RAI Volume 2, Chapter 2.1.1.7, Sixth Set, Number 6, Supplemental Question 12a:

Confirm that the configuration of confinement heating, ventilation, and air-conditioning (HVAC), electrical and battery room cooling HVAC, and related electrical power structures, systems, and components (SSCs) in the Receipt Facility (RF) are identical to respective important to safety (ITS) SSCs in the Canister Receipt and Closure Facility (CRCF) and the Wet Handling Facility (WHF) (or provide an explanation of any system configuration differences), including a description of any capabilities for automatic or manual connection of HVAC Train A to ITS electrical power system Train B, and vice versa. Identify the design criteria, basis, or proposed operating procedures enabling this configuration. Identify where in the preclosure safety analysis (PCSA) this capability has been analyzed or credited.

1. RESPONSE

In the clarification call of October 22, 2009, the NRC requested additional explanation as to whether the PCSA accounted for cross-connections of Trains A and B among HVAC and electrical power trains, and if the PCSA included maintenance outages. This additional clarification question is addressed in Section 1.2.

1.1 CONFIRM CONFIGURATION OF CONFINEMENT HEATING, VENTILATION, AND AIR-CONDITIONING, ELECTRICAL AND BATTERY ROOM COOLING HEATING, VENTILATION, AND AIR-CONDITIONING IN THE RECEIPT FACILITY

The configuration and design methodology, criteria, and bases used for the confinement HVAC, electrical and battery room cooling HVAC, and related electrical power SSCs in the RF are the same as the associated ITS SSCs in the WHF and the CRCF. However, the RF electrical SSCs are designed based upon their respective connected loads and are, therefore, not like the associated ITS SSCs in the WHF and the CRCF with respect to ampacity, ratings, capacity, and layout. The configuration and design methodology relationship are shown in SAR Figures 1.2.6-31 through 1.2.6-33 for the RF, SAR Figures 1.2.4-104 through 1.2.4-106 for the CRCF, and SAR Figures 1.2.5-87 through 1.2.5-89 for the WHF. The design does not include cross-connect capabilities of the RF HVAC Train A to ITS electrical power Train B, or vice versa. Also, consistent with the design, there are no cross-connect capabilities between electrical Train A and B, so it is not possible to power RF HVAC Train A from electrical Train B, or vice versa.

SAR Table 1.9-5 identifies no ITS functions within the RF for the confinement HVAC, electrical and battery room cooling HVAC, and related electrical SSCs to prevent or mitigate an event sequence. Therefore, the electrical and HVAC systems for the RF are classified as non-ITS. The confinement HVAC, electrical and battery room cooling HVAC, and related electrical SSCs in the WHF and CRCF are classified as ITS, as indicated in SAR Tables 1.9-3 and 1.9-4. Additionally, the non-ITS electrical loads within the RF are isolated from the ITS electrical power subsystem by the use of ITS electrical isolation devices, 26D-EEE0-JS-00001 and 26D-EEE0-JS-00002, as shown in SAR Figures 1.4.1-10 and 1.4.1-11. Electrical isolation for the RF non-ITS power system is in accordance with IEEE Std 308-2001, *IEEE Standard Criteria for Class 1E Power Systems for Nuclear Power Generating Stations*; IEEE Std 384-1992, *IEEE*

Standard Criteria for Independence of Class 1E Equipment and Circuits; and IEEE Std 603-1998, *IEEE Standard Criteria for Safety Systems for Nuclear Power Generating Stations*. The ITS load sequencers shown in SAR Figures 1.4.1-18 and 1.4.1-19 automatically load the Emergency Diesel Generator Facility (EDGF), CRCF, and WHF. The electrical design also provides the ability to manually transfer power from the ITS bus in the EDGF to the RF.

1.2 PRECLOSURE SAFETY ANALYSIS OF THE RECEIPT FACILITY ELECTRICAL AND HEATING, VENTILATION, AND AIR-CONDITIONING SYSTEMS

The HVAC and electrical systems are modeled in *Receipt Facility Reliability and Event Sequence Categorization Analysis* (BSC 2009a, Sections B7.4 and B8.4) as ITS systems. However, the results of the analysis concluded that these systems were not required to mitigate an event sequence or reduce the probability of an event sequence and, therefore, were designated as non-ITS. The fault trees found in Figures B7.4-3 through B7.4-23 for HVAC, Figures B8.4-5 through B8.4-16 for Train A electrical power, and Figures B8.4-17 through B8.4-28 for Train B electrical power do not include cross-connections between trains. Train A electric power is modeled as providing power to Train A HVAC, and Train B electric power is modeled as providing power to Train B HVAC, consistent with the design.

HVAC trains are fed by the normal electrical power subsystem until a loss of offsite power is detected. Upon the loss of offsite power, the HVAC exhaust system stops operating. Both ITS diesel generators automatically start upon the loss of offsite power. After the ITS diesel generators reach synchronous speed, the ITS load sequencers sequentially load the ITS buses, including restoration of power to both ITS HVAC exhaust fan trains in the EDGF, CRCF, and WHF.

Procedural Safety Control-7 (PSC-7) listed in SAR Table 1.9-10, requires one train of HVAC to be operating and the second train to be in standby before commencing waste handling operations. Maintenance outages for major components of 40 hours per year are modeled for the standby HVAC train. Therefore, when one train is operating, the other train is modeled in standby with consideration for maintenance. For ease of modeling, ITS HVAC Train A, including the RF HVAC Train A, is designated as the operating train and Train B is modeled as the standby train. This is equivalent to modeling each train with a percentage of time in the operating mode and a percentage of time in the standby mode. Both ITS electrical power trains are modeled with maintenance outages based on fault exposure time of 168 hours, or one week per year.

1.2.1 Maintenance Basic Events Associated with Important to Safety Electrical Power System Fault Trees

The system/pivotal event analysis associated with the ITS electrical power system for the CRCF is found in Section B8 of *Canister Receipt and Closure Facility Reliability and Event Sequence Categorization Analysis* (BSC 2009b). Section B8.4 of the analysis presents the Train A and Train B ITS AC electrical power failure scenarios, which include basic events associated with maintenance of ITS electrical power SSCs.

Maintenance-related failures are considered in Section B8.4 of *Canister Receipt and Closure Facility Reliability and Event Sequence Categorization Analysis* (BSC 2009b) for electrical power and in Section B7.4 for HVAC. Tables 1 and 2 present the basic events and identify their locations in the fault trees for ITS electric power and HVAC, respectively.

Table 1. Maintenance-Related Basic Events in the ITS Electrical Power System

Modeled Electrical Train	Basic Event	Description	Gate	Figure	Page
Train A	060-#EEE-LDCNTRA-BUA-MTN	ITS Load Center Train A out of service for Maintenance	EP-CRCF-17	B8.4-5	B8-45
Train B	060-#EEE-LDCNTRA-BUA-MTN	ITS Load Center Train A out of service for Maintenance	EP-CRCF-58	B8.4-17	B8-69
Train A	060-#EEE-LDCNTRB-BUA-MTN	ITS Load Center Train B out of service for Maintenance	EP-CRCF-18	B8.4-5	B8-45
Train B	060-#EEE-LDCNTRB-BUA-MTN	ITS Load Center Train B out of service for Maintenance	EP-CRCF-57	B8.4-17	B8-69
Train A	060-#EEE-LDCNTRA-BUA-ROE	Failure to Restore ITS Load Center Train A post maintenance	EP-CRCF-17	B8.4-5	B8-45
Train B	060-#EEE-LDCNTRA-BUA-ROE	Failure to Restore ITS Load Center Train A post maintenance	EP-CRCF-58	B8.4-17	B8-69
Train A	060-#EEE-LDCNTRB-BUA-ROE	Failure to Restore ITS Load Center Train B post maintenance	EP-CRCF-18	B8.4-5	B8-45
Train B	060-#EEE-LDCNTRB-BUA-ROE	Failure to Restore ITS Load Center Train B post maintenance	EP-CRCF-57	B8.4-17	B8-69
Train A	26D-#EEY-ITSDG-A-#DG-MTN	ITS Diesel Generator A Out Of Service for Maintenance	EP-ITS-DG-A-9	B8.4-10	B8-55
Train B	26D-#EEY-ITSDG-A-#DG-MTN	ITS Diesel Generator A Out Of Service for Maintenance	EP-ITS-DG-B-10	B8.4-22	B8-79
Train A	26D-#EEY-ITSDG-B-#DG-MTN	ITS Diesel Generator B Out Of Service for Maintenance	EP-ITS-DG-A-10	B8.4-10	B8-55
Train B	26D-#EEY-ITSDG-B-#DG-MTN	ITS Diesel Generator B Out Of Service for Maintenance	EP-ITS-DG-B-9	B8.4-22	B8-79
Train A	26D-#EEY-ITSDG-A-#DG-RSS	Failure to properly return ITS diesel generator A to service after maintenance	EP-ITS-DG-A-9	B8.4-10	B8-55
Train B	26D-#EEY-ITSDG-A-#DG-RSS	Failure to properly return ITS diesel generator A to service after maintenance	EP-ITS-DG-B-10	B8.4-22	B8-79
Train A	26D-#EEY-ITSDG-B-#DG-RSS	Failure to properly return ITS diesel generator B to service after maintenance	EP-ITS-DG-A-10	B8.4-10	B8-55
Train B	26D-#EEY-ITSDG-B-#DG-RSS	Failure to properly return ITS diesel generator B to service after maintenance	EP-ITS-DG-B-9	B8.4-22	B8-79

Table 2. Maintenance-Related Basic Events in the ITS HVAC System

Modeled Train	Basic Event	Description	Gate	Figure	Page
Train B	060-VCTO-TRAINB-MAINT	Train B unavailable due to maintenance	HVAC005	B7.4-6	B7-31

2. COMMITMENTS TO NRC

None.

3. DESCRIPTION OF PROPOSED LA CHANGE

None.

4. REFERENCES

BSC (Bechtel SAIC Company) 2009a. *Receipt Facility Reliability and Event Sequence Categorization Analysis*. 200-PSA-RF00-00200-000-00B. Las Vegas, Nevada: Bechtel SAIC Company. ACC: ENG.20090112.0010

BSC 2009b. *Canister Receipt and Closure Facility Reliability and Event Sequence Categorization Analysis*. 060-PSA-CR00-00200-000-00B. Las Vegas, Nevada: Bechtel SAIC Company. ACC: ENG.20090112.0004

IEEE Std 308-2001. 2002. *IEEE Standard Criteria for Class 1E Power Systems for Nuclear Power Generating Stations*. New York, New York: Institute of Electrical and Electronic Engineers. TIC: 252746.

IEEE Std 384-1992. 1998. *IEEE Standard Criteria for Independence of Class 1E Equipment and Circuits*. New York, New York: Institute of Electrical and Electronics Engineers. TIC: 258693.

IEEE Std 603-1998. *IEEE Standard Criteria for Safety Systems for Nuclear Power Generating Stations*. New York, New York: The Institute of Electrical and Electronics Engineers. TIC: 242993.

RAI Volume 2, Chapter 2.1.1.6, Second Set, Number 9, Supplemental Question 12b:

The response to RAI 2.2.1.1.6-2-009 indicates that the maximum allowable time needed before important to safety (ITS) diesel generators are started and loaded is up to 8 hours to support safety performance objectives with no power assuming loss of offsite power. However, the ITS uninterruptible power supplies are described in the SAR as being needed to provide continuous power (for up to 15 minutes) to ITS instruments that need continuous power to support ITS structures, systems, and components (SSCs), with the implication that no power will be available to run ITS uninterruptible power supply loads after batteries powering ITS uninterruptible power supplies have been exhausted but before ITS diesel generators are required to be loaded. Describe the ITS uninterruptible power supply loads that require continuous power and their design criteria and design bases for radiological safety, and identify whether any ITS uninterruptible power supply loads are needed after 15 minutes when uninterruptible power supply battery power is depleted during a loss of offsite power, prior to the 8 hour allowed time for starting and loading the ITS diesel generators, or prior to recovery of power using normal power following a loss of offsite power that exceeds 15 minutes.

1. RESPONSE

The estimated time by which the ITS diesel generators are needed to start and be fully loaded with the ITS loads in the event of loss of offsite power is up to 8 hours. However, the duration for starting, accelerating, sequencing, and loading of the ITS diesel generators is in accordance with Section 4.1 of IEEE Std 387-1995, *Standard Criteria for Diesel-Generator Units Applied as Standby Power Generating Stations,* and expected to be less than 3 minutes. The automatic load sequencing for the ITS buses is in accordance with SAR Section 1.4.1.2.1.

The 15 minute battery capacity is for the normal uninterruptible power supplies as described in SAR Section 1.4.1.1.1.5. The normal uninterruptible power supply is used to power non-ITS facility process equipment and instrumentation to stop ongoing operations in a controlled manner during a loss of power, such as the welding machines for waste package closure systems located in the Canister Receipt and Closure Facility (CRCF) and Initial Handling Facility (IHF), and the welding machines for the closure of transportation, aging, and disposal canisters loaded within the Wet Handling Facility (WHF). The normal uninterruptible power supplies are non-ITS and are independent from the ITS uninterruptible power supply units. The normal uninterruptible power supply units also provide power to portions of the digital control and management information system, radiation/radiological monitoring system, environmental–meteorological monitoring system, and communication system located in the CRCF, IHF, WHF, Receipt Facility, and the Central Control Center Facility. The normal uninterruptible power supply does not provide power to ITS instrumentation.

1.1 DESCRIBE THE IMPORTANT TO SAFETY UNINTERRUPTIBLE POWER SUPPLY LOADS THAT REQUIRE CONTINUOUS POWER AND THEIR DESIGN CRITERIA AND DESIGN BASES

The ITS uninterruptible power supply provides continuous ITS power upon the loss of offsite power; however the preclosure safety analysis does not require any ITS loads to be fed from the ITS uninterruptible power supply upon the loss of offsite power. The instrumentation and controls for the safety functions performed by ITS SSCs such as overhead cranes, waste package positioning room shield doors, and cask port slide gates are not required to be continuously supported by the ITS uninterruptible power supply, as these SSCs fail-safe upon the loss of power. Therefore, there is no 15 minute or 8 hour ITS uninterruptible power supply requirement to support the safety performance objectives during the loss of offsite power.

The ITS electrical subsystem design includes the ITS uninterruptible power supply as a means of providing additional flexibility and capability, improving the overall performance (i.e., voltage regulation) of the ITS electrical SSCs, and having a contingency power supply, if needed. Assigned loads for the ITS uninterruptible power supplies, such as the loads described in SAR Section 1.4.1.3.1 and Section 1.3 of the supplemental response to RAI 2.2.1.1.7-6-004, will be determined during detailed design. The ITS design load allocation assumes the ITS uninterruptible power supplies are fully loaded (i.e., maximum power requirements), allowing for electrical load growth during detailed design.

The ITS uninterruptible power supplies described in SAR Section 1.4.1.3 are designed in accordance with the codes and standards listed in SAR Section 1.4.1.2.8, including NFPA 70 *National Electrical Code*; ANSI/IEEE Std 944-1986, *IEEE Recommended Practice for the Application and Testing of Uninterruptible Power Supplies for Power Generating Stations*; and IEEE Std 1184-1994, *IEEE Guide for the Selection and Sizing of Batteries for Uninterruptible Power Systems*.

The CRCF ITS uninterruptible power supply inverter single-line diagrams are shown in SAR Figures 1.4.1-22 and 1.4.1-23. The WHF ITS uninterruptible power supply inverter single-line diagrams are shown in SAR Figures 1.4.1-24 and 1.4.1-25. The Emergency Diesel Generator Facility ITS uninterruptible power supply inverter single-line diagrams are shown in SAR Figures 1.4.1-26 and 1.4.1-27.

The ITS uninterruptible power supply units are supplied from an ITS 480 V AC source. The ITS uninterruptible power supply systems are comprised of independent and redundant uninterruptible power supplies, each supplying an associated bus by battery charger through a static inverter.

The ITS 125 V DC power supply provides control power for tripping and closing the 13.8 kV ITS switchgear circuit breakers, allowing the ITS diesel generators to start and load. The supply consists of two redundant and independent 125 V DC battery banks with their associated chargers and distribution panels. Physical separation and isolation prevent a fault in one load group from affecting the other load group. The ITS 125 V DC batteries described in SAR

Section 1.4.1.3.1 are sized in accordance with IEEE Std 485-1997, *IEEE Recommended Practice for Sizing Lead-Acid Batteries for Stationary Applications*, to have sufficient capacity to supply the required loads for a duration of 8 hours.

1.2 POWER SOURCE FOR IMPORTANT TO SAFETY RADIATION DETECTORS

In the public call with the NRC staff on October 22, 2009, the NRC requested the DOE to clarify if the ITS radiation detectors should be fed from the ITS uninterruptible power supplies.

SSCs such as the ITS radiation detectors are designed and interlocked (an ITS function) to ensure that the shield doors separating the waste package loadout areas in the IHF and CRCF are not inadvertently opened if high radiation conditions are present. Both the ITS radiation detectors and ITS shield doors are fed from the normal power supply subsystem. During a loss of offsite power, normal facility operations cease, the ITS shield doors fail as is (i.e., closed when high radiation present) and become nonoperational. The ITS radiation detectors are not required to function during the loss of offsite power as the ITS shield doors are deenergized and nonoperational. Therefore, it is appropriate to feed the ITS radiation detectors from the normal power supply subsystem. SAR Figure 1.4.1-3 (Sheet 5 of 16, circuits 16 and 17), shows the CRCF waste package vestibule room shield doors fed from the normal power supply. Similarly, the ITS shield doors and radiation detectors in the IHF are fed from the normal power supply as shown in SAR Section 1.4.1.2.1 and SAR Figures 1.4.1-10 and 1.4.1-11.

2. COMMITMENTS TO NRC

None.

3. DESCRIPTION OF PROPOSED LA CHANGE

None.

4. REFERENCES

ANSI/IEEE Std 944-1986. 1996. *IEEE Recommended Practice for the Application and Testing of Uninterruptible Power Supplies for Power Generating Stations*. New York, New York: Institute of Electrical and Electronics Engineers. TIC: 255429.

NFPA 70. 2005. *National Electrical Code*. 2005 Edition. Quincy, Massachusetts: National Fire Protection Association. TIC: 258735.

IEEE Std 387-1995. 2001. *Standard Criteria for Diesel-Generator Units Applied as Standby Power Generating Stations*. New York, New York: Institute of Electrical and Electronics Engineers. TIC: 258750.

IEEE Std 485-1997. 2003. *IEEE Recommended Practice for Sizing Lead-Acid Batteries for Stationary Applications*. New York, New York: Institute of Electrical and Electronics Engineers. TIC: 256688.

IEEE Std 1184-1994. 1995. *IEEE Guide for the Selection and Sizing of Batteries for Uninterruptible Power Systems*. New York, New York: Institute of Electrical and Electronics Engineers. TIC: 254113.

RAI Volume 2, Chapter 2.1.1.7, Sixth Set, Number 4, Supplemental Question 12c:

Provide a description of the methodology and criteria used to make a determination that the cable raceway system carrying important to safety (ITS) electrical power, controls, and instrument signals among the ITS diesel generator and all ITS structures, systems, and components (SSCs) throughout the geologic repository operations area that rely on ITS electrical power, control, and instrument signals to accomplish safety functions, do not need to be subjected to same set of quality requirements as ITS SSCs (i.e., why they are classified as non-ITS as described in SAR Section 1.4.1.2.6). Provide a commitment with regard to design methodology, and design criteria (as described in applicable industry codes and standards) that will be used to complete the design of ITS electrical power systems beyond main buses, switch gear, motor control centers, and load center SSCs described in the Emergency Diesel Generator Facility, Canister Receipt and Closure Facility (CRCF), and the Wet Handling Facility.

1. RESPONSE

1.1 CLASSIFICATION OF IMPORTANT TO SAFETY STRUCTURES, SYSTEMS AND COMPONENTS, INCLUDING CABLE RACEWAYS

The clarification call with the NRC on October 22, 2009, identified that the response should include a justification for why electrical conductors and electrical distribution equipment are ITS and raceway structural elements such as conduit and cable trays are non-ITS. This response provides that justification, and in doing so, distinguishes between the function of the conductors within the cable, and the function of the remainder of the cable (e.g., the jacket). That distinction is shown in Table 1.

The process for classifying SSCs as ITS or non-ITS is summarized in SAR Sections 1.6.1, 1.6.2, and 1.9. This classification is based on the specific safety functions performed by the SSCs that are relied upon to prevent the occurrence of an event sequence or mitigate the consequences of an event sequence, as demonstrated in the event sequence analyses. The ITS power subsystem supplies power to the ITS confinement and ITS cooling portions of the heating, ventilation, and air-conditioning (HVAC) system.

In the seismic event sequence analysis, HVAC and electrical power are not relied upon for either prevention or mitigation of the event sequence. The analysis assumes that if a seismic event were sufficiently severe to cause the breach of a waste form container, the HVAC system is considered to be failed. Thus the HVAC system is not modeled in the seismic event sequence analysis (SAR Section 1.7.1.4). There are no electrical power SSCs or associated conductor support and physical protection SSCs (e.g., raceway, cable trays, cable jackets) that are ITS for purposes of seismic event sequence prevention or mitigation. Because a loss of offsite power coupled with canister breach has been demonstrated to have a frequency that is beyond Category 2, as indicated in SAR Tables 1.7-7 through 1.7-19, loss of offsite power was determined to not be an initiating event, and no external event sequence relies upon electrical power to reduce the probability of or mitigate such event sequences.

When classifying SSCs as ITS or non-ITS during the internal event sequence analyses, consideration is given to the relative reliability of an SSC in the event sequence as part of determining whether or not it can be relied upon to prevent or mitigate the event sequence. This same criteria is applied in determining the classification of components within a system that has been designated as ITS. For example, the ITS HVAC system confinement and filtration functions are relied upon to mitigate the consequences of a potential event sequence. They rely on active ITS electric power distribution components such as switchgear, load centers, motor control centers, and distribution panels, which, in turn, power active components (including those in the standby mode) such as ITS HVAC filtration and cooling components. Table B8.4-1 of *Canister Receipt and Closure Facility Reliability and Event Sequence Categorization Analysis* (BSC 2009) indicates a mean fan failure-to-run failure rate of 7×10^{-5} per hour and failure-to-start failure rate of 2×10^{-3} per demand. Components such as breakers and diesel generators that must actuate to provide power upon demand have failure rates of 2×10^{-4} per demand for a breaker and 8×10^{-3} per demand for a diesel generator.

In contrast, noncurrent carrying equipment that provides physical protection or structural support of conductors (e.g., cable jacket, conduit, and cable trays) have much lower probabilities of failure than active components because they are not subject to the same higher frequency failure mechanisms. For example, estimates of electrical cable failures are less than 1×10^{-8} per hour (Denson et al. 1994, p. 2-28). In addition, local failure of a conduit or cable tray may or may not interrupt the continuity of the circuit (depending on the failure), which would be necessary to interrupt ITS electrical power functions. These types of components are not explicitly analyzed because of their failure rates being substantially lower than other components relied upon, resulting in even lower frequencies of interrupting electrical power. They are not relied upon to prevent (i.e., reduce the probability of) an event sequence. Their inclusion or exclusion from the preclosure safety analysis (PCSA) event sequence model does not change the nuclear safety design bases for the ITS electrical power system and ITS portions of the HVAC system shown in SAR Section 1.9. Thus, these components are designated as non-ITS. This classification does not mean that noncurrent carrying equipment are unimportant for the purposes of normal operation; these SSCs are designed to the appropriate standards to ensure reliable performance for their normal operating function as described in Section 1.2 of this response.

Electrical conductors supplying current to components supporting a safety function are ITS. The clarification call with the NRC on October 22, 2009, resulted in a request to identify where in the PCSA such conductors are included. The failure mode modeled for conductors in the PCSA electric power fault tree is failure to provide continuity of circuit. The dominant failure mechanism for conductors is associated with their attachment points (i.e., terminations) at electrical buses, switchgear, load centers, motor control centers, distribution panels, and load terminations where the failure of a connection device (e.g., splices, mechanical lugs, pressure terminals, terminal blocks, or crimp-on) may lead to failure to provide circuit continuity. It is far less likely that conductors fail in the middle of a feeder or circuit run where there are no conductor splices or termination points. It is typical in probabilistic risk assessments, which is the technology used for this portion of the PCSA, to not explicitly model each conductor. Rather, the key end points (i.e., panels, load centers, buses) of groups of conductors are modeled in the fault tree. Table B8.4-1 of *Canister Receipt and Closure Facility Reliability and Event Sequence*

Categorization Analysis (BSC 2009) shows the basic events associated with failure to provide circuit continuity in the ITS electrical power system fault tree. Examples of these basic events and their respective gates in the Train A electrical power fault tree are:

- 060-#EEE-LDCNTRA-BUA-FOH CRCF Load Center A Fails; Gate EP-CRCF-1, Page B8-45

- 26D-#EEU-208_DGA-BUD-FOH ITS DC Panel A DC Bus Failure; Gate EP-CRCF-2B-A, Page B8-47

- 27A-#EEN-OPENBS2-BUA-FOH 13.8 kV Open Bus 2 Bus Failure; Gate GATE-18-14, Page B8-67

Table B8.4-5 of *Canister Receipt and Closure Facility Reliability and Event Sequence Categorization Analysis* (BSC 2009) shows the basic events associated with failure to provide circuit continuity in the ITS electrical power system fault tree. These basic events and their respective gates in the Train B electrical power fault tree are:

- 060-#EEE-LDCNTRB-BUA-FOH CRCF ITS Load Center B Fails; Gate EP-CRCF-51, Page B8-69

- 26D-#EEU-208_DGB-BUD-FOH ITS DG B DC Panel Failure; Gate EP-CRCF-52B1, Page B8-71

- 27A-#EEN-OPENBS4-BUA-FOH 13.8 kV Open Bus 4 Bus Failure; Gate GATE-19-0-1, Page B8-91

The fault trees show the components and the logic that leads to Train A or Train B ITS electrical power failure including electrical buses, switchgear, load centers, motor control centers, distribution panels, and load terminations, as well as active electrical power components and basic events associated with maintenance unavailability. The response to RAI 2.2.1.1.7-6-006 describes how the PCSA evaluates one train operating while the other train is unavailable due to maintenance.

1.2 DESIGN METHODOLOGY AND DESIGN CRITERIA

The clarification call with the NRC on October 22, 2009, expanded this question to what connections are made from the ITS load center to the ITS loads, or the ITS motor control center to the ITS loads. The NRC staff cited the CRCF distribution panel 060-EEE0-PL-00003 as an example of an ITS panel that could feed loads other than the ITS HVAC system. The loads on ITS panel 060-EEE0-PL-00003 are addressed in Section 1.3.

SAR Table 1.9-1 defines the ITS distribution components of the ITS power subsystem as the feeders up to and including ITS loads, ITS DC power, and ITS uninterruptible power supply power. The ITS power distribution subsystem includes the current carrying components (i.e., cables, conductors, circuit breakers, fuses, relays, bus bars, isolation devices, and terminations) between the ITS diesel generators and the ITS load. The noncurrent carrying components (i.e., raceways, enclosures, fittings, and cable trays) supporting or providing physical protection of the ITS distribution subsystem are classified as non-ITS.

The ITS AC and DC electrical power subsystems incorporate design features that address reliability requirements, physical separation, and electrical independence. The implementation of these design features for the ITS power subsystem is accomplished by designing the ITS AC and DC electrical power systems in accordance with the codes and standards listed in SAR Section 1.4.1.2.8, including the ITS electrical power subsystems beyond main buses, switchgear, motor control centers, and load centers.

SAR Section 1.4.1.4.7 states that cables are listed, derated, labeled, or approved using the methods and practices of NFPA 70, *National Electrical Code*. Additionally, SAR Section 1.4.1.2.9 states that the design of the electric power system SSCs and raceways supporting ITS cables uses the methods and practices of the *International Building Code 2000* (ICC 2003). SAR Section 1.4.1.2.8 states that the power, control, and instrumentation cables installed in cable trays are designed in accordance with flame test performance requirements in IEEE Std 1202-2006, *IEEE Standard for Flame-Propagation Testing of Wire and Cable*.

Cable trays and raceways that support functions of the ITS electrical power subsystem are designed and installed using the methods and practices of NFPA 70. Table 1 provides a tabulation of electrical component functions (conducting or supporting) as defined by NFPA 70 and their associated safety classification.

Power system cables are designed using the methods and practices of IEEE Std 525-1992, *IEEE Guide for the Design and Installation of Cable Systems in Substations*; UL 1581, *Reference Standard for Electrical Wires, Cables, and Flexible Cords*; ANSI/UL 44-2002, *Standard for Thermoset-Insulated Wires and Cables*; ANSI/UL 514B-2004, *Conduit, Tubing, and Cable Fittings*; and UL 83, *Thermoplastic-Insulated Wires and Cables*. The 15 kV and 5 kV power cables are shielded and are either a single conductor or a triplexed Class B stranded copper conductor, with a 133% insulation level, rated for continuous operation at 90°C, 130°C for emergency overload operation, and 250°C for short circuit conditions using the methods and practices of the following National Electrical Manufacturers Association (NEMA) and Insulated Cable Engineers Association (ICEA) standards:

- NEMA WC 8-1988, *Ethylene-Propylene-Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy*
- NEMA WC 50-1976, *Ampacities Including Effect of Shield Losses for Single-Conductor Solid-Dielectric Power Cable, 15kV through 69kV (Copper and Aluminum Conductors)*
- NEMA WC 51-2003, *Ampacities of Cables Installed in Cable Trays*
- NEMA WC 58-1997, *Portable and Power Feeder Cables for Use in Mines and Similar Applications*

- NEMA WC 70/ICEA S-95-658-1999, *Standard for Nonshielded Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy*

- NEMA WC 71-1999, *Standard for Nonshielded Cables Rated 2001-5000 Volts for Use in the Distribution of Electric Energy*

- NEMA WC 72-1999, *Continuity of Coating Testing for Electrical Conductors*

- NEMA WC 74-2006, *5-46kV Shielded Power Cable for Use in the Transmission and Distribution of Electric Energy*.

The 480 V power, 277 or 208/120 V lighting, 480 V motor feeder, and 120 V control cables are single conductors, copper, rated 600 V and 75°C. The conductors are hard-drawn or solid or stranded copper. All power and control wiring is solid or stranded copper, flame-retardant, moisture and heat-resistant or heat-resistant thermoplastic, insulated at 75°C.

For cable with requirements for use in radiation environments, the aging effect of cables is evaluated using the methods and practices of IEEE Std 1205-2000, *IEEE Guide for Assessing, Monitoring, and Mitigating Aging Effects on Class 1E Equipment Used in Nuclear Power Generating Stations*.

The ampacity rating of conductors and cables uses the methods and practices of NPFA 70, *National Electrical Code*; IEEE Std 835-1994, *IEEE Standard Power Cable Ampacity Tables*; and NEMA WC 51-2003, *Ampacities of Cables Installed in Cable Trays*. The conductors classified as ITS and located in harsh environments will be qualified in accordance with IEEE Std 383-2003, *IEEE Standard for Qualifying Class 1E Electric Cables and Field Splices for Nuclear Power Generating Stations*, and Regulatory Guide 1.131, *Qualification Tests of Electric Cables, Field Splices, and Connections for Light-Water-Cooled Nuclear Power Plants*.

Distribution panels (i.e., panelboards), switchboards (i.e., load centers and switchgear), and motor control centers are designed, manufactured, and tested using the methods and practices of:

- ANSI/UL 50-2007, *Enclosures for Electrical Equipment, Non-Environmental Considerations*

- IEEE Std 141-1993, *IEEE Recommended Practice for Electric Power Distribution for Industrial Plants*

- IEEE Std C37.20.2-1999, *IEEE Standard for Metal-Clad Switchgear*

- NEMA ICS 18-2001, *Motor Control Centers*

- NEMA PB 1-2006, *Panelboards*

- NEMA PB 2-2006, *Deadfront Distribution Switchboards*

- NFPA 70, *National Electrical Code*
- UL 67, *Panelboards*
- UL 845, *Standard for Safety for Motor Control Centers*
- UL 891, *Standard for Safety Switchboards—Eleventh Edition*

Power and lighting enclosures are designed using the methods and practices of NEMA 250-2003, *Enclosures for Electrical Equipment (1000 Volts Maximum)*, and ANSI/UL 514A-2004, *Metallic Outlet Boxes*. Instrument enclosures are designed per NEMA ICS 6-1993, *Industrial Control and Systems: Enclosures*. The minimum acceptable standard of protection against liquid and solid ingress for indoor and outdoor mounted equipment is NEMA 4 or 4X, as appropriate. Indoor service enclosures not subject to potential liquid or solid ingress are NEMA 12. NEMA 1 enclosures are acceptable for equipment located in rooms with HVAC.

Redundant ITS circuits associated with their power supply trains are routed in separate conduits, cable trays, or ducts. ITS and non-ITS circuits are separated such that any failure in non-ITS circuits will not impact ITS circuits, propagate any fire from non-ITS to ITS raceways, and vice versa. Minimum spacing between cable trays is 12 in. and greater where separation is required for ITS cables that are installed in accordance with IEEE Std 384-1992, *IEEE Standard Criteria for Independence of Class 1E Equipment and Circuits*. Cable trays are arranged from top to bottom, with trays containing the highest voltage cables at the top and trays containing the lowest voltage cables at the bottom. Cable trays, supports, hangers, conduits, and fittings are effectively connected to the system ground network. Cable trays are grounded at both ends and individual tray sections are connected together for ground circuit continuity.

Cable trays are designed using the methods and practices of NFPA 70, Article 392, *Cable Trays*; NEMA VE 1-2002, *Metal Cable Tray Systems*; and NEMA VE 2-2000, *Cable Tray Installation Guidelines*.

1.3 LOADS ON IMPORTANT TO SAFETY DISTRIBUTION PANEL 060-EEE0-PL-00003

SAR Figure 1.4.1-12 shows that CRCF distribution panel 060-EEE0-PL-00003 is fed from transformer 060-EEE0-XFMR-00003 and MCC 060-EEE0-MCC-00001. Similar configurations are provided in the Wet Handling Facility and Emergency Diesel Generator Facility. The design of the ITS distribution system includes provisions for 120/208 V ITS power as a means to provide power to ITS instrumentation and controls. There are few ITS instrumentation and control loads that require ITS power, as the ITS instrumentation and controls fail safe upon the loss of power. The specific circuit designs for the ITS instrumentation and controls will be determined during detailed design; however, the ITS design load allocation assumes that each of the ITS distribution panels similar to 060-EEE0-PL-00003 are fully loaded (i.e., maximum kVA). This assumption builds additional conservatism into the design and capacity of the associated ITS electrical power subsystems motor control center, switchgear, main buses, and diesel generators.

Examples of some of the ITS instrumentation and controls powered by the 120/208 V ITS distribution panels include:

- ITS battery room exhaust fan low flow coincident with low differential pressure across an operating ITS battery room exhaust fan
- ITS battery room exhaust fan tripped signal indicating that the operating ITS exhaust fan has tripped
- ITS electrical and battery rooms HVAC supply subsystem low ITS exhaust flow coincident with low differential pressure across an operating ITS fan coil unit fan
- ITS fan tripped signal indicating that the operating fan coil unit has tripped
- ITS temperature control for the battery room duct reheat coil through ITS silicon controlled rectifier controller
- ITS temperature sensor/transmitters (i.e., temperature controller) in the electrical room and in the battery room to control the ITS air-cooled condensing unit
- ITS position indication of the back draft dampers to verify damper position prior to starting the ITS exhaust fans or placing the system in Auto mode.

2. COMMITMENTS TO NRC

None.

3. DESCRIPTION OF PROPOSED LA CHANGE

None.

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Table 1. Electrical Component Functions as defined by NFPA 70 and Safety Classifications

SSC Description	Referenced Portion of NFPA 70	Safety Classification
Overcurrent Protection Devices—Fuses and circuit breakers	Article 240	ITS
Insulated Conductors	Article 310	ITS
Conductor shielding (solid dielectric)	Section 310.6	ITS
Conductor splices, connections, and terminations	Section 110.14	ITS
Cabinets, Cutout Boxes, Enclosures	Article 312	Non-ITS
Outlet, Device, Pull, and Junction Boxes; Conduit Bodies; Fittings; and Handhole Enclosures	Article 314	Non ITS
Associated supports	Section 314.23	Non ITS
Associated covers	Section 314.41	Non ITS
Armored Cable: Type AC	Article 320	
Securing and supporting of AC	Section 320.30	Non-ITS
Flexible metallic armor (metal tape) protecting conductors	Section 320.100	Non-ITS
Insulated conductors, connections, terminations	Section 320.104	ITS
Medium Voltage Cable	Article 328	
Nonmetallic jacket	Section 328.2	Non-ITS
Solid dielectric conductors and associated connections	Section 328.100	ITS
Metal-Clad Cable: Type MC	Article 330	
Securing and supporting of MC Cable	Section 330.30	Non-ITS
Boxes and associated fittings	Section 330.40	Non-ITS
Flexible metallic armor (metal tape) protecting conductors	Section 330.116	Non-ITS
Insulated conductors, connections, terminations	Sections 330.104 and 112	ITS
Mineral-Insulated, Metal-Sheathed Cable: Type MI	Article 332	
Securing and supporting of MI cable	Section 332.30	Non-ITS
Boxes and associated fittings	Section 332.40	Non-ITS
Mineral-Insulated, Metal sheathing	Section 332.116	Non-ITS
Insulated conductors, connections, terminations	Sections 332.104 and 116	ITS
Power and Control Tray Cable: Type TC	Article 336	
Nonmetallic jacket	Section 336.116	Non-ITS
Insulated conductors, connections, terminations	Section 336.104	ITS
Intermediate Metal Conduit: Type IMC	Article 342	
Rigid Metal Conduit: Type RMC	Article 344	Non-ITS
Flexible Metal Conduit: Type FMC	Article 348	Non-ITS
Liquidtight Flexible Metal Conduit: Type LFMC	Article 350	Non-ITS
Rigid Polyvinyl Chloride Conduit: Type PVC	Article 352	Non-ITS
High Density Polyethylene Conduit: Type HDPE Conduit	Article 353	Non-ITS
Liquidtight Flexible Nonmetallic Conduit: Type LFNC	Article 356	Non-ITS
Electrical Metallic Tubing: Type EMT	Article 358	Non-ITS
Electrical Nonmetallic Tubing: Type ENT	Article 362	Non-ITS
Auxiliary Gutters	Article 366	Non-ITS

SSC Description	Referenced Portion of NFPA 70	Safety Classification
Busways	Article 368	
Securing and supporting	Section 368.30	Non-ITS
Enclosure, associated fittings and dead ends	Sections 368.58, 237, and 244	Non-ITS
Internally conductive components, terminations and connections	Section 368.238	ITS
Cablebus	Article 370	
Securing and supporting	Section 370.6	Non-ITS
Enclosure, associated fittings and dead ends	Section 370.7	Non-ITS
Conductors and terminations	Sections 370.4 and 8	ITS
Metal Wireways	Article 376	Non-ITS
Nonmetallic Wireways	Article 378	Non-ITS
Strut-Type Channel Raceway	Article 384	Non-ITS
Surface Metal Raceways	Article 386	Non-ITS
Surface Nonmetallic Raceways	Article 388	Non-ITS
Cable Trays	Article 392	Non-ITS
Switchboards and Panelboards	Article 408	
Enclosure, associated fittings, covers, doors, and supports		Non-ITS
Internally conductive components and terminals		ITS
Industrial Control Panels	Article 409	
Enclosure, associated fittings covers, doors, and supports		Non-ITS
Internally conductive components and terminals		ITS

NOTE: AC = armored cable; EMT = electrical metallic tubing, ENT = electrical nonmetallic tubing, FMC = flexible metal conduit, HDPE = high density polyethylene conduit, IMC = intermediate metal conduit, LFMC = liquid tight flexible metal conduit, LFNC = liquid tight flexible nonmetallic conduit, MC = metal-clad cable, MI = mineral-insulated, metal-sheathed cable, PVC = rigid polyvinyl chloride conduit, RMC = rigid metal conduit, TC = power and control tray cable.