate AC (AAC) source during station blackout (SBO) conditions. An alternate feed is provided from EPSS division 2 to EPSS division 1 to supply a standby source of power to required safety-related systems, safety-related support systems, or components that do not have four 100 percent redundant trains when the EPSS division 1 EDG or certain portions of the EPSS division 1 electrical distribution system are not available. A similar alternate feed provides standby power to EPSS division 2 from EPSS division 1 when the EPSS division 2 EDG or certain portions of the EPSS division 2 electrical distribution system are not available. Similar alternate feeds are used between EPSS division 3 and EPSS division 4. Implementation of the alternate feed is completed manually to satisfy single failure criteria when certain electrical components, including EDGs, are out of service.

Each EDG automatically starts and connects to its EPSS 6.9 kV switchgear when a loss of power or a degraded voltage condition is detected at the respective division supply bus. An automatic start will also occur if a safety injection signal (SIS) is initiated from the protection system. The required safety-related loads are automatically sequenced onto the EDG when the generator has obtained nominal speed and voltage, and a loss of voltage or a degraded voltage signal is received. Each EDG has the capacity and capability to power the required safety-related loads when an alternate feed is implemented between divisions.

The Class 1E uninterruptible power supply (EUPS) has four separate and redundant 250 Vdc divisions that provide power to EUPS DC loads and to inverters that power safety-related and select non-safety-related loads. The EUPS inverters provide three-phase 480 Vac power to Class 1E MCCs that supply safety-related loads, including power to instrumentation and control via AC/DC converters. The EUPS configuration is shown in Figure 8.3-5—Class 1E Uninterruptible Power Supply System Single Line Drawing. The SBODGs can power a battery charger in each EUPS division during SBO conditions.

The NPSS distributes 13.8 kV, 6.9 kV and 480 Vac power to non-safety-related loads throughout the power plant, including reactor coolant pumps, as shown in Figure 8.3-3—Normal Power Supply System Single Line Drawing. The system is configured in four trains of switchgear, load centers, MCCs, and distribution system transformers. Trains 1 and 2 provide the connection point for each SBODG. The SBODGs provide power to selected Turbine Island equipment for asset protection if necessary during loss of power events, and further provide power to the EPSS during SBO conditions.

The two SBODGs are non-Class 1E diesel generators that are provided as an AAC source that is aligned to selected EPSS buses to maintain the power plant in a safe shutdown condition during postulated SBO conditions. Each SBODG automatically starts from a loss of voltage on its respective 6.9 kV NPSS bus, and is manually aligned to the assigned EPSS bus to provide power to the EPSS during an SBO.

The 12-hour uninterruptible power supply system (12UPS) provides uninterruptible power for non-safety-related Nuclear Island and Turbine Island loads, and instrumentation & control systems. Figure 8.3-6—12-Hour Uninterruptible Power Supply System Single Line Drawing shows system batteries, battery chargers, inverters, and system connections. The 12UPS battery chargers are powered from the SBODGs during loss of power conditions.

The non-Class 1E uninterruptible power supply system (NUPS) provides uninterruptible power for non-safety-related AC and DC Turbine Island loads and DC power to the control rod drive mechanism operating coils in the Nuclear Island. The NUPS batteries, battery chargers, and inverters are shown in Figure 8.3-7—Non-Class 1E Uninterruptible Power Supply System Single Line Drawing. The NUPS battery chargers are powered from the SBODGs during loss of power conditions.

8.1.3 Safety-Related Loads

The safety-related loads are normally powered from the PPS and are supplied standby power from the station EDGs. The safety-related AC loads are included in Table 8.3-4—Division 1 Emergency Diesel Generator Nominal Loads, Table 8.3-5—Division 2 Emergency Diesel Generator Nominal Loads, Table 8.3-6—Division 3 Emergency Diesel Generator Nominal Loads, and Table 8.3-7—Division 4 Emergency Diesel Generator Nominal Loads. Safety-related DC and inverter powered AC loads are included in Table 8.3-13—Division 1 Class 1E Uninterruptible Power Supply Nominal Loads, Table 8.3-14—Division 2 Class 1E Uninterruptible Power Supply Nominal Loads, Table 8.3-15—Division 3 Class 1E Uninterruptible Power Supply Nominal Loads, and Table 8.3-16—Division 4 Class 1E Uninterruptible Power Supply Nominal Loads. Safety function performed by safety-related loads is described in the applicable sections of Chapters 5, 6, 7, 8, and 9. A COL applicant that references the U.S. EPR design certification will identify site-specific loading differences that raise EDG or Class 1E battery loading, and demonstrate the electrical distribution system is adequately sized for the additional load.

8.1.4 Design Bases

8.1.4.1 Offsite Power System

Station power is provided by a minimum of two offsite transmission lines, each with the capacity and capability to maintain core cooling and containment integrity, as well as other safety-related functions during postulated events. Each offsite source to the EPSS buses is immediately available in the event of a loss of the other offsite power source. In order to better assure GDC 17 compliance regarding operability of the off-site sources a digital relay monitoring system measures phase voltages and currents at the input (high side) of the EATs and will provide information in the control room to alert operators of a degraded condition in any phase of the off-site sources. The monitoring system detects:

1. An open phase with no EAT high-side ground.
2. An open phase with an EAT high side ground between the open phase and the EAT.
3. Two EAT high side open phases (simultaneously).

In the event condition 1, 2, or 3 is detected, the phase monitoring system provides a control room alarm and automatically separates the EAT from the off-site power source and transfers EAT loads to the unaffected EAT or the emergency diesel generators.

It will also provide inputs to the electrical system fast transfer function and to breakers for separation from off-site power interlocked with the Safety Injection (SI) function. It will also provide off-site source voltage monitoring for display to operators.

Physical separation is provided between the two offsite power sources to minimize the possibility of simultaneous failure during normal operations and postulated accident and environmental conditions.

The normal power supply to safety-related and non-safety-related loads is from the switchyard via the station auxiliary transformers. This arrangement permits supplying power to station loads without requiring bus transfers during startup and shutdown operations.

The EAT alignment to the Class 1E divisional buses utilizes no intervening non-Class 1E buses, and Class 1E buses do not share a common winding with the transformers supplying the non-Class 1E switchgear.

The NAT supply to the NPSS provides a normal and alternate offsite power supply to the non-safety-related plant loads.

Each EAT is normally aligned to two EPSS divisions and each serves as the alternate power source for the other two EPSS divisions. Each EAT is sized to provide power to loads in all four EPSS divisions under postulated design basis conditions.

The NATs are sized to provide power to the non-safety-related loads during power plant operations. Both NATs are normally in service. Each NAT is sufficient to power all four of the NPSS trains to allow for NAT maintenance or a transfer of a load due to a NAT failure.

8.1.4.2 Onsite Power System

The onsite Class 1E distribution system has the capacity and capability to supply power to the safety-related loads to mitigate design basis accident conditions with a concurrent loss of offsite power (LOOP).

The onsite Class 1E distribution system has four redundant divisions. This degree of redundancy maintains power to safety-related loads to complete required safety-related functions in the event of a single failure. Electrical independence and physical separation is provided between redundant onsite Class 1E distribution divisions so a failure in one division does not prevent safety-related function completion.

Each of the four onsite Class 1E distribution divisions consisting of switchgear, load centers, MCCs, batteries and inverters are contained in Seismic Category I structures. An internal hazard does not prevent the completion of a required system safety-related function due to physical separation between redundant Class 1E equipment. The Class 1E equipment is qualified as Seismic Category I and can withstand seismic design basis loads without loss of safety-related function.

The EUPS batteries are sized to provide power for two hours to loads connected to the Class 1E distribution equipment required to place and maintain the plant in the safe shutdown condition, without utilization of the battery charger. The EUPS battery chargers are sized to supply continuous steady-state loads while recharging the respective battery.

Each EDG is sized so that it can supply standby power to loads connected to Class 1E distribution system equipment in its respective division and loads aligned to the other EPSS division during alternate feed implementation for safe plant shutdown following a design basis accident with a LOOP.

The EDGs automatically start as determined by an undervoltage or degraded bus voltage condition on their respective Class 1E EPSS bus. The EDG load sequencer properly applies the large loads to the EDG. An SIS will cause the EDG to automatically start, attain rated speed and voltage, and remain in a ready-to-load condition.

Class 1E electrical isolation devices are provided where non-Class 1E circuits connect to Class 1E systems. The isolation devices prevent, to the extent practical, faults or other failures in the non-Class 1E circuits from degrading the Class 1E circuits below acceptable levels.

The onsite Class 1E distribution system permits periodic inspections, tests, and surveillances to assess and verify their capability to perform their safety-related function.

Alternate feeds are provided between EPSS divisions to provide normal and standby power to required safety-related systems, safety-related support systems, or components that do not have four 100 percent redundant trains when certain electrical components, including EDGs, are out of service.

Physical and electrical separation is maintained between redundant Class 1E cables and between Class 1E and non-Class 1E cables so that a single cable or equipment fault will not prevent completion of a required safety-related function, and a non-Class 1E cable fault will not affect redundant Class 1E circuits.

Class 1E cables and their cable raceways are permanently marked in a distinctive manner so that redundant Class 1E systems, Class 1E and non-Class 1E cables, and associated circuits are readily distinguishable.

Two SBODGs are provided as an AAC source to mitigate postulated SBO conditions.

8.1.4.3 Criteria, Regulatory Guides, Standards, and Technical Positions

This section describes the design of the U.S. EPR power distribution system with respect to 10 CFR 50 Appendix A, compliance to GDC, and conformance to listed RGs, IEEE Standards and NRC generic letters. The electric power systems design complies with regulatory requirements and conforms with regulatory guides and industry standards. Unless indicated as not applicable to the electrical distribution system, an item shown as acceptance criterion or that it is used as guidance indicates that the U.S. EPR is in compliance with the regulation or conformance with the guidance as indicated. Table 8.1-1—Acceptance Criteria and Guidelines Applicability for Electric Power Systems, provides a list of GDC, NRC Regulations, RGs, BTPs, NUREG Reports, SECYs and their applicability to the U.S. EPR electric power distribution system.

8.1.4.3.1 General Design Criteria

U.S. EPR compliance with GDC is addressed in Section 3.1. Details of compliance with GDC 2, GDC 4, GDC 5, GDC 17, GDC 18 and GDC 50 are described in Section 8.2.2, Section 8.3.1.2 or Section 8.3.2.2.

8.1.4.3.2 Regulatory Guides

See Table 8.1-1 for a list of NRC RGs and a list of the corresponding FSAR sections for a description of RG conformance.

8.1.4.3.3 IEEE Standards

As a minimum, these IEEE standards are implemented in the U.S. EPR electrical system design:

- IEEE Std 308-2001, "IEEE Standard Criteria for Class 1E Power Systems for Nuclear Power Generating Stations."
  - Onsite power system meets the specifications of IEEE Std 308-2001 as endorsed by RG 1.32 and are addressed in Section 8.3.1.2.4 and Section 8.3.2.2.4.
- IEEE Std 317-1983(R2003), "IEEE Standard for Electric Penetration Assemblies in Containment Structures for Nuclear Power Generating Stations."
  - Containment electrical penetration assemblies meet the specifications of IEEE Std 317-1983(R2003) and are addressed in Section 8.3.1.2.7. For justification of using IEEE Std 317-1983(R2003) instead of IEEE Std 317-1983 as endorsed by RG 1.63, refer to Section 3.11.2.3.1.
- IEEE Std 338-1987, "IEEE Standard Criteria for the Periodic Surveillance Testing of Nuclear Power Generating Station Safety Systems."
  - Class 1E distribution system periodic surveillance requirements conform to the specifications of IEEE Std 338-1987 as amended by RG 1.118 and they are addressed in Section 16.3.8.
- IEEE Std 379-2000, "IEEE Standard Application of the Single-Failure Criterion to Nuclear Power Generating Station Safety Systems."
  - Onsite power system meets single failure requirements of IEEE Std 379-2000 as endorsed by RG 1.53 and are addressed in Section 8.3.1.2.4.
- IEEE Std 384-1992, "IEEE Standard Criteria for Independence of Class 1E Equipment and Circuits."
  - Onsite power system equipment and cabling meet the requirements of IEEE Std 384-1992 as supplemented by RG 1.75 and are addressed in Section 8.3.1.2.4.
- IEEE Std 387-1995, "IEEE Standard Criteria for Diesel-Generator Units Applied as Standby Power Supplies for Nuclear Power Generating Stations."
  - The EDGs are designed, sized, and tested in accordance with the guidelines of IEEE Std 387-1995 as supplemented by RG 1.9 and is discussed in Section 8.3.1.1.5 and Section 8.3.1.2.4.
- IEEE Std 450-2002, "IEEE Recommended Practice for Maintenance, Testing and Replacement of Vented Lead-Acid Batteries for Stationary Applications."
  - Battery maintenance and testing is in accordance with IEEE Std 450-2002 as supplemented by RG 1.129 and is incorporated in the surveillance requirements provided in Section 16.3.8.4.
- IEEE Std 484-2002, "IEEE Recommended Practice for Installation Design and Installation of Vented Lead-Acid Batteries for Stationary Applications."

  - Initial design and installation of station batteries meet the criteria in IEEE Std 484-2002 as supplemented by RG 1.128 for proper design and installation of large lead-acid storage batteries and is discussed in Section 8.3.2.2.4.

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

  - Station batteries have been sized in accordance with IEEE Std 485-1997 battery sizing methodology.

- IEEE Std 242-2001, "IEEE Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems."

  - Distribution system analyses will be conducted in accordance with IEEE Std 242-2001 to verify the protection feature coordination capability to limit the loss of equipment due to postulated faults.

- IEEE Std 519-1992, "IEEE Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems."

  - Class 1E power quality meets IEEE Std 519-1992 and is addressed in Section 8.3.1.3.6.

- IEEE Std 535-1986, "IEEE Standard for Qualification of Class 1E Lead Storage Batteries for Nuclear Power Generating Systems."

  - Station Class 1E batteries are qualified in accordance with IEEE Std 535-1986 as endorsed by RG 1.158.

- IEEE Std 603-1998, "IEEE Standard Criteria for Safety Systems for Nuclear Power Generating Stations."

  - Class 1E distribution systems meet the design, reliability, qualification, and testability requirements of IEEE Std 603-1998 for safety systems power requirements. Section 7.1 describes the use of IEEE Std 603-1998 instead of Std 603-1991.

- IEEE Std 665-1995(R2001), "IEEE Guide for Generating Station Grounding."

  - Station grounding system design for personnel safety and equipment protection is in accordance with IEEE Std 665-1995(R2001) as augmented by RG 1.204 and is addressed in Section 8.3.1.3.8.

- IEEE Std 666-1991(R1996), "IEEE Design Guide for Electrical Power Service Systems for Generating Stations."

  - Electrical distribution system grounding is done per the guidelines in IEEE Std 666-1991(R1996) as endorsed by RG 1.204 and is addressed in Section 8.3.1.3.8.

- IEEE Std 741, "IEEE Standard Criteria for the Protection of Class 1E Power Systems and Equipment in Nuclear Power Generating Stations."
  - Containment electrical penetration assembly protection meets the guidance of IEEE Std 741-1986 as endorsed by RG 1.63 and is addressed in Section 8.3.1.1.11.
  - Undervoltage and degraded voltage setpoints are developed in accordance with IEEE Std 741-1997 as described in BTP 8-6 and is addressed in Section 8.3.1.1.3.
- IEEE Std 1050-1996, "IEEE Guide for Instrumentation and Control Equipment Grounding in Generating Stations."
  - Instrumentation and control systems are grounded in accordance with the specifications of IEEE Std 1050-1996 as endorsed by RG 1.204 and is addressed in Section 8.3.1.3.8.
- IEEE Std C62.23-1995(R2001), "IEEE Application Guide for Surge Protection of Electrical Generating Plants."
  - Station surge protection is designed in accordance with the specifications of IEEE Std C62.23-1995(R2001) as endorsed by RG 1.204 and is addressed in Section 8.3.1.3.5.

8.1.4.3.4 Branch Technical Positions

The guidelines of the following Branch Technical Positions were implemented in the design of the U.S. EPR electrical system:

- BTP 8-1, "Requirements on Motor-Operated Valves in the ECCS Accumulator Lines."
  - Safety injection system accumulator motor operated isolation valves have the indications, alarm features, and control features described in BTP 8-1 and are described in Section 7.6.1.2.2 and Section 7.5.2.2.5.
- BTP 8-2, "Use of Diesel-Generator Sets for Peaking."
  - Station EDGs provide standby power in the event of a loss of offsite power. They are periodically connected to the offsite power source one at a time for surveillance load testing in accordance with station technical specification surveillance requirements and post maintenance testing. EDGs are not used for peaking service.
- BTP 8-3, "Stability of Offsite Power Systems."
  - Grid stability studies for the electrical transmission grid which are used to provide offsite power to the plant are performed to demonstrate that loss of the largest operating unit on the grid will not result in loss of grid stability or

availability of the site specific transmission system. Section 8.2.2.4 provides additional details regarding grid stability analysis.

- BTP 8-4, "Application of the Single Failure Criterion to Manually Controlled Electrically Operated Valves."
  - Evaluation of systems susceptible to the application of the single failure criterion to manually-controlled electrically-operated valves meets the guidance in BTP 8-4 and is described in Section 8.3.1.2.11.
- BTP 8-5 "Supplemental Guidance for Bypass and Inoperable Status Indication for Engineered Safety Features Systems."
  - Guidance from BTP 8-5 has been used in the design of the bypass and inoperable status indicators. Section 7.5.2.2.5 and Section 18.7 provide information on the indicators.
- BTP 8-6, "Adequacy of Station Electric Distribution System Voltages."
  - Degraded grid voltage protection is provided by means of a time delayed degraded voltage monitoring scheme. The selection of the undervoltage setpoints and time delay meet BTP 8-6 guidance for safety-related load protection from degraded grid voltage. Further information regarding degraded voltage monitoring and protection, and analytical model verification is provided in Section 8.3.1.1.3 and Section 8.3.1.3.1.
- BTP 8-7, "Criteria for Alarms and Indications Associated with Diesel-Generator Unit Bypassed and Inoperable Status."
  - The bypassed and inoperable status indications for the standby EDGs meet BTP 8-7 guidance and are described in Section 8.3.1.1.5 and Section 18.7.

8.1.4.4 NRC Generic Letters

As a minimum, information in the following NRC generic letters was considered in the U.S. EPR electrical systems design:

- Generic Letter 1996-01, "Testing of Safety-Related Logic Circuits."
  - Plant surveillance test procedures are developed to test portions of the logic circuitry, including any parallel logic, interlocks, bypasses and inhibit circuits as indicated in NRC generic letter 1996-01, so that safety-related functions are verified to operate as designed when initiated.
- Generic Letter 2006-02, "Grid Reliability and the Impact on Plant Risk and the Operability of Offsite Power."
  - The COL applicant that references the U.S. EPR design certification is responsible for addressing the information presented in NRC generic letter 2006-02 as indicated in Section 8.2.1.1.

- Generic Letter 2007-01, "Inaccessible or Underground Power Cable Failures that Disable Accident Mitigation Systems or Cause Plant Transients."
  - Provisions are included in the electrical distribution system design to minimize the potential for cable degradation due to moisture exposure. The design provisions and the monitoring capability to detect degradation of inaccessible or underground power cables as indicated in NRC generic letter 2007-01 are described in Section 8.3.1.1.9.

8.1.5 References

1. IEEE Std 308-2001, "IEEE Standard Criteria for Class 1E Power Systems for Nuclear Power Generating Stations," Institute of Electrical and Electronics Engineers, 2001.

2. IEEE Std 317-1983(R2003), "IEEE Standard for Electric Penetration Assemblies in Containment Structures for Nuclear Power Generating Stations," Institute of Electrical and Electronics Engineers, 1983.

3. IEEE Std 338-1987, "IEEE Standard Criteria for the Periodic Surveillance Testing of Nuclear Power Generating Station Safety Systems," Institute of Electrical and Electronics Engineers, 1987.

4. IEEE Std 379-2000, "IEEE Standard Application of the Single-Failure Criterion to Nuclear Power Generating Station Safety Systems," Institute of Electrical and Electronics Engineers, 2000.

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

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

7. IEEE Std 450-2002, "IEEE Recommended Practice for Maintenance, Testing and Replacement of Vented Lead-Acid Batteries for Stationary Applications," Institute of Electrical and Electronics Engineers, 2002.

8. IEEE Std 484-2002, "IEEE Recommended Practice for Installation Design and Installation of Vented Lead-Acid Batteries for Stationary Applications," Institute of Electrical and Electronics Engineers, 2002.

9. IEEE Std 485-1997, "IEEE Recommended Practice for Sizing Lead-Acid Batteries for Stationary Application," Institute of Electrical and Electronics Engineers, 1997.

10. IEEE Std 242-2001, "IEEE Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems," Institute of Electrical and Electronics Engineers, 2001.

11. IEEE Std 519-1992, “IEEE Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems,” Institute of Electrical and Electronics Engineers, 1992.

12. IEEE Std 535-1986, “IEEE Standard for Qualification of Class 1E Lead Storage Batteries for Nuclear Power Generating Systems,” Institute of Electrical and Electronics Engineers, 1986.

13. IEEE Std 603-1998, “IEEE Standard Criteria for Safety Systems for Nuclear Power Generating Stations,” Institute of Electrical and Electronics Engineers, 1998.

14. IEEE Std 665-1995(R2001), “IEEE Guide for Generating Station Grounding,” Institute of Electrical and Electronics Engineers, 1996.

15. IEEE Std 666-1991(R1996), “IEEE Design Guide for Electrical Power Service Systems for Generating Stations,” Institute of Electrical and Electronics Engineers, 1991.

16. IEEE Std 741-1986, “IEEE Standard Criteria for the Protection of Class 1E Power Systems and Equipment in Nuclear Power Generating Stations,” Institute of Electrical and Electronics Engineers, 1986.

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

18. IEEE Std 1050-1996, “IEEE Guide for Instrumentation and Control Equipment Grounding in Generating Stations,” Institute of Electrical and Electronics Engineers, 1996.

19. IEEE Std C62.23-1995(R2001), “IEEE Application Guide for Surge Protection of Electrical Generating Plants,” Institute of Electrical and Electronics Engineers, 1995.

20. BTP 8-1, “Requirements on Motor-Operated Valves in the ECCS Accumulator Lines.,” U.S. Nuclear Regulatory Commission, Standard Review Plan, Branch Technical Position, Rev. 3, March 2007.

21. BTP 8-2, “Use of Diesel-Generator Sets for Peaking,” U.S. Nuclear Regulatory Commission, Standard Review Plan, Branch Technical Position, Rev. 3, March 2007.

22. BTP 8-3, “Stability of Offsite Power Systems,” U.S. Nuclear Regulatory Commission, Standard Review Plan, Branch Technical Position, Rev. 3, March 2007.

23. BTP 8-4, “Application of the Single Failure Criterion to Manually Controlled Electrically Operated Valves,” U.S. Nuclear Regulatory Commission, Standard Review Plan, Branch Technical Position, Rev. 3, March 2007.

24. BTP 8-5 “Supplemental Guidance for Bypass and Inoperable Status Indication for Engineered Safety Features Systems,” U.S. Nuclear Regulatory Commission, Standard Review Plan, Branch Technical Position, Rev. 3, March 2007.

25. BTP 8-6, “Adequacy of Station Electric Distribution System Voltages,” U.S. Nuclear Regulatory Commission, Standard Review Plan, Branch Technical Position, Rev. 3, March 2007.

26. BTP 8-7, “Criteria for Alarms and Indications Associated with Diesel-Generator Unit Bypassed and Inoperable Status,” U.S. Nuclear Regulatory Commission, Standard Review Plan, Branch Technical Position, Rev. 3, March 2007.

27. NRC Generic Letter No. 96-01, “Testing of Safety-Related Logic Circuits,” U.S. Nuclear Regulatory Commission, Office Of Nuclear Reactor Regulation, January 10, 1996.

28. NRC Generic Letter 2006-02, “Grid Reliability and the Impact on Plant Risk and the Operability of Offsite Power,” U.S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation, February 1, 2006.

29. NRC Generic Letter 2007-01: “Inaccessible or Underground Power Cable Failures that Disable Accident Mitigation Systems or Cause Plant Transients,” U.S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation, February 7, 2007.

30. Deleted.

31. SECY-90-016, “Evolutionary Light Water Reactor Certification Issues and Their Relationships to Current Regulatory Requirements.” United States Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation, 1990.

32. SECY-94-084 “Policy and Technical Issues Associated with the Regulatory Treatment of Non-Safety Systems in Passive Plant Designs,” United States Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation, 1994.

33. SECY-95-132 “Policy and Technical Issues Associated with the Regulatory Treatment of Non-Safety Systems (RTNSS) in Passive Plant Designs,” United States Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation, 1995.

34. SECY-91-078 “EPRI’s Requirements Document and Additional Evolutionary LWR Certification Issues,” United States Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation, 1991.

35. SECY-05-227 “Final Rule – AP1000 Design Certification,” United States Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation, 2005.

36. NUREG-0718, “Licensing Requirements for Pending Applications for Construction Permits and Manufacturing License,” Rev. 2, United States Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation, 1982.

37. NUREG-0737 “Clarification of TMI Action Plan Requirements,” United States Nuclear Regulatory Commission, Division of Licensing, Office of Nuclear Reactor Regulation, 1980.

38. NUREG/CR-0660 “Enhancement of Onsite Diesel Generator Reliability,” Boner, Gerald L., Hanners, Harvey W., University of Dayton Research Institute, Dayton, Ohio; for the Division of Operating Reactors, Office of Nuclear Regulation, United States Nuclear Regulatory Commission, 1979.

39. NUREG-1793 “Final Safety Evaluation Report Related to Certification of the AP1000 Standard Design,” Division of Regulatory Improvement Programs, Office of Nuclear Reactor Regulation, U.S. Nuclear Regulatory Commission, 2004.

Table 8.1-1—Acceptance Criteria and Guidelines Applicability for Electric Power Systems
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Criteria	Title	Applicable DCD Section				Remarks
		8.2	8.3.1	8.3.2	8.4	
1. General Design Criteria (GDCs), Appendix A to 10 CFR 50						
a. GDC 2	"Design Bases for Protection Against Natural Phenomena"	A	A	A		
b. GDC 4	"Environmental and Dynamic Effects Design Bases"	A	A	A		
c. GDC 5	"Sharing of Structures, Systems, and Components"	A	A	A		
d. GDC 17	"Electric Power Systems"	A	A	A	A	
e. GDC 18	"Inspection and Testing of Electrical Power Systems"	A	A	A	A	
f. GDC 33, 34, 35, 38, 41 & 44		A	A	A		As they relate to the operation of electric power systems, encompassed in GDC 17, to ensure that the safety functions of the systems described in GDCs 33, 34, 35, 38, 41, and 44 are accomplished.
g. GDC 50	"Containment Design Bases"		A	A		
2. Regulations (10 CFR 50 and 10 CFR 52)						
a. 10 CFR 50.34	"Contents of Applications; Technical Information"					
i. 50.34(f)(2) (v)	"Safety System Status Monitoring"	A	A	A		(Related to TMI Item I.D.3)
ii. 50.34(f)(2) (xiii)	"Reliability of Power Supplies for Natural Circulation"		A			(Related to TMI Item II.E.3.1)

Table 8.1-1—Acceptance Criteria and Guidelines Applicability for Electric Power Systems
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Criteria	Title	Applicable DCD Section				Remarks
		8.2	8.3.1	8.3.2	8.4	
iii. 50.34(f)(2) (xx)	"Power Supplies for Pressurizer Relief Valves, Block Valves, and Level Indicators"		A			(Related to TMI Item II.G.1)
b. 10 CFR 50.55a	"Codes and Standards"		A	A		
c. 10 CFR 50.63	"Loss of All Alternating Current Power"	A	A	A	A	
d. 10 CFR 50.65(a)(4)	"Requirements for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants"	A	A	A	A	
e. 10 CFR 52.47(b)(1)	"Contents of Applications"	A	A	A	A	
f. 10 CFR 52.80(a)	"Contents of Applications; Additional Technical Information"	A	A	A	A	
3. Regulatory Guides (RG)						
a. RG 1.6	"Independence Between Redundant Standby (Onsite) Power Sources and Between Their Distribution Systems"		G	G		
b. RG 1.9	"Selection, Design, Qualification and Testing of Emergency Diesel-Generator Units Used as Class 1E Onsite Electric Power Systems at Nuclear Power Plants"		G		G	
c. RG 1.32	"Criteria for Safety-Related Electric Power Systems for Nuclear Power Plants"	G	G	G		

Table 8.1-1—Acceptance Criteria and Guidelines Applicability for Electric Power Systems
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Criteria	Title	Applicable DCD Section				Remarks
		8.2	8.3.1	8.3.2	8.4	
d. RG 1.47	"Bypassed and Inoperable Status Indication for Nuclear Power Plant Safety Systems"		G	G		
e. RG 1.53	"Application of the Single-Failure Criterion to Nuclear Power Plant Protection Systems"		G	G		
f. RG 1.63	"Electric Penetration Assemblies in Containment Structures Nuclear Power Plants"		G	G		
g. RG 1.75	"Physical Independence of Electric Systems"		G	G		
h. RG 1.81	"Shared Emergency and Shutdown Electric Systems for Multi-Unit Nuclear Power Plants"		G	G		
i. RG 1.106	"Thermal Overload Protection for Electric Motors on Motor Operated Valves"		G	G		
j. RG 1.118	"Periodic Testing of Electric Power and Protection Systems"		G	G		
k. RG 1.128	"Installation Design and Installation of Vented Lead-Acid Storage Batteries for Nuclear Power Plants"			G		
l. RG 1.129	"Maintenance, Testing, and Replacement of Vented Lead-Acid Storage Batteries for Nuclear Power Plants"			G		

Table 8.1-1—Acceptance Criteria and Guidelines Applicability for Electric Power Systems
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Criteria	Title	Applicable DCD Section				Remarks
		8.2	8.3.1	8.3.2	8.4	
m. RG 1.153	"Criteria for Safety Systems"		G	G		
n. RG 1.155	"Station Blackout"	G	G	G	G	
o. RG 1.160	"Monitoring the Effectiveness of Maintenance at Nuclear Power Plants"	G	G	G	G	
p. RG 1.182	"Assessing and Managing Risk Before Maintenance Activities at Nuclear Power Plants"	G	G	G	G	
q. RG 1.204	"Guidelines for Lightning Protection of Nuclear Power Plants"	G	G			
r. RG 1.206	Regulatory Guide – "Combined License Applications for Nuclear Power Plants (LWR Edition)"	G	G	G	G	
4. Branch Technical Positions						
a. BTP 8-1	"Requirements on Motor-Operated Valves in the ECCS Accumulator Lines"		G			
b. BTP 8-2	"Use of Diesel-Generator Sets for Peaking"		G			
c. BTP 8-3	"Stability of Offsite Power Systems"	G				
d. BTP 8-4	"Application of the Single Failure Criterion to Manually-Controlled Electrically-Operated Valves"		G			

Table 8.1-1—Acceptance Criteria and Guidelines Applicability for Electric Power Systems
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Criteria	Title	Applicable DCD Section				Remarks
		8.2	8.3.1	8.3.2	8.4	
e. BTP 8-5	"Supplemental Guidance for Bypass and Inoperable Status Indication for Engineered Safety Features Systems"		G	G		
f. BTP 8-6	"Adequacy of Station Electric Distribution System Voltages"	G	G			
g. BTP 8-7	"Criteria for Alarms and Indications Associated with Diesel-Generator Unit Bypassed and Inoperable Status"		G			
5. NUREG Reports						
a. NUREG-0718	"Licensing Requirements for Pending Applications for Construction Permits and Manufacturing License"		G	G		
b. NUREG-0737	"Clarification of TMI Action Plan Requirements"		A			
c. NUREG/CR-0660	"Enhancement of Onsite Diesel Generator Reliability"		G			
d. NUREG-1793	"Final Safety Evaluation Report Related to Certification of the AP1000 Standard Design"					Not Applicable
6. Commission Papers (SECY)						
a. SECY-90-016	"Evolutionary Light Water Reactor Certification Issues and Their Relationships to Current Regulatory Requirements, 1990"	A	A		A	As it relates to the use of AAC power sources.

Table 8.1-1—Acceptance Criteria and Guidelines Applicability for Electric Power Systems
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Criteria	Title	Applicable DCD Section				Remarks
		8.2	8.3.1	8.3.2	8.4	
b. SECY-94-084	"Policy and Technical Issues Associated with the Regulatory Treatment of Non-Safety Systems in Passive Plant Designs, 1994"					Not Applicable
c. SECY-95-132	"Policy and Technical Issues Associated with the Regulatory Treatment of Non-Safety Systems (RTNSS) in Passive Plant Designs, 1995"					Not Applicable
d. SECY-91-078	"EPRI's Requirements Document and Additional Evolutionary LWR Certification Issues, 1991"	A				As it relates to the inclusion of an alternate power source to non-safety-related loads.
e. SECY-05-227	"Final Rule – AP1000 Design Certification, 2005"					Not Applicable

A Denotes item as applicable acceptance criteria to U.S. EPR electrical distribution systems.

G Denotes item used as guidance in the U.S. EPR electrical distribution system design as identified in the noted Section.

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