Tennessee Valley Authority, 1101 Market Street, Chattanooga, Tennessee 37402

CNL-18-118

November 29, 2018

10 CFR 50.90

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D.C. 20555-0001

Watts Bar Nuclear Plant, Unit 1
Facility Operating License No. NPF-90
Docket No. 50-390

Watts Bar Nuclear Plant, Unit 2
Facility Operating License No. NPF-96
Docket No. 50-391

Subject: **Application to Revise Technical Specifications Regarding DC Electrical Systems TSTF-500, Revision 2, "DC Electrical Rewrite - Update to TSTF -360" (WBN-TS-18-09)**

In accordance with the provisions of Title 10 of the *Code of Federal Regulations* (10 CFR) 50.90, "Application for amendment of license, construction permit, or early site permit," Tennessee Valley Authority (TVA) is submitting a request for an amendment to the technical specifications (TS) for Watts Bar Nuclear Plant (WBN), Units 1 and 2.

The proposed amendment would modify TS requirements related to direct current (DC) electrical systems in accordance with Technical Specification Task Force (TSTF) Traveler TSTF-500, Revision 2, "DC Electrical Rewrite - Update to TSTF-360."

Enclosure 1 provides a description and assessment of the proposed change including the requested confirmation of applicability and plant-specific verifications, technical analyses, regulatory analyses, and environmental considerations. Enclosure 2 provides markups of the existing TS and Bases pages to show the proposed changes. Enclosure 3 provides revised (clean) TS pages. Enclosure 4 provides a summary of the regulatory commitments made in this submittal. Enclosure 5 provides copies of letters from battery manufacturers verifying the acceptability of using float current monitoring. Enclosure 6 provides an evaluation of extending the Completion Time for TS 3.8.4, "DC Sources - Operating," Required Action A.3.

The WBN Plant Operations Review Committee has reviewed this proposed change and determined that operation of WBN Units 1 and 2 in accordance with the proposed change will not endanger the health and safety of the public.

TVA has determined that there are no significant hazard considerations associated with the proposed change and that the change qualifies for a categorical exclusion from environmental review pursuant to the provisions of 10 CFR 51.22(c)(9). Additionally, in accordance with 10 CFR 50.91(b)(1), TVA is sending a copy of this letter and the enclosures to the Tennessee Department of Environment and Conservation.

TVA requests approval of the proposed license amendment within one year from the date of this submittal, with implementation of the amendment within 90 days to support the WBN Unit 1 Cycle 16 refueling outage scheduled for Spring 2020.

Enclosure 4 contains the new commitments in this submittal. Please address any questions regarding this request to Michael A. Brown at (423) 751-3275.

I declare under penalty of perjury that the foregoing is true and correct. Executed on this 29th day of November 2018.

Respectfully,

Erin K. Henderson
Director, Nuclear Regulatory Affairs

Enclosures:

1. Description and Assessment of Proposed Change
2. Markups of Technical Specification and Bases Changes
3. Clean Technical Specification and Bases Changes
4. Regulatory Commitments
5. Letters from Battery Manufacturers Verifying the Acceptability of Using Float Current Monitoring
6. Evaluation of an Extended Completion Time for Technical Specification 3.8.4, Required Action A.3

cc (Enclosures):

NRC Regional Administrator – Region II
NRC Project Manager – Watts Bar Nuclear Plant
NRC Senior Resident Inspector – Watts Bar Nuclear Plant
Director, Division of Radiological Health – Tennessee State Department of Environment and Conservation

Enclosure 1

Description and Assessment of Proposed Change

Subject: **Application to Revise Technical Specifications Regarding DC Electrical Systems TSTF-500, Revision 2, "DC Electrical Rewrite - Update to TSTF-360" (WBN-TS-18-09)**

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Enclosure 1

Description and Assessment of Proposed Change

1.0 DESCRIPTION

In accordance with the provisions of Title 10 of the Code of Federal Regulations (10 CFR) 50.90, "Application for amendment of license, construction permit, or early site permit," Tennessee Valley Authority (TVA) is submitting a request for an amendment to the technical specifications (TS) for Watts Bar Nuclear Plant (WBN) Unit 1 and Unit 2.

The TS requirements are being revised from requirements on battery cells to requirements on the battery. This focuses the requirements on the assumed safety function of the battery. The proposed amendment would modify TS requirements related to direct current (DC) electrical systems in Limiting Condition for Operation (LCO) 3.8.4, “DC Sources - Operating,” LCO 3.8.5, “DC Sources - Shutdown,” and LCO 3.8.6, “Battery Cell Parameters.” A new “Battery Monitoring and Maintenance Program” is being proposed for Section 5.7.2, “Programs and Manuals.”

Specifically, the proposed change requests new actions for an inoperable battery charger and alternate battery charger testing criteria for LCO 3.8.4 and LCO 3.8.5. The proposed change also includes the relocation of a number of Surveillance Requirements (SRs) in TS 3.8.4 that perform preventive maintenance on the safety-related batteries to a licensee-controlled program. It is proposed that LCO 3.8.6 be modified by relocating Table 3.8.6-1, “Battery Cell Parameter Requirements,” to a licensee-controlled program, and that specific actions with associated Completion Times (CTs) for out-of-limits conditions for battery cell voltage, electrolyte level, and electrolyte temperature be added to TS 3.8.6. In addition, specific SRs are being proposed for verification of these parameters.

A new program is being proposed for Section 5.7.2 of the Administrative Controls for the maintenance and monitoring of station batteries. The items proposed to be relocated will be contained within this program, titled the “Battery Monitoring and Maintenance Program.”

The proposed change provides new Actions for an inoperable battery charger and alternate battery charger testing criteria. The longer CT for an inoperable battery charger will allow additional time for maintenance and testing. In addition, a number of SRs are relocated to licensee control including the monitoring of battery cell parameter requirements and performance of battery maintenance activities.

The changes are consistent with Nuclear Regulatory Commission (NRC)-approved Technical Specification Task Force (TSTF) Traveler TSTF-500, Revision 2 (TSTF-500) (Reference 1). The availability of this TS improvement was published in the Federal Register on September 1, 2011 (76 FR 54510) (Reference 2), as supplemented on November 8, 2011 (76 FR 69296) (Reference 3).

The changes to the TS and Bases are consistent with the changes contained in TSTF-500, Revision 2, Attachment B, as they apply to NUREG-4131, Revision 1.0, as the current WBN Units 1 and 2 TS do not reflect the adoption of TSTF-360.

2.0 ASSESSMENT

2.1 APPLICABILITY OF TSTF-500 AND MODEL SAFETY EVALUATION

TVA has reviewed the model Safety Evaluation (SE) referenced in the Federal Register Notice of Availability published on September 1, 2011 (76 FR 54510). The review included the NRC staff's SE, as well as the supporting information provided in TSTF-500. As described herein, TVA has concluded that the technical bases for the proposed changes presented in TSTF-500 and the model SE prepared by the NRC staff are applicable to WBN and support incorporation of this amendment into the WBN Unit 1 and Unit 2 TS.

The current WBN TS 3.8.4, 3.8.5, and 3.8.6 include requirements for the emergency diesel generators (DGs) 125 V DC electrical power subsystems. Therefore, the proposed WBN TS use different numbering than the Standard TS (STS) (NUREG-1431) on which TSTF-500 is based.

The WBN TS 3.8.4, 3.8.5, and 3.8.6 include separate Conditions, Required Actions, and Surveillance Requirements for the DG DC electrical power subsystems to reflect the differences in the designs for the vital DC and DG DC electrical power subsystems. The design of the vital DC subsystems supports a 7-day CT for an inoperable battery charger and the design of the DG DC subsystem does not support a CT longer than 72-hour for an inoperable battery charger. In addition, the minimum established float voltage for the vital DC batteries is less than or equal to 2 amps and the minimum established float current for the DG DC batteries is less than or equal to 1 amp. Although these differences necessitate additional Conditions, Required Actions, and Surveillance Requirements to accommodate the differences between the vital DC and DG DC electrical power subsystems, they do not affect the applicability of the model SE to the WBN Unit 1 and 2 TS.

An additional numbering difference occurs between TSTF-500 and the WBN Unit 1 and Unit 2 TS with the addition of the "Battery Monitoring and Maintenance Program." The Battery Monitoring and Maintenance Program is contained in TS 5.7.2.22, as opposed to TS 5.5.14, as indicated in TSTF-500. This difference is editorial and does not affect the applicability of TSTF-500 to the WBN Unit 1 and Unit 2 TS.

The WBN DC system is similar to the system described in TSTF-500, with respect to its ability to meet the duty cycle assumed in the accident analyses and with its operations in the float and equalize modes. The WBN 125 V Vital DC electrical power system consists of a combined Unit 1 and Unit 2 system, each separated into two independent Class 1E DC electrical power subsystems per unit. A description of the 125 V vital DC Control System is contained in Enclosure 6. Following is a description of the DG 125V DC Control System.

<u>Design Features of the Diesel Generator 125V DC Control System</u>

A DG battery subsystem is provided for each DG. Each subsystem is comprised of a battery, dual battery charger assembly, distribution center, and cabling. The DG battery provides DC control power and field-flash when the charger is unavailable. If 480V AC is available, the charger supplies the normal DC loads, maintains the battery in a fully

charged condition, and recharges the battery while supplying the required loads regardless of the status of the plant. The batteries are physically and electrically independent. The DG control power systems are ungrounded and have ground detection instrumentation. Each DG battery has sufficient capacity when fully charged to supply the required loads for a minimum of four-hours following a loss of normal power. Battery capacity design requirements consider minimum required voltage for loads and the effects of aging and ambient temperature. Each battery is normally required to supply loads only during the time interval between loss of normal feed to its charger and the receipt of emergency power to the charger from its respective diesel-generator. The batteries, comprised of 58 cells, have adequate capacity considering the minimum terminal voltage of 105 volts and derating for 50°F temperature and aging.

The normal supply of DC current to the battery boards is from the battery charger. Each charger maintains a float voltage of approximately 130 volts on the associated battery board with the battery connected to the board and is capable of maintaining 135 volts during an equalizing charge period (all loads can tolerate approximately 135V equalizing voltage). Each of the chargers (normal and alternate) in the dual charger assembly has a dedicated AC source from two respective 480V AC Diesel Generator Auxiliary Boards. If the normal charger is unavailable, the alternate charger is selected by the 125V DC transfer switch included in the assembly. The charger is a solid-state type that converts a 3-phase 480V AC input to a nominal 125V DC output. The DC output voltage will vary no more than ± 1.0% for a supply voltage amplitude variation of ± 10% and frequency variation of ± 2.0%. Some operational features of the chargers are:

(1) an output voltage adjustable over the range of 125 to 135 volts,
(2) equalize and float modes of operation (the charger normally operates in the float mode at 130 volts, but can be switched to the equalize mode with an output of 135 volts),
(3) a current-limit feature that limits continuous overload operation to approximately 140% of rated output,
(4) protective devices which prevent a failed charger from loading the battery, and
(5) metering and alarm circuits to monitor the charger output.

Differences Between WBN Unit 1 and Unit 2 TS and TSTF-500

The WBN Unit 1 and Unit 2 TS differ from the Standard TS (STS) (NUREG-1431) which were the basis for TSTF-500, Revision 2, in the following ways:

- WBN Unit 1 and Unit 2 LCO 3.8.4 refer to four channels of vital DC. NUREG-1431 LCO 3.8.4 refers to Train A and Train B vital DC electrical power subsystems. The WBN Unit 1 and Unit 2 TS are being revised to adopt the NUREG-1431 language. This change aligns the LCO statement to the current Condition A statement regarding “One vital DC electrical power subsystem inoperable.” This change reflects the design of the vital DC electrical power subsystems that requires either Train A (Channels I and III) or Train B (Channels II and IV) to perform the safety function associated with the vital DC electrical power subsystems for WBN Unit 1 and Unit 2. This change aligns the WBN Unit 1 and Unit 2 TS to TSTF-500 and therefore, does not affect the applicability of the published model SE.

- WBN Unit 1 LCO 3.8.4 and LCO 3.8.5 are modified by a Note that allows the C-S DG and its associated DC electrical Power subsystem to be substituted for any of the required DGs and their associated DC electrical power subsystem. As documented in Reference 4, the WBN C-S DG is not being maintained. Therefore, the C-S DG cannot meet the requirements specified in TS 3.8.1 Bases that would allow it to be substituted for any required DG. Removal of a similar Note in WBN Unit 1 LCO 3.8.1, “AC Sources - Operating,” was approved by the NRC in Reference 5. These differences do not affect the applicability of the published model SE.

- WBN Unit 1 and Unit 2 were designed with five qualified class 1E, safety-related vital batteries and eight qualified class 1E, safety-related vital battery chargers. The fifth vital battery serves as a replacement for any one of the other four vital batteries during their testing, maintenance, and outages with no loss of system reliability under any mode of operation. Each of the four battery boards has a charger normally connected and has access to a spare charger for use upon loss of the normal charger. Based on the operational flexibility of the vital DC system, a loss of one battery on one subsystem does not require a subsystem to be considered inoperable once the fifth battery is adequately surveilled and connected. Therefore, LCO 3.8.4 is modified by a note that allows vital battery V to be substituted for vital battery I, II, III, or IV. In addition, TS 3.8.4, Condition A, and TS 3.8.5, Condition A, are revised to state one or two "required" vital battery charger(s) on one subsystem inoperable. Because this change does not alter the intended application of the LCO and its related Actions, the change is considered a minor variation from TSTF-500.

- The WBN vital DC batteries and the DG DC batteries have different required float currents for determining that their respective batteries are charged. Therefore, the proposed WBN Unit 1 and Unit 2 TS include separate Action Conditions for inoperable batteries and battery chargers for the vital DC and DG DC electrical power subsystems. The additional Action Conditions for the DG DC electrical power subsystem is consistent with the current technical specifications and results in a numbering difference for the Action Conditions. These differences do not affect the applicability of the published model SE.

- The WBN vital DC and the DG DC electrical power subsystems have different required float voltages for verifying the effectiveness of the associated battery chargers. Therefore, the proposed WBN Unit 1 and Unit 2 TS include SR 3.8.4.1 for vital DC electrical power subsystem and SR 3.8.4.2 for DG DC electrical power subsystem. The additional SR for the DG DC electrical power subsystem is in the current technical specifications and results in a difference in the SR numbering. These differences do not affect the applicability of the published model SE.

- The WBN vital DC and the DG DC electrical power subsystem battery chargers have different design capacities and performance characteristics. Therefore, there are separate SRs to verify the capacity of the charger to restore the associated battery from the design minimum charge state to the fully charged state, irrespective of the status of the plant during the demand occurrence. The additional SR for the DG DC electrical power subsystem is in the current technical

specifications and results in a difference in the SR numbering. These differences do not affect the applicability of the published model SE.

2.2 VERIFICATIONS AND REQUIRED FINAL SAFETY ANALYSIS REPORT CHANGES

As described in Section 4.7.1, "Verifications," in TSTF-500, TVA provides the following verifications.

1. Enclosure 5 contains letters from the manufacturers of the batteries used at WBN Units 1 and 2 verifying the acceptability of using float current monitoring instead of specific gravity monitoring as a reliable and accurate indication of the state-of-charge of the battery and that this will hold true over the life of the battery.

2. As indicated in Enclosure 4, TVA commits to verify that the equipment that will be used to monitor float current under SR 3.8.6.1 and SR 3.8.6.2 will have the necessary accuracy and capability to measure electrical currents in the expected range. Additionally, TVA commits to verify that the minimum required procedural time to measure battery float current will be 30 seconds or as recommended by the float current measurement instrument manufacturer. This minimum float current measurement time is required to provide a more accurate battery float current reading.

3. TVA verifies that battery room temperature is routinely monitored such that a room temperature excursion could reasonably expect to be detected and corrected prior to the average battery electrolyte temperature dropping below the minimum electrolyte temperature.

4. Enclosure 6 contains a description of the 125V DC vital system, including a discussion of the battery chargers, spare battery chargers, capability of the batteries to be charged from a power source that is independent of the offsite power supply, and a description of the onsite standby power supply that can be used to power the battery chargers.

5. Not applicable. TVA is not requesting a CT greater than 2 hours for TS 3.8.4, Required Action B.1 or C.1.

6. The cell resistance limits in existing SR 3.8.4.5 and SR 3.8.4.6 are relocated to the "Battery Monitoring and Maintenance Program." The cell connection resistance limits listed in the table below are based on vendor recommendations. The resistance limits apply to overall connection resistance and allows for normal degradation while maintaining battery operability.

Connection	Vital Batteries (µOhm)	DG Batteries (µOhm)
Inter-cell	80	80
Inter-rack	50	50
Inter-tier	120	50
Terminal Connections	50	50

7. TVA is proposing to delete the SR 3.8.4.13 (new SR 3.8.4.7) Note "once per 60 months" restriction on performing the modified performance discharge test instead of the service test. TVA verifies that the modified performance discharge test completely encompasses the load profile of the battery service test and that it adequately confirms the intent of the service test to verify the battery capacity to supply the design basis load profile.

8. As indicated in Enclosure 4, TVA commits to relocating the monitoring of battery parameters (i.e., specific gravity, electrolyte level, cell temperature, float voltage, connection resistance, and physical condition) to the licensee-controlled program, required and described in TS Section 5.7, "Programs, Programs, and Manuals," and titled the "Battery Monitoring and Maintenance Program."

9. As indicated in Enclosure 4, TVA commits to verifying that plant procedures will require verification of the selection of the pilot cell or cells when performing SR 3.8.6.5.

The Model SE, Attachment 2, "List of Required Final Analysis Report (FSAR) Descriptions," indicates several statements that are required to be included in the FSAR. As indicated in Enclosure 4 of this letter, TVA commits to revising the FSAR to include the following, as part of the adoption of TSTF-500, Revision 2:

1. How a two percent design margin for the vital batteries corresponds to a two-amp float current value indicating that the battery is at least 98 percent charged.

2. How a 2 percent design margin for the DG batteries corresponds to a one-amp float current value indicating that the battery is at least 98 percent charged.

3. How long term battery performance is obtained by maintaining a float voltage greater than or equal to the minimum established design limits provided by the battery manufacturer.

4. How the batteries are sized with correction margins that include temperature and aging and how these margins are maintained.

5. The minimum established design limit for battery terminal float voltage.

6. The minimum established design limit for electrolyte level.

7. The minimum established design limit for electrolyte temperature.

8. How each battery is designed with additional capacity above that required by the design duty cycles to allow for temperature variations and other factors.

9. Normal DC system operation i.e., powered from the battery chargers with the batteries floating on the system, and with a loss of normal power to the battery charger.

10. The minimum requirements for the alternate means (i.e., spare battery charger) that are used to obtain an extended battery charger CT.

2.3 OPTIONAL CHANGES AND VARIATIONS

TVA is proposing the following variation from the TS changes described in the TSTF-500, Revision 2, or the applicable parts of the NRC staff's model SE referenced in the Federal Register on September 1, 2011 (76 FR 54510), as supplemented on November 8, 2011 (76 FR 69296). These options were recognized as acceptable variations in TSTF-500 and the NRC staff's model SE.

TVA is proposing a CT longer than 72 hours for TS 3.8.4, Required Action A.3, and TS 3.8.5, Required Action A.3. An evaluation is included as Enclosure 6, which supports the longer CT and describes the availability of a spare battery charger and that the battery charger is appropriately sized. The CT is consistent with the WBN Units 1 and 2 UFSAR description that a means to charge the batteries is available and that the capability includes power supplied from a source that is independent of the offsite power supply. A description of the power source is also included.

TVA is not requesting a Completion Time longer than 12 hours to restore battery float current with one or two required battery chargers on one subsystem inoperable (TSTF-500, TS 3.8.4, Required Action A.2, and TS 3.8.5, Required Action A.2).

TVA is not requesting a Completion Time longer than 2 hours for one or two batteries on one subsystem inoperable (TSTF-500, TS 3.8.4, Required Action B.1). Therefore, as there is no difference in the Completion Time for Required Action B.1 and the Completion Time for Required Action C.1, TVA is not adopting TSTF-500, TS 3.8.4, Condition B.

WBN Unit 1 and Unit 2 implementation of TSTF-500, as it applies to LCO 3.8.5, includes adoption of new Action A, as the potential exists to require both vital DC electrical power subsystems during a portion of the LCO 3.8.5 applicability.

3.0 REGULATORY ANALYSIS

3.1 NO SIGNIFICANT HAZARDS CONSIDERATION DETERMINATION

Tennessee Valley Authority (TVA) has evaluated the proposed changes to the TS using the criteria in Section 50.92 to Title 10 of the Code of Federal Regulations (10 CFR) and has determined that the proposed changes do not involve a significant hazards consideration.

The proposed amendment would revise TS requirements related to direct current (DC) electrical systems in TS limiting condition for operation (LCO) 3.8.4, "DC Sources - Operating," LCO 3.8.5, "DC Sources - Shutdown," and LCO 3.8.6, "Battery Cell Parameters." A new "Battery Monitoring and Maintenance Program" is being proposed for Section 5.7.2, "Programs and Manuals." As required by 10 CFR 50.91(a), the TVA analysis of the issue of no significant hazards consideration is presented below:

1. Does the proposed change involve a significant increase in the probability or consequences of any accident previously evaluated?

Response: No.

The proposed changes restructure the Technical Specifications (TS) for the direct current (DC) electrical power system and are consistent with TSTF-500, Revision 2. The proposed changes modify TS Actions relating to battery and battery charger inoperability. The DC electrical power system, including associated battery chargers, is not an initiator of any accident sequence analyzed in the Final Safety Analysis Report (FSAR). Rather, the DC electrical power system supports equipment used to mitigate accidents. The proposed changes to restructure TS and change surveillances for batteries and chargers to incorporate the updates included in TSTF-500, Revision 2, will maintain the same level of equipment performance required for mitigating accidents assumed in the FSAR. Operation in accordance with the proposed TS would ensure that the DC electrical power system is capable of performing its specified safety function as described in the FSAR. Therefore, the mitigating functions supported by the DC electrical power system will continue to provide the protection assumed by the analysis. The relocation of preventive maintenance surveillances, and certain operating limits and actions, to a licensee-controlled Battery Monitoring and Maintenance Program will not challenge the ability of the DC electrical power system to perform its design function. Appropriate monitoring and maintenance that are consistent with industry standards will continue to be performed. In addition, the DC electrical power system is within the scope of 10 CFR 50.65, “Requirements for monitoring the effectiveness of maintenance at nuclear power plants,” which will ensure the control of maintenance activities associated with the DC electrical power system.

The integrity of fission product barriers, plant configuration, and operating procedures as described in the FSAR will not be affected by the proposed changes. Therefore, the consequences of previously analyzed accidents will not increase by implementing these changes. Therefore, the proposed changes do not involve a significant increase in the probability or consequences of an accident previously evaluated.

2. Does the proposed change create the possibility of a new or different kind of accident from any previously evaluated?

Response: No

The proposed changes involve restructuring the TS for the DC electrical power system. The DC electrical power system, including associated battery chargers, is not an initiator to any accident sequence analyzed in the FSAR. Rather, the DC electrical power system supports equipment used to mitigate accidents. The proposed changes to restructure the TS and change surveillances for batteries and chargers to incorporate the updates included in TSTF-500, Revision 2, will maintain the same level of equipment performance required for mitigating accidents assumed in the FSAR. Administrative and mechanical controls are in place to ensure the design and operation of the DC systems continues to meet the plant design basis described in the FSAR. Therefore, operation of the facility in accordance with this proposed change will not create the possibility of a new or different kind of accident from any accident previously evaluated.

3. Does the proposed change involve a significant reduction in the margin of safety?

Response: No.

The margin of safety is established through equipment design, operating parameters, and the setpoints at which automatic actions are initiated. The equipment margins will be maintained in accordance with the plant-specific design bases because of the proposed changes. The proposed changes will not adversely affect operation of plant equipment. These changes will not result in a change to the setpoints at which protective actions are initiated. Sufficient DC capacity to support operation of mitigation equipment is ensured. The changes associated with the new battery Maintenance and Monitoring Program will ensure that the station batteries are maintained in a highly reliable manner. The equipment fed by the DC electrical sources will continue to provide adequate power to safety-related loads in accordance with analysis assumptions. TS changes made in accordance with TSTF-500, Revision 2, maintain the same level of equipment performance stated in the FSAR and the current TSs. Therefore, the proposed changes do not involve a significant reduction of safety.

3.2 APPLICABLE REGULATORY REQUIREMENTS/CRITERIA

TVA has reviewed the NRC staff's model SE referenced in the Notice of Availability and concluded that the Regulatory Evaluation section is applicable to WBN Units 1 and 2.

WBN Units 1 and 2 commitments to regulatory guidance differs from that provided in the Regulatory Evaluation section in the model SE as described below.

- The model SE refers to Revision 3 of Regulatory Guide (RG) 1 .32, "Criteria for Power Systems for Nuclear Power Plants." However, as described in FSAR Section 8.3.1.1, the design of the DG 125 VDC control power system for WBN Units 1 and 2 conforms to RG 1.32, Revision 2. The other portions of the electrical power system conform to RG 1.32, Revision 0.

- The model SE refers to Revision 3 of RG 1.75, "Criteria for Independence of Electrical Safety Systems." However, as described in FSAR Section 8.1, RG 1.75 was issued after the Watts Bar design was complete. A description of how WBN Units 1 and 2 meet the intent of RG 1.75, Revision 0, is provided in FSAR Section 8.3.1.4.2.

TVA concluded these differences do not result in any needed changes for adoption of TSTF-500, Revision 2, at WBN Units 1 and 2 and do not affect the applicability of the NRC staff model SE.

4.0 ENVIRONMENTAL CONSIDERATION

The proposed TS change would change a requirement with respect to installation or use of a facility component located within the restricted area, as defined in 10 CFR Part 20, and would change an inspection or surveillance requirement. However, the proposed change does not involve (i) a significant hazards consideration, (ii) a significant change in the types or significant increase in the amounts of any effluent that may be released

offsite, or (iii) a significant increase in individual or cumulative occupational radiation exposure. Accordingly, the proposed TS change meets the eligibility criterion for categorical exclusion set forth in 10 CFR 51.22(c)(9). Therefore, pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the proposed TS change.

5.0 REFERENCES

1. Technical Specifications Task Force Traveler TSTF-500, Revision 2, "DC Electrical Rewrite-Update to TSTF-360" (ML092670242).
2. Federal Register (76 FR 54510): Notice of Availability of Proposed Models for Plant Specific Adoption of Technical Specifications Task Force Traveler TSTF-500, Revision 2, "DC Electrical Rewrite-Update to TSTF-360," dated September 1, 2011.
3. Federal Register (76 FR 69296): Notice of Availability of Proposed Models for Plant Specific Adoption of Technical Specifications Task Force Traveler TSTF-500, Revision 2, "DC Electrical Rewrite-Update to TSTF-360," dated November 8, 2011.
4. TVA Letter to NRC, "Technical Specification Change Request to Revise Completion Time for Inoperable Diesel Generator," dated November 30, 2009 (ML093640790).
5. NRC letter to TVA, "Watts Bar Nuclear Plant, Unit 1 - Issuance of Amendment Regarding the Completion Time for the Inoperable Emergency Diesel Generator(s) (TAC No. ME2985)," dated July 6, 2010 (ML101390154).

Enclosure 2

Markups of Technical Specification and Bases Changes

WBN Unit 1 Markups of Technical Specification and Bases

3.8 ELECTRICAL POWER SYSTEMS

3.8.4 DC Sources - Operating

LCO 3.8.4 ~~Four channels of~~ The Train A and Train B vital DC electrical power subsystems and four Diesel Generator (DG) DC electrical power subsystems shall be OPERABLE.

----------NOTE~~S~~----------

~~1.~~ Vital Battery V may be substituted for any of the required vital batteries.

~~2. The C-S DG and its associated DC electrical power subsystem may be substituted for any of the required DGs and their associated DC electrical power subsystem.~~

APPLICABILITY: MODES 1, 2, 3, and 4.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One or two required vital battery charger(s) on one subsystem inoperable.	A.1 Restore battery terminal voltage to greater than or equal to the minimum established float voltage. AND A.2 Verify battery float current ≤ 2 amps. AND A.3 Restore vital battery charger(s) to OPERABLE status.	2 hours Once per 12 hours 7 days
~~A~~B. One vital DC electrical power subsystem inoperable for reasons other than Condition A.	~~A~~B.1 Restore vital DC electrical power subsystem to OPERABLE status.	2 hours

(continued)

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
~~B~~C. Required Action and Associated Completion Time of Condition A or B not met.	~~B~~C.1 Be in MODE 3. AND ~~B~~C.2 Be in MODE 5.	6 hours 36 hours
D. One DG DC battery charger inoperable.	D.1 Restore DG battery terminal voltage to greater than or equal to the minimum established float voltage. AND D.2 Verify battery float current ≤ 1 amp. AND D.3 Restore DG battery charger to OPERABLE status.	2 hours Once per 12 hours 72 hours
~~C~~E. One DG DC electrical power subsystem inoperable for reasons other than Condition D.	~~C~~E.1 Restore DG DC electrical power subsystem to OPERABLE status.	2 hours
~~D~~F. Required Action and associated Completion Time of Condition ~~C~~D or E not met.	~~D~~F.1 Declare associated DG inoperable.	Immediately

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.8.4.1	Verify vital battery terminal voltage is ~~≥ 128 V (132 V for vital battery V) on float charge~~ greater than or equal to the minimum established float voltage.	7 days
SR 3.8.4.2	Verify DG battery terminal voltage is ~~≥ 124 V on float charge~~ greater than or equal to the minimum established float voltage.	7 days
SR 3.8.4.3	Verify for the vital batteries that the alternate feeder breakers to each required battery charger are open.	7 days
SR 3.8.4.4	Verify correct breaker alignment and indicated power availability for each DG 125 V DC distribution panel and associated battery charger.	7 days

(continued)

SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE		FREQUENCY
~~SR 3.8.4.5~~	~~Verify no visible corrosion at terminals and connectors for the vital batteries.~~ ~~OR~~ ~~Verify connection resistance for the vital batteries is ≤ 80 E-6 ohm for inter-cell connections, ≤ 50 E-6 ohm for inter-rack connections, ≤ 120 E-6 ohm for inter-tier connections, and ≤ 50 E-6 ohm for terminal connections.~~	~~92 days~~
~~SR 3.8.4.6~~	~~Verify no visible corrosion at terminals and connectors for the DG batteries.~~ ~~OR~~ ~~Verify connection resistance for the DG batteries is ≤ 80 E-6 ohm for inter-cell connections, ≤ 50 E-6 ohm for inter-tier connections, and ≤ 50 E-6 ohm for terminal connections.~~	~~92 days~~
~~SR 3.8.4.7~~	~~Verify battery cells, cell plates, and racks show no visual indication of physical damage or abnormal deterioration.~~	~~12 months~~
~~SR 3.8.4.8~~	~~Remove visible terminal corrosion and verify battery cell to cell and terminal connections are coated with anti-corrosion material.~~	~~12 months~~

(continued)

SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE		FREQUENCY
~~SR 3.8.4.9~~	~~Verify connection resistance for the vital batteries is ≤ 80 E-6 ohm for inter-cell connections, ≤ 50 E-6 for inter-rack connections, ≤ 120 E-6 ohm for inter-tier connections, and ≤ 50 E-6 ohm for terminal connections.~~	~~12 months~~
~~SR 3.8.4.10~~	~~Verify connection resistance for the DG batteries is ≤ 80 E-6 ohm for inter-cell connections, ≤ 50 E-6 ohm for inter-tier connections, and ≤ 50 E-6 ohm for terminal connections.~~	~~12 months~~
SR 3.8.4.~~11~~5	~~NOTE~~ ~~This Surveillance is normally not performed in MODE 1, 2, 3, or 4. However, credit may be taken for unplanned events that satisfy this SR.~~ Verify each vital battery charger ~~is capable of recharging its associated battery from a service or capacity discharge test while supplying normal loads~~ supplies ≥ 200 amps at greater than or equal to the minimum established float voltage for ≥ 4 hours. OR Verify each vital battery charger ~~is capable of operating for ≥ 4 hours at current limit 220 - 250 amps~~ can recharge the battery to the fully charged state within 36 hours while supplying the largest combined demands of the various continuous steady state loads, after a battery discharge to the bounding design basis event discharge state.	18 months

(continued)

SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE		FREQUENCY
SR 3.8.4.~~12~~6	----------NOTE---------- Credit may be taken for unplanned events that satisfy this SR. ---------- Verify each ~~diesel generator~~ DG battery charger ~~is capable of recharging its associated battery from a service or capacity discharge test while supplying normal loads~~ supplies ≥ 20 amps at greater than or equal to the minimum established float voltage for ≥ 4 hours. OR Verify each DG battery charger can recharge the battery to the fully charged state within 24 hours while supplying the largest combined demands of the various continuous steady state loads, after a battery discharge to the bounding design basis event discharge state.	18 months
SR 3.8.4.~~13~~7	----------NOTES---------- 1. The modified performance discharge test in SR 3.8.~~4.14~~6.7 may be performed in lieu of the service test in SR 3.8.4.~~13~~7 ~~once per 60 months~~. 2. This Surveillance is not performed in MODE 1, 2, 3, or 4 for required vital batteries. Credit may be taken for unplanned events that satisfy this SR. ---------- Verify battery capacity is adequate to supply, and maintain in OPERABLE status, the required emergency loads and any connected nonsafety loads for the design duty cycle when subjected to a battery service test.	18 months

(continued)

SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE		FREQUENCY
~~SR 3.8.4.14~~	~~----------NOTES----------~~ ~~This Surveillance is not performed in MODE 1, 2, 3, or 4 for required vital batteries. Credit may be taken for unplanned events that satisfy this SR.~~ ~~----------~~ ~~Verify battery capacity is ≥ 80% of the manufacturer's rating when subjected to a performance discharge test or a modified performance discharge test.~~	~~60 months~~ ~~AND~~ ~~12 months when battery shows degradation or has reached 85% of expected life with capacity < 100% of manufacturer's rating~~ ~~AND~~ ~~24 months when battery has reached 85% of the expected life with capacity ≥ 100% of manufacturer's rating~~

3.8 ELECTRICAL POWER SYSTEMS

3.8.5 DC Sources - Shutdown

LCO 3.8.5 Vital DC and Diesel Generator (DG) DC electrical power subsystems shall be OPERABLE to support the DC electrical power distribution subsystem(s) required by LCO 3.8.10, "Distribution Systems - Shutdown" and to support the Diesel Generators (DGs) required by LCO 3.8.2, "AC Sources - Shutdown."

----------NOTE~~S~~----------

~~1.~~ Vital Battery V may be substituted for any of the required vital batteries.

~~2. The C-S DG and its associated DC electrical power subsystem may be substituted for any of the required DGs and their associated DC electrical power subsystems.~~

APPLICABILITY: MODES 5 and 6,
During movement of irradiated fuel assemblies.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One or two required vital battery charger(s) on one subsystem inoperable. AND The redundant subsystem vital battery and charger(s) OPERABLE.	A.1 Restore battery terminal voltage to greater than or equal to the minimum established float voltage. AND A.2 Verify battery float current ≤ 2 amps. AND A.3 Restore battery charger(s) to OPERABLE status.	2 hours Once per 12 hours 7 days

(continued)

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
~~A~~B. One or more required vital DC electrical power subsystems inoperable for reasons other than Condition A. OR Required Actions and associated Completion Time of Condition A not met.	~~A~~B.1.1 Declare affected required feature(s) inoperable. OR ~~A~~B.2.1 Suspend CORE ALTERATIONS. AND ~~A~~B.2.2 Suspend movement of irradiated fuel assemblies. AND ~~A~~B.2.3 Initiate action to suspend operations involving positive reactivity additions. AND ~~A~~B.2.4 Initiate action to restore required DC electrical power subsystems to OPERABLE status.	Immediately Immediately Immediately Immediately Immediately
~~B~~C. One required DG DC electrical power subsystem inoperable.	~~B~~C.1 Declare associated DG inoperable.	Immediately

SURVEILLANCE REQUIREMENTS

SURVEILLANCE				FREQUENCY
SR 3.8.5.1	----------NOTE---------- The following SRs are not required to be performed: SR 3.8.4.~~11~~5, SR 3.8.4.~~12~~6, and SR 3.8.4.~~13~~7, ~~and SR 3.8.4.14~~. ----------			
	For DC sources required to be OPERABLE, the following SRs are applicable:			In accordance with applicable SRs
	SR 3.8.4.1	SR 3.8.4.6	~~SR 3.8.4.11~~	
	SR 3.8.4.2	SR 3.8.4.7	~~SR 3.8.4.12~~	
	SR 3.8.4.3	~~SR 3.8.4.8~~	~~SR 3.8.4.13~~	
	SR 3.8.4.4	~~SR 3.8.4.9~~	~~SR 3.8.4.14~~	
	SR 3.8.4.5	~~SR 3.8.4.10~~		

3.8 ELECTRICAL POWER SYSTEMS

3.8.6 Battery ~~Cell~~ Parameters

LCO 3.8.6 Battery ~~cell~~ parameters for Train A and Train B electrical power subsystem 125 V vital batteries and 125 V diesel generator (DG) batteries shall be within ~~the~~ limits ~~of Table 3.8.6-1~~.

APPLICABILITY: When associated DC electrical power subsystems and DGs are required to be OPERABLE.

ACTIONS

----------NOTE----------
Separate Condition entry is allowed for each battery bank.

~~CONDITION~~	~~REQUIRED ACTION~~	~~COMPLETION TIME~~
~~A. One or more batteries with one or more battery cell parameters not within Category A or B limits.~~	~~A.1 Verify pilot cells electrolyte level and float voltage meet Table 3.8.6-1 Category C limits.~~ ~~AND~~ ~~A.2 Verify battery cell parameters meet Table 3.8.6-1 Category C limits.~~ ~~AND~~ ~~A.3 Restore battery cell parameters to Category A and B limits of Table 3.8.6-1.~~	~~1 hour~~ ~~24 hours~~ ~~AND~~ ~~Once per 7 days thereafter~~ ~~31 days~~

~~(continued)~~

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One or two required vital battery(ies) on one subsystem with one or more battery cells float voltage < 2.07 V.	A.1 Perform SR 3.8.4.1. AND A.2 Perform SR 3.8.6.1. AND A.3 Restore affected cell voltage ≥ 2.07 V.	2 hours 2 hours 24 hours
B. One or two required vital battery(ies) on one subsystem with float current > 2 amps.	B.1 Perform SR 3.8.4.1. AND B.2 Restore vital battery float current to ≤ 2 amps.	2 hours 12 hours
C. One DG battery with one or more battery cells float voltage < 2.07 V.	C.1 Perform SR 3.8.4.2. AND C.2 Perform SR 3.8.6.2. AND C.3 Restore affected cell voltage ≥ 2.07 V.	2 hours 2 hours 24 hours
D. One DG battery with float current > 1 amp.	D.1 Perform SR 3.8.4.2. AND D.2 Restore vital battery float current to ≤ 1 amp.	2 hours 12 hours

(continued)

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
----------NOTE---------- Required Action E.2 shall be completed if electrolyte level was below the top of plates. ----------	----------NOTE---------- Required Actions E.1 and E.2 are only applicable if electrolyte level was below the top of plates. ----------	
E. One or two required vital battery(ies) on one subsystem with one or more cells electrolyte level less than minimum established design limits. OR One DG battery with one or more cells electrolyte level less than minimum established design limits.	E.1 Restore electrolyte level to above top of plates. AND E.2 Verify no evidence of leakage. AND E.3 Restore electrolyte level to greater than or equal to minimum established design limits.	8 hours 12 hours 31 days
F. One or two required vital battery(ies) on one subsystem with pilot cell electrolyte temperature less than minimum established design limits. OR One DG battery with pilot cell electrolyte temperature less than minimum established design limits.	F.1 Restore battery pilot cell temperature to greater than or equal to minimum established design limits.	12 hours

(continued)

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
G. One or more batteries in redundant subsystems with battery parameters not within limits. OR More than one DG battery with battery parameters not within limits.	G.1 Restore battery parameters to within limits.	2 hours
~~B~~H. Required Action and associated Completion Time of Condition A, B, C, D, E, F, or G not met. OR One or two required vital battery(ies) on one subsystem with one or more battery cells float voltage < 2.07 V and float current > 2 amps. OR One DG battery with one or more battery cells float voltage < 2.07 V and float current > 1 amp. ~~One or more batteries with average electrolyte temperature of the representative cells < 60°F for vital batteries and < 50°F for DG batteries.~~ ~~OR~~ ~~One or more batteries with one or more battery cell parameters not within Category C values.~~	~~B~~H.1 Declare associated battery inoperable.	Immediately

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
~~SR 3.8.6.1~~	~~Verify battery cell parameters meet Table 3.8.6-1 Category A limits.~~	~~7 days~~
~~SR 3.8.6.2~~	~~Verify battery cell parameters meet Table 3.8.6-1 Category B limits.~~	~~92 days~~ ~~AND~~ ~~Once within 24 hours after a battery discharge < 110 V for vital batteries (113.5 V for vital battery V) or 106.5 V for DG batteries~~ ~~AND~~ ~~Once within 24 hours after a battery overcharge > 150 V for vital batteries (155 V for vital battery V) or 145 V for DG batteries~~
~~SR 3.8.6.3~~	~~Verify average electrolyte temperature of representative cells is ≥ 60°F for vital batteries and ≥ 50°F for the DG batteries.~~	~~92 days~~

Insert Surveillance Requirements from next page.

Insert the following Surveillance Requirements for LCO 3.8.6:

SURVEILLANCE		FREQUENCY
SR 3.8.6.1	----------NOTE---------- Not required to be met when vital battery terminal voltage is less than the minimum established float voltage of SR 3.8.4.1. ---------- Verify each vital battery float current is ≤ 2 amps.	7 days
SR 3.8.6.2	----------NOTE---------- Not required to be met when DG battery terminal voltage is less than the minimum established float voltage of SR 3.8.4.2. ---------- Verify each DG battery float current is ≤ 1 amp.	7 days
SR 3.8.6.3	Verify each required vital battery and each DG battery pilot cell float voltage is ≥ 2.07 V.	31 days
SR 3.8.6.4	Verify each required vital battery and each DG battery connected cell electrolyte level is greater than or equal to minimum established design limits.	31 days
SR 3.8.6.5	Verify each required vital battery and each DG battery pilot cell temperature is greater than or equal to minimum established design limits.	31 days
SR 3.8.6.6	Verify each required vital battery and each DG battery connected cell float voltage is ≥ 2.07 V.	92 days

SURVEILLANCE		FREQUENCY
SR 3.8.6.7	----------NOTES---------- This Surveillance is not performed in MODE 1, 2, 3, or 4 for required vital batteries. Credit may be taken for unplanned events that satisfy this SR. ----------	
	Verify battery capacity is ≥ 80% of the manufacturer's rating when subjected to a performance discharge test or a modified performance discharge test.	60 months AND 12 months when battery shows degradation or has reached 85% of expected life with capacity < 100% of manufacturer's rating AND 24 months when battery has reached 85% of the expected life with capacity ≥ 100% of manufacturer's rating

Table 3.8.6-1 (page 1 of 1)
Battery Cell Parameters Requirements

PARAMETER	CATEGORY A: LIMITS FOR EACH DESIGNATED PILOT CELL	CATEGORY B: LIMITS FOR EACH CONNECTED CELL	CATEGORY C: ALLOWABLE LIMIT FOR EACH CONNECTED CELL
Electrolyte Level	> Minimum level indication mark, and ≤ 1/4 inch above maximum level indication mark (a)	> Minimum level indication mark, and ≤ 1/4 inch above maximum level indication mark (a)	Above top of plates, and not overflowing
Float Voltage	≥ 2.13 V	≥ 2.13 V	> 2.07 V
Specific Gravity (b)(c)	≥ 1.200	≥ 1.195 AND Average of all connected cells > 1.205	Not more than 0.020 below average of all connected cells AND Average of all connected cells ≥ 1.195

(a) It is acceptable for the electrolyte level to temporarily increase above the specified maximum level during equalizing charges provided it is not overflowing.

(b) Corrected for electrolyte temperature and level. Level correction is not required, however, when battery charging is < 2 amps when on float charge for vital batteries and < 1.0 amp for DG batteries.

(c) A battery charging current of < 2 amps when on float charge for vital batteries and < 1.0 amp for DG batteries is acceptable for meeting specific gravity limits following a battery recharge, for a maximum of 31 days. When charging current is used to satisfy specific gravity requirements, specific gravity of each connected cell shall be measured prior to expiration of the 31 day allowance.

5.7 Procedures, Programs, and Manuals

5.7.2.20 Control Room Envelope Habitability Program (continued)

d. Measurement, at designated locations, of the CRE pressure relative to all external areas adjacent to the CRE boundary during the pressurization mode of operation by one train of the CREVS, operating at the flow rate defined in the Ventilation Filter Testing Program (VFTP), at a Frequency of 18 months on a STAGGERED TEST BASIS. The results shall be trended and used as part of the 18 month assessment of the CRE boundary.

e. The quantitative limits on unfiltered air inleakage into the CRE. These limits shall be stated in a manner to allow direct comparison to the unfiltered air inleakage measured by the testing described in paragraph c. The unfiltered air inleakage limit for radiological challenges is the inleakage flow rate assumed in the licensing basis analyses of DBA consequences. Unfiltered air inleakage limits for hazardous chemicals must ensure that exposure of CRE occupants to these hazards will be within the assumptions in the licensing basis.

f. The provisions of SR 3.0.2 are applicable to the frequencies for assessing CRE habitability, determining CRE unfiltered inleakage, and measuring CRE pressure and assessing the CRE boundary as required by paragraphs c and d, respectively.

Note: The addition of TS 5.7.2.21, “Spent Fuel Storage Rack Neutron Absorber Monitoring Program,” has been proposed per TVA letter CNL-17-144, dated December 20, 2017. Therefore, the proposed addition of the “Battery Monitoring and Maintenance Program” is numbered “TS 5.7.2.22,” to reflect the anticipated approval of the license amendment request associated with TVA letter CNL-17-144.

Insert TS 5.7.2.22, “Battery Monitoring and Maintenance Program”

INSERT

5.7.2.22 Battery Monitoring and Maintenance Program

This Program provides controls for battery restoration and maintenance. The program shall be in accordance with IEEE Standard (Std) 450-2002, "IEEE Recommended Practice for Maintenance, Testing, and Replacement of Vented Lead-Acid Batteries for Stationary Applications," as endorsed by Regulatory Guide 1.129, Revision 2 (RG), with RG exceptions and program provisions as identified below:

a. The program allows the following RG 1.129, Revision 2 exceptions:

1. Battery temperature correction may be performed before or after conducting discharge tests.

2. RG 1.129, Regulatory Position 1, Subsection 2, "References," is not applicable to this program.

3. In lieu of RG 1.129, Regulatory Position 2, Subsection 5.2, "Inspections," the following shall be used: "Where reference is made to the pilot cell, pilot cell selection shall be based on the lowest voltage cell in the battery."

4. In Regulatory Guide 1.129, Regulatory Position 3, Subsection 5.4.1, "State of Charge Indicator," the following statements in paragraph (d) may be omitted: "When it has been recorded that the charging current has stabilized at the charging voltage for three consecutive hourly measurements, the battery is near full charge. These measurements shall be made after the initially high charging current decreases sharply and the battery voltage rises to approach the charger output voltage."

5. In lieu of RG 1.129, Regulatory Position 7, Subsection 7.6, "Restoration", the following may be used: "Following the test, record the float voltage of each cell of the string."

b. The program shall include the following provisions:

1. Actions to restore battery cells with float voltage < 2.13 V;

2. Actions to determine whether the float voltage of the remaining battery cells is ≥ 2.13 V when the float voltage of a battery cell has been found to be < 2.13 V;

3. Actions to equalize and test battery cells that had been discovered with electrolyte level below the top of the plates;

4. Limits on average electrolyte temperature, battery connection resistance, and battery terminal voltage; and

5. A requirement to obtain specific gravity readings of all cells at each discharge test, consistent with manufacturer recommendations.

B 3.8 ELECTRICAL POWER SYSTEMS

B 3.8.4 DC Sources - Operating

BASES

BACKGROUND

The station DC electrical power system provides the AC emergency power system with control power. It also provides both motive and control power to selected safety related equipment and preferred AC vital bus power (via inverters). As required by 10 CFR 50, Appendix A, GDC 17 (Ref. 1), the DC electrical power system is designed to have sufficient independence, redundancy, and testability to perform its safety functions, assuming a single failure. The DC electrical power system also conforms to the recommendations of Regulatory Guide 1.6 (Ref. 2) and IEEE-308 (Ref. 3).

125 V Vital DC Electrical Power Subsystem

The vital 125 VDC electrical power system is a Class IE system whose safety function is to provide control power for engineered safety features equipment, emergency lighting, vital inverters, and other safety-related DC powered equipment for the entire unit. The system capacity is sufficient to supply these loads and any connected nonsafety loads during normal operation and to permit safe shutdown and isolation of the reactor for the "loss of all AC power" condition. The system is designed to perform its safety function subject to a single failure.

The 125V DC vital power system is composed of the four ~~redundant~~ channels (Channels I and III are associated with Train A and Channels II and IV are associated with Train B) and consists of four lead-acid-calcium batteries, eight battery chargers (including two pairs of spare chargers), four distribution boards, battery racks, and the required cabling, instrumentation and protective features. Each channel is electrically and physically independent from the equipment of all other channels so that a single failure in one channel will not cause a failure in another channel. Each channel consists of a battery charger which supplies normal DC power, a battery for emergency DC power, and a battery board which facilitates load grouping and provides circuit protection. These four channels are used to provide emergency power to the 120V AC vital power system which furnishes control power to the reactor protection system. No automatic connections are used between the four ~~redundant~~ channels.

Battery boards I, II, III, and IV have a charger normally connected to them and also have manual access to a spare (backup) charger for use upon loss of the normal charger.

(continued)

BASES

BACKGROUND

125 V Vital DC Electrical Power Subsystem (continued)

Additionally, battery boards I, II, III, and IV have manual access to the fifth vital battery system. The fifth 125V DC Vital Battery System is intended to serve as a replacement for any one of the four 125V DC vital batteries during their testing, maintenance, and outages with no loss of system reliability under any mode of operation.

Each of the vital DC electrical power subsystems provide the control power for its associated Class 1E AC power load group, 6.9 kV switchgear, and 480 V load centers. The vital DC electrical power subsystems also provide DC electrical power to the inverters, which in turn power the AC vital buses. Additionally, they power the emergency DC lighting system.

The vital DC power distribution system is described in more detail in Bases for LCO 3.8.9, "Distribution System - Operating," and LCO 3.8.10, "Distribution Systems - Shutdown."

~~Each vital battery has adequate storage capacity to carry the required load continuously for at least 4 hours in the event of a loss of all AC power (station blackout) without an accident or for 30 minutes with an accident considering a single failure. Load shedding of nonrequired loads will be performed to achieve the required coping duration for station blackout conditions.~~

Each 125 VDC vital battery is separately housed in a ventilated room apart from its charger and distribution centers, except for Vital Battery V. Each subsystem is located in an area separated physically and electrically from the other subsystem to ensure that a single failure in one subsystem does not cause a failure in a redundant subsystem. There is no sharing between ~~redundant~~ Class 1E subsystems, such as batteries, battery chargers, or distribution panels.

Each battery has adequate storage capacity to meet the duty cycle(s) discussed in the FSAR, Chapter 8 (Ref 4). The battery is designed with additional capacity above that required by the design duty cycle to allow for temperature variations and other factors.

The batteries for the vital DC electrical power subsystems are sized to produce required capacity at 80% of nameplate rating, corresponding to warranted capacity at end of life cycles~~, derated for minimum ambient temperature~~ and the

(continued)

BASES

BACKGROUND

125 V Vital DC Electrical Power Subsystem (continued)

100% design demand. The minimum design voltage limit is 105 V. ~~The voltage limit is 2.13 V per cell, which corresponds to a total minimum voltage output of 128 V per battery (132 V for Vital Battery V). The criteria for sizing large lead storage batteries are defined in IEEE 485 (Ref. 5).~~

The battery cells are of flooded lead acid construction with a nominal specific gravity of 1.215. This specific gravity corresponds to an open circuit battery voltage of approximately 120 V for a 60 cell battery (i.e., cell voltage of 2.063 volts per cell (Vpc)). The open circuit voltage is the voltage maintained when there is no charging or discharging. Optimal long term performance however, is obtained by maintaining a float voltage 2.20 to 2.25 Vpc. This provides adequate over-potential, which limits the formation of lead sulfate and self discharge. The nominal float voltage of 2.22 Vpc corresponds to a total float voltage output of 132 V for a 60 cell battery as discussed in the FSAR, Chapter 8 (Ref. 4).

Each Vital DC electrical power subsystem battery charger has ample power output capacity for the steady state operation of connected loads required during normal operation, while at the same time maintaining its battery bank fully charged. Each battery charger also has sufficient excess capacity to restore the battery bank from the design minimum charge to its fully charged state within 12 hours (with accident loads being supplied) following a 30 minute AC power outage and in approximately 36 hours (while supplying normal steady state loads following a 2 hour AC power outage), (Ref. ~~6~~5).

The battery charger is normally in the float-charge mode. Float-charge is the condition in which the charger is supplying the connected loads and the battery cells are receiving adequate current to optimally charge the battery. This assures the internal losses of a battery are overcome and the battery is maintained in a fully charged state.

When desired, the charger can be placed in the equalize mode. The equalize mode is at a higher voltage than the float mode and charging current is correspondingly higher. The battery charger is operated in the equalize mode after a battery discharge or for routine maintenance. Following a battery discharge, the battery recharge characteristic accepts current at the current limit of the battery charger (if the discharge was significant, e.g., following a battery service test) until the battery terminal voltage approaches the charger voltage setpoint. Charging current then reduces exponentially during the remainder of the recharge cycle. Lead-calcium batteries have recharge efficiencies of greater than 95%, so once at least 105% of the ampere-hours discharged have been returned, the battery capacity would be restored to the same condition as it was prior to the discharge. This can be monitored by direct observation of the exponentially decaying charging current or by evaluating the amp-hours discharged from the battery and amp-hours returned to the battery.

(continued)

BASES

BACKGROUND (continued)

125 V Diesel Generator (DG) DC Electrical Power Subsystem

Control power for the DGs is provided by five DG battery systems, one per DG. Each system is comprised of a battery, a dual battery charger assembly, distribution center, cabling, and cable ways. The DG 125V DC control power and field-flash circuits have power supplied from their respective 125V distribution panel. The normal supply of DC current is from the associated charger. The battery provides control and field-flash power when the charger is unavailable. The charger supplies the normal DC loads, maintains the battery in a fully charged condition, and recharges (480V AC available) the battery while supplying the required loads regardless of the status of the unit. The batteries are physically and electrically independent. The battery has sufficient capacity when fully charged to supply required loads for a minimum of 30 minutes following a loss of normal power. Each battery is normally required to supply loads during the time interval between loss of normal feed to its charger and the receipt of emergency power to the charger from its respective DG.

APPLICABLE SAFETY ANALYSES

The initial conditions of Design Basis Accident (DBA) and transient analyses in the FSAR, Section 6 (Ref. ~~7~~6), and in the FSAR, Section 15 (Ref. ~~7~~6), assume that Engineered Safety Feature (ESF) systems are OPERABLE. The vital DC electrical power system provides normal and emergency DC electrical power for the emergency auxiliaries, and control and switching during all power for the emergency auxiliaries, and control and switching during all MODES of operation. The DG battery systems provide DC power for the DGs.

The OPERABILITY of the DC sources is consistent with the initial assumptions of the accident analyses and is based upon meeting the design basis of the plant. This includes maintaining the DC sources OPERABLE during accident conditions in the event of:

a. An assumed loss of all offsite AC power or all onsite AC power; and

b. A worst case single failure.

The DC sources satisfy Criterion 3 of the NRC Policy Statement.

(continued)

BASES

LCO

~~Four~~ Two 125V vital DC electrical power subsystems (Train A and Train B), each vital subsystem consisting of two channels. Each channel consisting of a battery bank, associated battery charger and the corresponding control equipment and interconnecting cabling supplying power to the associated DC bus within the channel; and four DG DC electrical power subsystems each consisting of a battery, a dual battery charger assembly, and the corresponding control equipment and interconnecting cabling are required to be OPERABLE to ensure the availability of the required power to shut down the reactor and maintain it in a safe condition after an anticipated operational occurrence (A00) or a postulated DBA. Loss of any DC electrical power subsystem does not prevent the minimum safety function from being performed (Ref. 4).

An OPERABLE vital DC electrical power subsystem requires all required batteries and respective chargers to be operating and connected to the associated DC buses.

The LCO is modified by ~~two~~ a Note~~s~~. The Note ~~1~~ indicates that Vital Battery V may be substituted for any of the required vital batteries. However, the fifth battery cannot be declared OPERABLE until it is connected electrically in place of another battery and it has satisfied applicable Surveillance Requirements. ~~Note 2 has been added to indicate that the C-S DG and its associated DC subsystem may be substituted for any of the required DGs. However, the C-S DG and its associated DC subsystem cannot be declared OPERABLE until it is connected electrically in place of another DG, and it has satisfied applicable Surveillance Requirements.~~

APPLICABILITY

The ~~four~~ vital DC electrical power sources and ~~four~~ DG DC electrical power sources are required to be OPERABLE in MODES 1, 2, 3, and 4 to ensure safe plant operation and to ensure that:

a. Acceptable fuel design limits and reactor coolant pressure boundary limits are not exceeded as a result of AOs or abnormal transients; and

b. Adequate core cooling is provided, and containment integrity and other vital functions are maintained in the event of a postulated DBA.

The DC electrical power requirements for MODES 5 and 6 are addressed in the Bases for LCO 3.8.5, "DC Sources - Shutdown."

(continued)

BASES

ACTIONS

A.1, A.2, and A.3

Condition A represents one vital DC subsystem with one or two battery chargers inoperable (e.g., the voltage limit of SR 3.8.4.1 is not maintained). The ACTIONS provide a tiered response that focuses on returning the battery to the fully charged state and restoring a fully qualified charger to OPERABLE status in a reasonable time period. Required Action A.1 requires that the battery terminal voltage be restored to greater than or equal to the minimum established float voltage within 2 hours. This time provides for returning the inoperable charger to OPERABLE status or providing an alternate means of restoring battery terminal voltage to greater than or equal to the minimum established float voltage. Restoring the battery terminal voltage to greater than or equal to the minimum established float voltage provides good assurance that, within 12 hours, the battery will be restored to its fully charged condition (Required Action A.2) from any discharge that might have occurred due to the charger inoperability.

A discharged battery having terminal voltage of at least the minimum established float voltage indicates that the battery is on the exponential charging current portion (the second part) of its recharge cycle. The time to return a battery to its fully charged state under this condition is simply a function of the amount of the previous discharge and the recharge characteristic of the battery. Thus there is good assurance of fully recharging the battery within 12 hours, avoiding a premature shutdown with its own attendant risk.

If established battery terminal float voltage cannot be restored to greater than or equal to the minimum established float voltage within 2 hours, and the charger is not operating in the current-limiting mode, a faulty charger is indicated. A faulty charger that is incapable of maintaining established battery terminal float voltage does not provide assurance that it can revert to and operate properly in the current limit mode that is necessary during the recovery period following a battery discharge event that the DC system is designed for.

If the charger is operating in the current limit mode after 2 hours that is an indication that the battery is partially discharged and its capacity margins will be reduced. The time to return the battery to its fully charged condition in this case is a function of the battery charger capacity, the amount of loads on the associated DC system, the amount of the previous discharge, and the recharge characteristic of the battery. The charge time can be extensive, and there is not adequate assurance that it can be recharged within 12 hours (Required Action A.2).

Required Action A.2 requires that the battery float current be verified as less than or equal to 2 amps. This indicates that, if the battery had been discharged as the result of the inoperable battery charger, it is now fully capable of supplying the maximum expected load requirement. The 2 amp value is based on returning the battery to 98% charge and assumes a 2% design margin for the battery. If at the

(continued)

BASES

ACTIONS

A.1, A.2, and A.3 (continued)

expiration of the initial 12 hour period the battery float current is not less than or equal to 2 amps this indicates there may be additional battery problems and the battery must be declared inoperable.

Required Action A.3 limits the restoration time for the inoperable battery charger to 7 days. This action is applicable if an alternate means of restoring battery terminal voltage to greater than or equal to the minimum established float voltage has been used (e.g., balance of plant non-Class 1E battery charger). The 7 day Completion Time reflects a reasonable time to effect restoration of the qualified battery charger to OPERABLE status.

~~A~~B.1

Condition ~~A~~B represents one vital ~~channel~~ DC electrical power subsystem with a loss of ability to completely respond to an event, and a potential loss of ability to remain energized during normal operation. It is, therefore, imperative that the operator's attention focus on stabilizing the plant, minimizing the potential for complete loss of DC power to the affected ~~train~~ subsystem. The 2 hour limit is consistent with the allowed time for an inoperable DC distribution subsystem ~~train~~.

If one of the required vital DC electrical power subsystems is inoperable for reasons other than Condition A (e.g., ~~inoperable battery, inoperable battery charger(s), or~~ inoperable battery charger and associated inoperable battery), the remaining vital DC electrical power subsystem has the capacity to support a safe shutdown and to mitigate an accident condition. Since a subsequent worst case single failure of the OPERABLE subsystem ~~would~~ could, however, result in ~~a situation where the ability of the 125V DC electrical power subsystem to support its required ESF function is not assured,~~ the loss of the minimum necessary vital DC electrical power subsystems to mitigate a worst-case accident, continued power operation should not exceed 2 hours. The 2 hour Completion Time is based on Regulatory Guide 1.93 (Ref. ~~8~~7) and reflects a reasonable time to assess plant status as a function of the inoperable vital DC electrical power subsystem and, if the vital DC electrical power subsystem is not restored to OPERABLE status, to prepare to effect an orderly and safe plant shutdown.

~~B.1 and B.2~~C,1 and C.2

If the inoperable vital DC electrical power subsystem cannot be restored to OPERABLE status within the required Completion Time, the plant must be brought to a MODE in which the LCO does not apply. To achieve this status, the plant must be brought to at least MODE 3 within 6 hours and to MODE 5 within 36 hours. The allowed Completion Times are reasonable, based on operating experience, to reach the required plant conditions from full power conditions in an orderly manner and without challenging plant systems. The Completion Time

(continued)

BASES

ACTIONS (continued)

~~B.1 and B.2~~C,1 and C.2 (continued)

to bring the plant to MODE 5 is consistent with the time required in Regulatory Guide 1.93 (Ref. ~~8~~7).

D.1, D.2, and D.3

Condition D represents one DG DC subsystem with one battery charger inoperable (e.g., the voltage limit of SR 3.8.4.1 is not maintained). The ACTIONS provide a tiered response that focuses on returning the battery to the fully charged state and restoring a fully qualified charger to OPERABLE status in a reasonable time period. Required Action D.1 requires that the battery terminal voltage be restored to greater than or equal to the minimum established float voltage within 2 hours. This time provides for returning the inoperable charger to OPERABLE status or providing an alternate means of restoring battery terminal voltage to greater than or equal to the minimum established float voltage.

Restoring the battery terminal voltage to greater than or equal to the minimum established float voltage provides good assurance that, within 12 hours, the battery will be restored to its fully charged condition (Required Action D.2) from any discharge that might have occurred due to the charger inoperability.

A discharged battery having terminal voltage of at least the minimum established float voltage indicates that the battery is on the exponential charging current portion (the second part) of its recharge cycle. The time to return a battery to its fully charged state under this condition is simply a function of the amount of the previous discharge and the recharge characteristic of the battery. Thus there is good assurance of fully recharging the battery within 12 hours, avoiding a premature shutdown with its own attendant risk.

If established battery terminal float voltage cannot be restored to greater than or equal to the minimum established float voltage within 2 hours, and the charger is not operating in the current-limiting mode, a faulty charger is indicated. A faulty charger that is incapable of maintaining established battery terminal float voltage does not provide assurance that it can revert to and operate properly in the current limit mode that is necessary during the recovery period following a battery discharge event that the DG DC system is designed for.

If the charger is operating in the current limit mode after 2 hours that is an indication that the battery is partially discharged and its capacity margins will be reduced. The time to return the battery to its fully charged condition in this case is a function of the battery charger capacity, the amount of loads on the associated DC system, the amount of the previous discharge, and the recharge characteristic of the battery. The charge time can be extensive, and there is not adequate assurance that it can be recharged within 12 hours (Required Action D.2).

(continued)

BASES

ACTIONS

D.1, D.2, and D.3 (continued)

Required Action D.2 requires that the battery float current be verified as less than or equal to 1 amp. This indicates that, if the battery had been discharged as the result of the inoperable battery charger, it is now fully capable of supplying the maximum expected load requirement. The 1 amp value is based on returning the battery to 98% charge and assumes a 2% design margin for the battery. If at the expiration of the initial 12 hour period the battery float current is not less than or equal to 1 amp this indicates there may be additional battery problems and the battery must be declared inoperable.

Required Action D.3 limits the restoration time for the inoperable battery charger to 72 hours. The 72 hour Completion Time reflects a reasonable time to effect restoration of the qualified battery charger to OPERABLE status.

~~C.1~~E.1

Condition ~~C~~E represents one DG with a loss of ability to completely respond to an event. Since a subsequent single failure on the opposite train could result in a situation where the required ESF function is not assured, continued power operation should not exceed 2 hours. The 2 hour time limit is consistent with the allowed time for an inoperable vital DC electrical power subsystem.

~~D.1~~F.1

If the DG DC electrical power subsystem cannot be restored to OPERABLE status in the associated Completion Time, the associated DG may be incapable of performing its intended function and must be immediately declared inoperable. This declaration also requires entry into applicable Conditions and Required Actions for an inoperable DG, LCO 3.8.1, "AC Sources-Operating."

(continued)

BASES (continued)

SURVEILLANCE REQUIREMENTS

SR 3.8.4.1 and SR 3.8.4.2

Verifying battery terminal voltage while on float charge for the batteries helps to ensure the effectiveness of the battery chargers, which support the ability of the batteries to perform their intended function ~~charging system and the ability of the batteries to perform their intended function~~. Float charge is the condition in which the charger is supplying the continuous charge required to overcome the internal losses of a battery ~~(or battery cell)~~ and maintain the battery ~~(or a battery cell)~~ in a fully charged state while supplying the continuous steady state loads of the associated DC subsystem. On float charge, battery cells will receive adequate current to optimally charge the battery. The voltage requirements are based on the ~~critical~~ nominal design voltage of the battery and are consistent with the ~~initial voltages assumed in the battery sizing calculations~~ minimum float voltage established by the battery manufacturer (2.20 Vpc times the number of connected cells or 132 V at the battery terminals for a 60 cell vital battery; 127.6 V at the battery terminals for a 58 cell DG battery). This voltage maintains the battery plates in a condition that supports maintaining the grid life. The 7 day Frequency is consistent with manufacturer recommendations ~~and IEEE-450 (Ref. 9)~~.

SR 3.8.4.3

Verifying that for the vital batteries that the alternate feeder breakers to each required battery charger is open ensures that independence between the power trains is maintained. The 7-day Frequency is based on engineering judgement, is consistent with procedural controls governing breaker operation, and ensures correct breaker position.

SR 3.8.4.4

This SR demonstrates that the DG 125V DC distribution panel and associated charger are functioning properly, with all required circuit breakers closed and buses energized from normal power. The 7 day Frequency takes into account the redundant DG capability and other indications available in the control room that will alert the operator to system malfunctions.

~~SR 3.8.4.5 and SR 3.8.4.6~~

~~Visual inspection to detect corrosion of the battery cells and connections, or measurement of the resistance of each intercell, interrack, intertier, and terminal connection, provides an indication of physical damage or abnormal deterioration that could potentially degrade battery performance.~~

(continued)

BASES

SURVEILLANCE REQUIREMENTS

SR 3.8.4.5 and SR 3.8.4.6 (continued)

The limits established for this SR must be no more than 20% above the resistance as measured during installation, or not above the ceiling value established by the manufacturer.

The Surveillance Frequency for these inspections, which can detect conditions that can cause power losses due to resistance heating, is 92 days. This Frequency is considered acceptable based on operating experience related to detecting corrosion trends.

SR 3.8.4.7

Visual inspection of the battery cells, cell plates, and battery racks provides an indication of physical damage or abnormal deterioration that could potentially degrade battery performance.

The 12 month Frequency for this SR is consistent with IEEE-450 (Ref. 9), which recommends detailed visual inspection of cell condition and rack integrity on a yearly basis.

SR 3.8.4.8, SR 3.8.4.9 and SR 3.8.4.10

Visual inspection and resistance measurements of intercell, interrack, intertier, and terminal connections provide an indication of physical damage or abnormal deterioration that could indicate degraded battery condition. The anticorrosion material is used to help ensure good electrical connections and to reduce terminal deterioration. The visual inspection for corrosion is not intended to require removal of and inspection under each terminal connection. The removal of visible corrosion is a preventive maintenance SR. The presence of visible corrosion does not necessarily represent a failure of this SR provided visible corrosion is removed during performance of SR 3.8.4.8. For the purposes of trending, inter-cell (vital and DG batteries) and inter-tier (vital and DG batteries) connections are measured from battery post to battery post. Inter-rack (vital batteries), inter-tier (DG Batteries), and terminal connections (vital and DG batteries) are measured from terminal lug to battery post.

(continued)

BASES

SURVEILLANCE REQUIREMENTS

~~SR 3.8.4.8, SR 3.8.4.9 and SR 3.8.4.10 (continued)~~

~~The connection resistance limits for SR 3.8.4.9 and SR 3.8.4.10 shall be no more than 20% above the resistance as measured during installation, or not above the ceiling value established by the manufacturer.~~

~~The Surveillance Frequencies of 12 months is consistent with IEEE-450 (Ref. 9), which recommends cell to cell and terminal connection resistance measurement on a yearly basis.~~

SR 3.8.4.~~11~~5

This SR ~~requires that each vital battery charger be capable of recharging its associated battery from a capacity or service discharge test while supplying normal loads, or alternatively, operating at current limit for a minimum of 4 hours at a nominal 125 VDC. These requirements are based on~~ verifies the design capacity of the vital battery chargers ~~(Ref. 4) and their performance characteristic of current limit operation for a substantial portion of the recharge period. Battery charger output current is limited to 110% - 125% of the 200 amp rated output. Recharging the battery or testing for a minimum of 4 hours is sufficient to verify the output capability of the charger can be sustained, that current limit adjustments are properly set and that protective devices will not inhibit performance at current limit settings~~. According to Regulatory Guide 1.32 (Ref. ~~6~~5), the battery charger supply is ~~required~~ recommended to be based on the largest combined demands of the various steady state loads and the charging capacity to restore the battery from the design minimum charge state to the fully charged state, irrespective of the status of the plant during these demand occurrences. ~~Verifying the capability of the charger to operate in a sustained current limit condition~~ The minimum required amperes and duration ensure~~s~~ that these requirements can be satisfied.

This SR provides two options. One option requires that each battery charger be capable of supplying 200 amps at the minimum established float voltage (132 V DC) for 4 hours. The ampere requirements are based on the output rating of the chargers. The voltage requirements are based on the charger voltage level after a response to a loss of AC power.

The other option requires that each vital battery charger be capable of recharging the battery after a service test coincident with supplying the largest coincident demands of the various continuous steady state loads (irrespective of the status of the plant during which these demands occur). This level of loading may not normally be available following the battery service test and will need to be supplemented with additional loads. The duration for this test may be longer than the charger sizing criteria since the battery recharge is affected by float voltage, temperature, and the exponential decay in charging current. The battery is recharged when the measured charging current is ≤ 2 amps.

(continued)

BASES

SURVEILLANCE REQUIREMENTS

SR 3.8.4.~~11~~5 (continued)

The Surveillance Frequency is acceptable, given the plant conditions required to perform the test and the other administrative controls existing to ensure adequate charger performance during these 18 month intervals. In addition, this Frequency is intended to be consistent with expected fuel cycle lengths.

~~This SR is modified by a Note. The reason for the Note is that performing the Surveillance may perturb the electrical distribution system and challenge safety systems. This Surveillance is normally performed during MODES 5 and 6 since it would require the DC electrical power subsystem to be inoperable during performance of the test. However, this Surveillance may be performed in MODES 1, 2, 3, or 4 provided the Vital Battery V is substituted in accordance with LCO Note 1. Credit may be taken for unplanned events that satisfy this SR. Examples of unplanned events may include:~~

~~1) Unexpected operational events which cause the equipment to perform the function specified by this Surveillance, for which adequate documentation of the required performance is available; and~~

~~2) Post corrective maintenance testing that requires performance of this Surveillance in order to restore the component to OPERABLE, provided the maintenance was required, or performed in conjunction with maintenance required to maintain OPERABILITY or reliability.~~

SR 3.8.4.~~12~~6

This SR ~~requires that each diesel generator battery charger be capable of recharging its associated battery from a capacity or service discharge test while supplying normal loads, or alternatively, operating at current limit for a minimum of 4 1/2 hours at a nominal 125 VDC. This requirement is based on~~ verifies the design capacity of the DG battery chargers ~~(Ref. 13) and their performance characteristic of current limit operation for a substantial portion of the recharge period. Battery charger output current is limited to a maximum of 140% of the 20 amp rated output. Recharging the battery verifies the output capability of the charger can be sustained, that current limit adjustments are properly set and that protective devices will not inhibit performance at current limit settings~~. According to Regulatory Guide 1.32 (Ref. ~~6~~5), the battery charger supply is ~~required~~ recommended to be based on the largest combined demands of the various steady state loads and the charging capacity to restore the battery from the design minimum charge state to the fully charged state, irrespective of the status of the plant during these demand occurrences. ~~Verifying the capability of the charger to operate in a sustained current limit condition~~ The minimum required amperes and duration ensure~~s~~ that these requirements can be satisfied.

(continued)

BASES

SURVEILLANCE REQUIREMENTS

SR 3.8.4.~~12~~6 (continued)

This SR provides two options. One option requires that each battery charger be capable of supplying 20 amps at the minimum established float voltage (127.6 V DC) for 4 hours. The ampere requirements are based on the output rating of the chargers. The voltage requirements are based on the charger voltage level after a response to a loss of AC power.

The other option requires that each vital battery charger be capable of recharging the battery after a service test coincident with supplying the largest coincident demands of the various continuous steady state loads (irrespective of the status of the plant during which these demands occur). This level of loading may not normally be available following the battery service test and will need to be supplemented with additional loads. The duration for this test may be longer than the charger sizing criteria since the battery recharge is affected by float voltage, temperature, and the exponential decay in charging current. The battery is recharged when the measured charging current is ≤ 1 amp.

The Surveillance Frequency is acceptable, given the ~~plant conditions required to perform the test and the other~~ administrative controls existing to ensure adequate charger performance during these 18 month intervals. ~~In addition, this Frequency is intended to be consistent with expected fuel cycle lengths.~~

For the DG DC electrical subsystem, this Surveillance may be performed in MODES 1, 2, 3, or 4 in conjunction with LCO 3.8.1.B since the DG DC electrical power subsystem supplies loads only for the inoperable diesel generator and would not otherwise challenge safety systems supplied from vital electrical distribution systems. If available, the C-S DG and its associated DC electrical power subsystem may be substituted in accordance with LCO Note 2. Additionally, credit may be taken for unplanned events that satisfy this SR. Examples of unplanned events may include:

1) Unexpected operational events which cause the equipment to perform the function specified by this Surveillance, for which adequate documentation of the required performance is available; and

2) Post corrective maintenance testing that requires performance of this Surveillance in order to restore the component to OPERABLE, provided the maintenance was required, or performed in conjunction with maintenance required to maintain OPERABILITY or reliability.

SR 3.8.4.~~13~~7

A battery service test is a special test of battery capability, as found, to satisfy the design requirements (battery duty cycle) of the DC electrical power system. The discharge rate and test length should correspond to worst case design duty cycle requirements based on Reference~~s~~ ~~10~~8 and ~~12~~10.

(continued)

BASES

SURVEILLANCE REQUIREMENTS

SR 3.8.4.~~13~~7 (continued)

The Surveillance Frequency of 18 months is consistent with the recommendations of Regulatory Guide 1.32 (Ref. ~~6~~5) and Regulatory Guide 1.129 (Ref. ~~11~~9), which state that the battery service test should be performed during refueling operations or at some other outage, with intervals between tests, not to exceed 18 months.

This SR is modified by two Notes. Note 1 allows the performance of a modified performance discharge test in lieu of a service test ~~once per 60 months. The modified performance discharge test is a simulated duty cycle consisting of just two rates; the one minute rate published for the battery or the largest current load of the duty cycle, followed by the test rate employed for the performance test, both of which envelope the duty cycle of the service test. Since the ampere-hours removed by a rated one minute discharge represents a very small portion of the battery capacity, the test rate can be changed to that for the performance test without compromising the results of the performance discharge test. The battery terminal voltage for the modified performance discharge test should remain above the minimum battery terminal voltage specified in the battery service test for the duration of time equal to that of the service test.~~

~~A modified discharge test is a test of the battery capacity and its ability to provide a high rate, short duration load (usually the highest rate of the duty cycle.) This will often confirm the battery's ability to meet the critical period of the load duty cycle, in addition to determining its percentage of rated capacity. Initial conditions for the modified performance discharge test should be identical to those specified for a service test.~~

The reason for Note 2 is that performing the Surveillance may perturb the vital electrical distribution system and challenge safety systems. However, this Surveillance may be performed in MODES I, 2, 3, or 4 provided that Vital Battery V is substituted in accordance with LCO Note I. For the DG DC electrical subsystem, this surveillance may be performed in MODES I, 2, 3, or 4 in conjunction with LCO 3.8.I.B since the supplied loads are only for the inoperable diesel generator and would not otherwise challenge safety system loads which are supplied from vital electrical distribution systems. If available, the C-S DG and its associated DC electrical power subsystem may be substituted in accordance with LCO Note 2. Additionally, credit may be taken for unplanned events that satisfy this SR. Examples of unplanned events may include:

1) Unexpected operational events which cause the equipment to perform the function specified by this Surveillance, for which adequate documentation of the required performance is available; and

(continued)

BASES

SURVEILLANCE REQUIREMENTS

SR 3.8.4.~~13~~7 (continued)

2) Post corrective maintenance testing that requires performance of this Surveillance in order to restore the component to OPERABLE, provided the maintenance was required, or performed in conjunction with maintenance required to maintain OPERABILITY or reliability.

~~SR 3.8.4.14~~

~~A battery performance discharge test is a test of constant current capacity of a battery, normally done in the as found condition, after having been in service, to detect any change in the capacity determined by the acceptance test. The test is intended to determine overall battery degradation due to age and usage.~~

~~A battery modified performance discharge test is described in the Bases for 3.8.4.13. Either the battery performance discharge test or the modified performance discharge test is acceptable for satisfying SR 3.8.4.14; however, only the modified performance discharge test may be used to satisfy SR 3.8.4.14 while satisfying the requirements of SR 3.8.4.13 at the same time.~~

~~The acceptance criteria for this Surveillance are consistent with IEEE-450 (Ref. 9) and IEEE-485 (Ref. 5). These references recommend that the battery be replaced if its capacity is below 80% of the manufacturer rating. A capacity of 80% shows that the battery rate of deterioration is increasing, even if there is ample capacity to meet the load requirements.~~

~~The Surveillance Frequency for this test is normally 60 months. If the battery shows degradation, or if the battery has reached 85% of its expected life and capacity is < 100% of the manufacturer's rating, the Surveillance Frequency is reduced to 12 months. However, if the battery shows no degradation but has reached 85% of its expected life, the Surveillance Frequency is only reduced to 24 months for batteries that retain capacity ≥ 100% of the manufacturer's rating. Degradation is indicated, according to IEEE-450 (Ref. 9), when the battery capacity drops by more than 10% relative to its capacity on the previous performance test or when it is ≥ 10% below the manufacturer rating. These Frequencies are consistent with the recommendations in IEEE-450 (Ref. 9).~~

(continued)

BASES

SURVEILLANCE REQUIREMENTS

SR 3.8.4.14 (continued)

This SR is modified by a Note. The reason for the Note is that performing the Surveillance may perturb the vital electrical distribution system and challenge safety systems. However, this Surveillance may be performed in MODES 1, 2, 3, or 4 provided that Vital Battery V is substituted in accordance with LCO Note 1. For the DG DC electrical subsystem, this surveillance may be performed in MODES 1, 2, 3, or 4 in conjunction with LCO 3.8.1.B since the supplied loads are only for the inoperable diesel generator and would not otherwise challenge safety system loads which are supplied from vital electrical distribution systems. If available, the C-S DG and its associated DC electrical power subsystem may be substituted in accordance with LCO Note 2. Additionally, credit may be taken for unplanned events that satisfy this SR. Examples of unplanned events may include:

1) Unexpected operational events which cause the equipment to perform the function specified by this Surveillance, for which adequate documentation of the required performance is available; and

2) Post corrective maintenance testing that requires performance of this Surveillance in order to restore the component to OPERABLE, provided the maintenance was required, or performed in conjunction with maintenance required to maintain OPERABILITY or reliability.

(continued)

BASES (continued)

REFERENCES

1. Title 10, Code of Federal Regulations, Part 50, Appendix A, General Design Criterion 17, “Electric Power System.”

2. Regulatory Guide 1.6, “Independence Between Redundant Standby (Onsite) Power Sources and Between Their Distribution Systems,” U.S. Nuclear Regulatory Commission, March 10, 1971.

3. IEEE-308-1971, “IEEE Standard Criteria for Class 1E Power Systems for Nuclear Power Generating Stations,” Institute of Electrical and Electronic Engineers.

4. Watts Bar FSAR, Section 8.3.2, “DC Power System.”

~~5. IEEE-485-1983, “Recommended Practices for Sizing Large Lead Storage Batteries for Generating Stations and Substations,” Institute of Electrical and Electronic Engineers.~~

~~6~~5. Regulatory Guide 1.32, “Criteria for Safety-Related Electric Power Systems for Nuclear Power Plants,” February 1977, U.S. Nuclear Regulatory Commission.

~~7~~6. Watts Bar FSAR, Section 15, “Accident Analysis” and Section 6 “Engineered Safety Features.”

~~8~~7. Regulatory Guide 1.93, “Availability of Electric Power Sources,” U.S. Nuclear Regulatory Commission, December 1974.

~~9. IEEE-450-1980/1995, “IEEE Recommended Practice for Maintenance Testing and Replacement of Large Lead Storage Batteries for Generating Stations and Subsystems,” Institute of Electrical and Electronic Engineers.~~

~~10~~8. TVA Calculation WBN EEB-MS-TI11-0003, “125 VDC Vital Battery and Charger Evaluation.”

~~11~~9. Regulatory Guide 1.129, “Maintenance Testing and Replacement of Large Lead Storage Batteries for Generating Stations and Subsystems,” U.S. Nuclear Regulatory Commission, February 1978.

(continued)

BASES

REFERENCES (continued)

~~12~~10. TVA Calculation WBN EEB-MS-TI11-0062, "125 V DC Diesel Generator Control Power System Evaluation."

~~13. Watts Bar FSAR, Section 8.3.1, "AC Power System."~~

B 3.8 ELECTRICAL POWER SYSTEMS

B 3.8.5 DC Sources - Shutdown

BASES

BACKGROUND

A description of the DC sources is provided in the Bases for LCO 3.8.4, "DC Sources - Operating."

APPLICABLE SAFETY ANALYSES

The initial conditions of Design Basis Accident and transient analyses in the FSAR, Section 6 (Ref. 1) and Section 15 (Ref. 1), assume that Engineered Safety Feature systems are OPERABLE. The vital DC electrical power system provides normal and emergency DC electrical power for the emergency auxiliaries, and control and switching during all MODES of operation. The DG battery systems provide DC power for the DGs.

The OPERABILITY of the DC sources is consistent with the initial assumptions of the accident analyses and the requirements for the supported systems' OPERABILITY.

The OPERABILITY of the minimum DC electrical power sources during MODES 5 and 6, and during movement of irradiated fuel assemblies ensures that:

a. The plant can be maintained in the shutdown or refueling condition for extended periods;

b. Sufficient instrumentation and control capability is available for monitoring and maintaining the plant status; and

c. Adequate DC electrical power is provided to mitigate events postulated during shutdown, such as a fuel handling accident.

The DC sources satisfy Criterion 3 of the NRC Policy Statement.

(continued)

BASES (continued)

LCO

The 125V Vital DC electrical power subsystems, each vital subsystem channel consisting of a battery bank, associated battery charger, and the corresponding control equipment and interconnecting cabling within the channel; and the DG DC electrical power subsystems, each consisting of a battery, a battery charger, and the corresponding control equipment and interconnecting cabling, are required to be OPERABLE to support required ~~trains~~ subsystems of the distribution systems required OPERABLE by LCO 3.8.10, "Distribution Systems - Shutdown" and the required DGs required OPERABLE by LCO 3.8.2, "AC Sources-Shutdown." As a minimum, one vital DC electrical power ~~train~~ subsystem (i.e., Channels I and III, or II and IV) and two DG DC electrical power subsystems (i.e., 1A-A and 2A-A or 1B-B and 2B-B) shall be OPERABLE. This ensures the availability of sufficient DC electrical power sources to operate the plant in a safe manner and to mitigate the consequences of postulated events during shutdown (e.g., fuel handling accidents).

The LCO is modified by ~~two~~ a Note~~s~~. The Note ~~1~~ indicates that Vital Battery V may be substituted for any of the required vital batteries. However, the fifth battery cannot be declared OPERABLE until it is connected electrically in place of another battery and it has satisfied applicable Surveillance Requirements. ~~Note 2 has been added to indicate that the C-S DG and its associated DC subsystem may be substituted for any of the required DGs. However, the C-S DG and its associated DC subsystem cannot be declared OPERABLE until it is connected electrically in place of another DG, and it has satisfied applicable Surveillance Requirements.~~

APPLICABILITY

The DC electrical power sources required to be OPERABLE in MODES 5 and 6, and during movement of irradiated fuel assemblies, provide assurance that:

a. Required features needed to mitigate a fuel handling accident are available;

(continued)

BASES

APPLICABILITY (continued)

b. Required features necessary to mitigate the effects of events that can lead to core damage during shutdown are available; and

c. Instrumentation and control capability is available for monitoring and maintaining the plant in a cold shutdown condition or refueling condition.

The DC electrical power requirements for MODES 1, 2, 3, and 4 are covered in LCO 3.8.4.

ACTIONS

A.1, A.2, and A.3

Condition A represents one subsystem with one or two battery charger(s) inoperable (e.g., the voltage limit of SR 3.8.4.1 is not maintained). The ACTIONS provide a tiered response that focuses on returning the battery to the fully charged state and restoring a fully qualified charger to OPERABLE status in a reasonable time period. Required Action A.1 requires that the battery terminal voltage be restored to greater than or equal to the minimum established float voltage within 2 hours. This time provides for returning the inoperable charger to OPERABLE status or providing an alternate means of restoring battery terminal voltage to greater than or equal to the minimum established float voltage. Restoring the battery terminal voltage to greater than or equal to the minimum established float voltage provides good assurance that, within 12 hours, the battery will be restored to its fully charged condition (Required Action A.2) from any discharge that might have occurred due to the charger inoperability.

A discharged battery having terminal voltage of at least the minimum established float voltage indicates that the battery is on the exponential charging current portion (the second part) of its recharge cycle. The time to return a battery to its fully charged state under this condition is simply a function of the amount of the previous discharge and the recharge characteristic of the battery. Thus there is good assurance of fully recharging the battery within [12] hours, avoiding a premature shutdown with its own attendant risk.

If established battery terminal float voltage cannot be restored to greater than or equal to the minimum established float voltage within 2 hours, and the charger is not operating in the current-limiting mode, a faulty charger is indicated. A faulty charger that is incapable of maintaining established battery terminal float voltage does not provide assurance that it can revert to and operate properly in the current limit mode that is necessary during the recovery period following a battery discharge event that the DC system is designed for.

If the charger is operating in the current limit mode after 2 hours that is an indication that the battery is partially discharged and its capacity margins will be reduced. The time to return the battery to its fully charged condition in this case

(continued)

BASES

ACTIONS

A.1, A.2, and A.3 (continued)

is a function of the battery charger capacity, the amount of loads on the associated DC system, the amount of the previous discharge, and the recharge characteristic of the battery. The charge time can be extensive, and there is not adequate assurance that it can be recharged within 12 hours (Required Action A.2).

Required Action A.2 requires that the battery float current be verified as less than or equal to 2 amps. This indicates that, if the battery had been discharged as the result of the inoperable battery charger, it has now been fully recharged. If at the expiration of the initial 12 hour period the battery float current is not less than or equal to 2 amps this indicates there may be additional battery problems and the battery must be declared inoperable.

Required Action A.3 limits the restoration time for the inoperable battery charger to 7 days. This action is applicable if an alternate means of restoring battery terminal voltage to greater than or equal to the minimum established float voltage has been used (e.g., balance of plant non-Class 1E battery charger). The 7 day Completion Time reflects a reasonable time to effect restoration of the qualified battery charger to OPERABLE status.

~~A~~B.1, ~~A~~B.2.1, ~~A~~B.2.2, ~~A~~B.2.3, and ~~A~~B.2.4

If two ~~trains~~ subsystems are required by LCO 3.8.10, the remaining ~~train~~ subsystem with DC power available may be capable of supporting sufficient systems to allow continuation of CORE ALTERATIONS and fuel movement. By allowing the option to declare required features inoperable with the associated vital DC power source(s) inoperable, appropriate restrictions will be implemented in accordance with the affected required features LCO ACTIONS. In many instances, this option may involve undesired administrative efforts. Therefore, the allowance for sufficiently conservative actions is made (i.e., to suspend CORE ALTERATIONS, movement of irradiated fuel assemblies, and operations involving positive reactivity additions). The Required Action to suspend positive reactivity additions does not preclude actions to maintain or increase reactor vessel inventory, provided the required SDM is maintained.

Suspension of these activities shall not preclude completion of actions to establish a safe conservative condition. These actions minimize probability of the occurrence of postulated events. It is further required to immediately initiate action to restore the required vital DC electrical power subsystems and to continue this action until restoration is accomplished in order to provide the necessary DC electrical power to the plant safety systems.

(continued)

BASES

ACTIONS

~~A~~B.1, ~~A~~B.2.1, ~~A~~B.2.2, ~~A~~B.2.3, and ~~A~~B.2.4 (continued)

The Completion Time of immediately is consistent with the required times for actions requiring prompt attention. The restoration of the required vital DC electrical power subsystems should be completed as quickly as possible in order to minimize the time during which the plant safety systems may be without sufficient power.

~~B~~C.1

If the DG DC electrical power subsystem cannot be restored to OPERABLE status in the associated Completion Time, the associated DG may be incapable of performing its intended function and must be immediately declared inoperable. This declaration also requires entry into applicable Conditions and Required Actions for an inoperable DG, LCO 3.8.2, "AC Sources-Shutdown."

SURVEILLANCE REQUIREMENTS

SR 3.8.5.1

SR 3.8.5.1 requires performance of all Surveillances required by SR 3.8.4.1 through SR 3.8.4.~~14~~7. Therefore, see the corresponding Bases for LCO 3.8.4 for a discussion of each SR.

This SR is modified by a Note. The reason for the Note is to preclude requiring the OPERABLE DC sources from being discharged below their capability to provide the required power supply or otherwise rendered inoperable during the performance of SRs. It is the intent that these SRs must still be capable of being met, but actual performance is not required.

REFERENCES

1. Watts Bar FSAR, Section 15, "Accident Analysis" and Section 6, "Engineered Safety Features."
2. Watts Bar FSAR, Section 8.0, "Electric Power."

B 3.8 ELECTRICAL POWER SYSTEMS

B 3.8.6 Battery ~~Cell~~ Parameters

BASES

BACKGROUND

This LCO delineates the limits on battery float current as well as electrolyte temperature, level, and float voltage~~, and specific gravity~~ for the 125V vital DC electrical power subsystem and diesel generator (DG) batteries. A discussion of these batteries and their OPERABILITY requirements is provided in the Bases for LCO 3.8.4, "DC Sources - Operating," and LCO 3.8.5, "DC Sources - Shutdown." In addition to the limitations of this Specification, the Battery Monitoring and Maintenance Program also implements a program specified in Specification 5.7.2.22 for monitoring various battery parameters.

The battery cells are of flooded lead acid construction with a nominal specific gravity of 1.215. This specific gravity corresponds to an open circuit battery voltage of approximately 120 V for 60 cell battery (i.e., cell voltage of 2.063 volts per cell (Vpc)). The open circuit voltage is the voltage maintained when there is no charging or discharging. Optimal long term performance however, is obtained by maintaining a float voltage 2.20 to 2.25 Vpc. This provides adequate over-potential which limits the formation of lead sulfate and self discharge. The nominal float voltage of 2.22 Vpc corresponds to a total float voltage output of 133.2 V for a 60 cell battery as discussed in the FSAR, Chapter 8 (Ref. 3).

APPLICABLE SAFETY ANALYSES

The initial conditions of Design Basis Accident (DBA) and transient analyses in the FSAR, Section 6 (Ref. 1) and Section 15 (Ref. 1), assume Engineered Safety Feature systems are OPERABLE. The vital DC electrical power system provides normal and emergency DC electrical power for the emergency auxiliaries, and control and switching during all MODES of operation. The DG battery systems provide DC power for the DGs.

The OPERABILITY of the DC subsystems is consistent with the initial assumptions of the accident analyses and is based upon meeting the design basis of the plant. This includes maintaining at least one ~~train~~ subsystem of DC sources OPERABLE during accident conditions, in the event of:

a. An assumed loss of all offsite AC power or all onsite AC power; and

b. A worst case single failure.

Battery ~~cell~~ parameters satisfy the Criterion 3 of the NRC Policy Statement.

(continued)

BASES (continued)

LCO

Battery ~~cell~~ parameters must remain within acceptable limits to ensure availability of the required DC power to shut down the reactor and maintain it in a safe condition after an anticipated operational occurrence or a postulated DBA. ~~Electrolyte~~ Battery parameter limits are conservatively established, allowing continued DC electrical system function even with ~~Category A and B~~ limits not met. Additional preventative maintenance, testing, and monitoring performed in accordance with the Battery Monitoring and Maintenance Program is conducted as specified in Specification 5.7.2.22.

APPLICABILITY

The battery ~~cell~~ parameters are required solely for the support of the associated vital DC and DG DC electrical power subsystems. Therefore, battery ~~electrolyte is~~ parameter limits are only required when the DC power source is required to be OPERABLE. Refer to the Applicability discussion in Bases for LCO 3.8.4 and LCO 3.8.5.

ACTIONS

~~A.1, A.2, and A.3~~

~~With one or more cells in one or more batteries not within limits (i.e., Category A limits not met, Category B limits not met, or Category A and B limits not met) but within the Category C limits specified in Table 3.8.6-1 in the accompanying LCO, the battery is degraded but there is still sufficient capacity to perform the intended function. Therefore, the affected battery is not required to be considered inoperable solely as a result of Category A or B limits not met, and operation is permitted for a limited period.~~

~~The pilot cell electrolyte level and float voltage are required to be verified to meet the Category C limits within 1 hour (Required Action A.1). This check will provide a quick indication of the status of the remainder of the battery cells. One hour provides time to inspect the electrolyte level and to confirm the float voltage of the pilot cells. One hour is considered a reasonable amount of time to perform the required verification.~~

~~Verification that the Category C limits are met (Required Action A.2) provides assurance that during the time needed to restore the parameters to the Category A and B limits, the battery is still capable of performing its intended function. A period of 24 hours is allowed to complete the initial verification because specific gravity measurements must be obtained for each connected cell. Taking into consideration both the time required to perform the required verification and the assurance that the battery cell~~

(continued)

BASES

ACTIONS

~~A.1, A.2, and A.3 (continued)~~

~~parameters are not severely degraded, this time is considered reasonable. The verification is repeated at 7 day intervals until the parameters are restored to Category A and B limits. This periodic verification is consistent with the normal Frequency of pilot cell surveillances.~~

~~Continued operation is only permitted for 31 days before battery cell parameters must be restored to within Category A and B limits. With the consideration that, while battery capacity is degraded, sufficient capacity exists to perform the intended function and to allow time to fully restore the battery cell parameters to normal limits, this time is acceptable prior to declaring the battery inoperable.~~

A.1, A.2, and A.3

With one or more cells in one or more batteries in one vital DC subsystem < 2.07 V, the battery cell is degraded. Within 2 hours verification of the required battery charger OPERABILITY is made by monitoring the battery terminal voltage (SR 3.8.4.1) and of the overall battery state of charge by monitoring the battery float charge current (SR 3.8.6.1). This assures that there is still sufficient battery capacity to perform the intended function. Therefore, the affected battery is not required to be considered inoperable solely as a result of one or more cells in one or more batteries < 2.07 V, and continued operation is permitted for a limited period up to 24 hours.

Since the Required Actions only specify "perform," a failure of SR 3.8.4.1 or SR 3.8.6.1 acceptance criteria does not result in this Required Action not met. However, if one of the SRs is failed the appropriate Condition(s), depending on the cause of the failures, is entered. If SR 3.8.6.1 is failed then there is not assurance that there is still sufficient battery capacity to perform the intended function and the battery must be declared inoperable immediately.

B.1 and B.2

One or more batteries in one vital DC subsystem with float current > 2 amps indicates that a partial discharge of the battery capacity has occurred. This may be due to a temporary loss of a battery charger or possibly due to one or more battery cells in a low voltage condition reflecting some loss of capacity. Within 2 hours verification of the required battery charger OPERABILITY is made by monitoring the battery terminal voltage. If the terminal voltage is found to be less than the minimum established float voltage there are two possibilities, the battery charger is inoperable or is operating in the current limit mode. Condition A addresses charger inoperability. If the charger is operating in the current limit mode after 2 hours that is an indication that the battery has been substantially discharged and likely cannot perform its required design functions. The time to return the battery to its fully charged condition in this case is a function of the

(continued)

BASES

ACTIONS

B.1 and B.2 (continued)

battery charger capacity, the amount of loads on the associated DC system, the amount of the previous discharge, and the recharge characteristic of the battery. The charge time can be extensive, and there is not adequate assurance that it can be recharged within 12 hours (Required Action B.2). The battery must therefore be declared inoperable.

If the float voltage is found to be satisfactory but there are one or more battery cells with float voltage less than 2.07 V, the associated "OR" statement in Condition H is applicable and the battery must be declared inoperable immediately. If float voltage is satisfactory and there are no cells less than 2.07 V there is good assurance that, within 12 hours, the battery will be restored to its fully charged condition (Required Action B.2) from any discharge that might have occurred due to a temporary loss of the battery charger.

A discharged battery with float voltage (the charger setpoint) across its terminals indicates that the battery is on the exponential charging current portion (the second part) of its recharge cycle. The time to return a battery to its fully charged state under this condition is simply a function of the amount of the previous discharge and the recharge characteristic of the battery. Thus there is good assurance of fully recharging the battery within 12 hours, avoiding a premature shutdown with its own attendant risk.

If the condition is due to one or more cells in a low voltage condition but still greater than 2.07 V and float voltage is found to be satisfactory, this is not indication of a substantially discharged battery and 12 hours is a reasonable time prior to declaring the battery inoperable.

Since Required Action B.1 only specifies "perform," a failure of SR 3.8.4.1 acceptance criteria does not result in the Required Action not met. However, if SR 3.8.4.1 is failed, the appropriate Condition(s), depending on the cause of the failure, is entered.

C.1, C.2, and C.3

With one or more cells in one or more batteries in one DG DC subsystem < 2.07 V, the battery cell is degraded. Within 2 hours verification of the required battery charger OPERABILITY is made by monitoring the battery terminal voltage (SR 3.8.4.2) and of the overall battery state of charge by monitoring the battery float charge current (SR 3.8.6.2). This assures that there is still sufficient battery capacity to perform the intended function.

Therefore, the affected battery is not required to be considered inoperable solely as a result of one or more cells in one or more batteries < 2.07 V, and continued operation is permitted for a limited period up to 24 hours.

(continued)

BASES

ACTIONS

C.1, C.2, and C.3 (continued)

Since the Required Actions only specify "perform," a failure of SR 3.8.4.2 or SR 3.8.6.2 acceptance criteria does not result in this Required Action not met. However, if one of the SRs is failed the appropriate Condition(s), depending on the cause of the failures, is entered. If SR 3.8.6.2 is failed then there is not assurance that there is still sufficient battery capacity to perform the intended function and the battery must be declared inoperable immediately.

D.1 and D.2

One or more batteries in one DG DC subsystem with float current > 1 amps indicates that a partial discharge of the battery capacity has occurred. This may be due to a temporary loss of a battery charger or possibly due to one or more battery cells in a low voltage condition reflecting some loss of capacity. Within 2 hours verification of the required battery charger OPERABILITY is made by monitoring the battery terminal voltage. If the terminal voltage is found to be less than the minimum established float voltage there are two possibilities, the battery charger is inoperable or is operating in the current limit mode. Condition B addresses charger inoperability. If the charger is operating in the current limit mode after 2 hours that is an indication that the battery has been substantially discharged and likely cannot perform its required design functions. The time to return the battery to its fully charged condition in this case is a function of the battery charger capacity, the amount of loads on the associated DC system, the amount of the previous discharge, and the recharge characteristic of the battery. The charge time can be extensive, and there is not adequate assurance that it can be recharged within 12 hours (Required Action D.2). The battery must therefore be declared inoperable.

If the float voltage is found to be satisfactory but there are one or more battery cells with float voltage less than 2.07 V, the associated "OR" statement in Condition H is applicable and the battery must be declared inoperable immediately. If float voltage is satisfactory and there are no cells less than 2.07 V there is good assurance that, within 12 hours, the battery will be restored to its fully charged condition (Required Action D.2) from any discharge that might have occurred due to a temporary loss of the battery charger.

A discharged battery with float voltage (the charger setpoint) across its terminals indicates that the battery is on the exponential charging current portion (the second part) of its recharge cycle. The time to return a battery to its fully charged state under this condition is simply a function of the amount of the previous discharge and the recharge characteristic of the battery. Thus there is good assurance of fully recharging the battery within 12 hours, avoiding a premature shutdown with its own attendant risk.

If the condition is due to one or more cells in a low voltage condition but still greater than 2.07 V and float voltage is found to be satisfactory, this is not

(continued)

BASES

ACTIONS

D.1 and D.2 (continued)

indication of a substantially discharged battery and 12 hours is a reasonable time prior to declaring the battery inoperable.

Since Required Action D.1 only specifies "perform," a failure of SR 3.8.4.2 acceptance criteria does not result in the Required Action not met. However, if SR 3.8.4.2 is failed, the appropriate Condition(s), depending on the cause of the failure, is entered.

E.1, E.2, and E.3

With one or more required batteries in one vital DC subsystem or one DG battery with one or more cells electrolyte level above the top of the plates, but below the minimum established design limits, the battery still retains sufficient capacity to perform the intended function. Therefore, the affected battery is not required to be considered inoperable solely as a result of electrolyte level not met. Within 31 days the minimum established design limits for electrolyte level must be re-established.

With electrolyte level below the top of the plates there is a potential for dryout and plate degradation. Required Actions E.1 and E.2 address this potential (as well as provisions in Specification 5.7.2.22, Battery Monitoring and Maintenance Program). They are modified by a Note that indicates they are only applicable if electrolyte level is below the top of the plates. Within 8 hours level is required to be restored to above the top of the plates. The Required Action E.2 requirement to verify that there is no leakage by visual inspection and the Specification 5.7.2.22.b item to initiate action to equalize and test in accordance with manufacturer's recommendation. They are performed following the restoration of the electrolyte level to above the top of the plates. Based on the results of the manufacturer's recommended testing the battery(ies) may have to be declared inoperable and the affected cell(s) replaced.

F.1

With one or more batteries in one vital DC subsystem or one DG battery with pilot cell temperature less than the minimum established design limits, 12 hours is allowed to restore the temperature to within limits. A low electrolyte temperature limits the current and power available. Since the battery is sized with margin, while battery capacity is degraded, sufficient capacity exists to perform the intended function and the affected battery is not required to be considered inoperable solely as a result of the pilot cell temperature not met.

(continued)

BASES

ACTIONS (continued)

G.1

With one or more batteries in redundant vital DC subsystems with battery parameters not within limits there is not sufficient assurance that battery capacity has not been affected to the degree that the batteries can still perform their required function, given that redundant batteries are involved. With redundant batteries involved this potential could result in a total loss of function on multiple systems that rely upon the batteries. With more than one DG battery with battery parameters not within limits there is not sufficient assurance that battery capacity has not been affected to the degree that the batteries can still perform their required function.

The longer Completion Times specified for battery parameters on non-redundant batteries not within limits are therefore not appropriate, and the parameters must be restored to within limits on at least one subsystem within 2 hours.

~~B~~H.1

With one or more batteries with ~~one or more~~ any battery ~~cell~~ parameter~~s~~ outside the ~~Category C limits for any connected cell,~~ allowances of the Required Actions for Condition A, B, C, D, E, F, or G, sufficient capacity to supply the maximum expected load requirement is not assured and the corresponding ~~vital DC or DG DC electrical power subsystem~~ battery must be declared inoperable. Additionally, ~~other potentially extreme conditions, such as not completing the Required Actions of Condition A within the required Completion Time or average electrolyte temperature of representative cells falling below 60°F for the vital batteries or 50°F for DG batteries, are also cause for immediately declaring the associated vital DC or DG DC electrical power subsystem inoperable.~~ discovering one or more vital DC batteries in one subsystem with one or more battery cells float voltage less than 2.07 V and float current greater than 2 amps, or one DG battery cells float voltage greater than or equal to 2.07 V and float current greater than 1 amp, indicates that the battery capacity may not be sufficient to perform the intended functions. The battery must therefore be declared inoperable immediately.

~~SURVEILLANCE REQUIREMENTS~~

~~SR 3.8.6.1~~

~~This SR verifies that Category A battery cell parameters are consistent with IEEE-450 (Ref. 2), which recommends regular battery inspections (at least one per month) including voltage, specific gravity, and electrolyte temperature of pilot cells.~~

(continued)

BASES

SURVEILLANCE REQUIREMENTS (continued)

SR 3.8.6.2

The quarterly inspection of specific gravity and voltage is consistent with IEEE-450 (Ref. 2). In addition, within 24 hours of a battery discharge < 110 V (113.5V for Vital Battery V or 106.5 for DG batteries) or a battery overcharge > 150 V (155 V for Vital Battery V or 145 V for DG batteries), the battery must be demonstrated to meet Category B limits. Transients, such as motor starting transients, which may momentarily cause battery voltage to drop to ≤ 110 V (113.5 V for Vital Battery V or 106.5 V for DG batteries), do not constitute a battery discharge provided the battery terminal voltage and float current return to pre-transient values. This inspection is also consistent with IEEE-450 (Ref. 2), which recommends special inspections following a severe discharge or overcharge, to ensure that no significant degradation of the battery occurs as a consequence of such discharge or overcharge.

SR 3.8.6.3

This Surveillance verification that the average temperature of representative cells is ≥ 60°F for the vital batteries and ≥ 50°F for the DG batteries, is consistent with a recommendation of IEEE-450 (Ref. 2), that states that the temperature of electrolytes in representative cells should be determined on a quarterly basis.

Lower than normal temperatures act to inhibit or reduce battery capacity. This SR ensures that the operating temperatures remain within an acceptable operating range. This limit is based on manufacturer recommendations.

Table 3.8.6-1

This table delineates the limits on electrolyte level, float voltage, and specific gravity for three different categories. The meaning of each category is discussed below.

(continued)

BASES

SURVEILLANCE REQUIREMENTS

Table 3.8.6-1 (continued)

Category A defines the normal parameter limit for each designated pilot cell in each battery. The cells selected as pilot cells are those whose temperature, voltage, and electrolyte specific gravity approximate the state of charge of the entire battery.

The Category A limits specified for electrolyte level are based on manufacturer recommendations and are consistent with the guidance in IEEE-450 (Ref. 2), with the extra ¼ inch allowance above the high water level indication for operating margin to account for temperatures and charge effects. In addition to this allowance, footnote a to Table 3.8.6-1 permits the electrolyte level to be above the specified maximum level during equalizing charge, provided it is not overflowing. These limits ensure that the plates suffer no physical damage, and that adequate electron transfer capability is maintained in the event of transient conditions. IEEE-450 (Ref. 2) recommends that electrolyte level readings should be made only after the battery has been at float charge for at least 72 hours.

The Category A limit specified for float voltage is ≥ 2.13 V per cell. This value is based on the recommendations of IEEE-450 (Ref. 2), which states that prolonged operation of cells < 2.13 V can reduce the life expectancy of cells.

The Category A limit specified for specific gravity for each pilot cell is ≥ 1.200 (0.015 below the manufacturer fully charged nominal specific gravity or a battery charging current that had stabilized at a low value). This value is characteristic of a charged cell with adequate capacity. According to IEEE-450 (Ref. 2), the specific gravity readings are based on a temperature of 77°F (25°C).

The specific gravity readings are corrected for actual electrolyte temperature and level. For each 3°F (1.67°C) above 77°F (25°C), 1 point (0.001) is added to the reading; 1 point is subtracted for each 3°F below 77°F. The specific gravity of the electrolyte in a cell increases with a loss of water due to electrolysis or evaporation.

(continued)

BASES

SURVEILLANCE REQUIREMENTS

Table 3.8.6-1 (continued)

Category B defines the normal parameter limits for each connected cell. The term "connected cell" excludes any battery cell that may be jumpered out.

The Category B limits specified for electrolyte level and float voltage are the same as those specified for Category A and have been discussed above. The Category B limit specified for specific gravity for each connected cell is ≥ 1.195 (0.020 below the manufacturer fully charged, nominal specific gravity) with the average of all connected cells > 1.205 (0.010 below the manufacturer fully charged, nominal specific gravity). These values are based on manufacturer's recommendations. The minimum specific gravity value required for each cell ensures that the effects of a highly charged or newly installed cell will not mask overall degradation of the battery.

Category C defines the limits for each connected cell. These values, although reduced, provide assurance that sufficient capacity exists to perform the intended function and maintain a margin of safety. When any battery parameter is outside the Category C limits, the assurance of sufficient capacity described above no longer exists, and the battery must be declared inoperable.

The Category C limits specified for electrolyte level (above the top of the plates and not overflowing) ensure that the plates suffer no physical damage and maintain adequate electron transfer capability. The Category C limits for float voltage is based on IEEE-450 (Ref. 2), which states that a cell voltage of 2.07 V or below, under float conditions and not caused by elevated temperature of the cell, indicates internal cell problems and may require cell replacement.

The Category C limits of average specific gravity ≥ 1.195 is based on manufacturer recommendations (0.020 below the manufacturer recommended

(continued)

BASES

SURVEILLANCE REQUIREMENTS

~~Table 3.8.6-1 (continued)~~

~~fully charged, nominal specific gravity). In addition to that limit, it is required that the specific gravity for each connected cell must be no less than 0.020 below the average of all connected cells. This limit ensures that the effect of a highly charged or new cell does not mask overall degradation of the battery.~~

~~The footnotes to Table 3.8.6-1 are applicable to Category A, B, and C specific gravity. Footnote b to Table 3.8.6-1 requires the above mentioned correction for electrolyte level and temperature, with the exception that level correction is not required when battery charging current is < 2 amps on float charge for vital batteries and < 1.0 amps for DG batteries. This current provides, in general, an indication of overall battery condition.~~

~~Because of specific gravity gradients that are produced during the recharging process, delays of several days may occur while waiting for the specific gravity to stabilize. A stabilized charger current is an acceptable alternative to specific gravity measurement for determining the state of charge. This phenomenon is discussed in IEEE-450 (Ref. 2). Footnote c to Table 3.8.6-1 allows the float charge current to be used as an alternate to specific gravity for up to 31 days following a battery recharge. Within 31 days each connected cell's specific gravity must be measured to confirm the state of charge. Following a minor battery recharge (such as equalizing charge that does not follow a deep discharge) specific gravity gradients are not significant, and confirming measurements may be made in less than 31 days.~~

SR 3.8.6.1 and SR 3.8.6.2

Verifying battery float current while on float charge is used to determine the state of charge of the battery. Float charge is the condition in which the charger is supplying the continuous charge required to overcome the internal losses of a battery and maintain the battery in a charged state. The equipment used to monitor float current must have the necessary accuracy and capability to measure electrical currents in the expected range. The float current requirements are based on the float current indicative of a charged battery. The 7 day Frequency is consistent with IEEE-450 (Ref. 2).

SR 3.8.6.1 is modified by a Note that states the float current requirement is not required to be met when battery terminal voltage is less than the minimum established float voltage of SR 3.8.4.1. When this float voltage is not maintained the Required Actions of LCO 3.8.4 ACTION A are being taken, which provide the necessary and appropriate verifications of the battery condition. Furthermore, the float current limit of 2 amps is established based on the nominal float voltage value and is not directly applicable when this voltage is not maintained.

SR 3.8.6.2 is modified by a Note that states the float current requirement is not required to be met when battery terminal voltage is less than the minimum established float voltage of SR 3.8.4.2. When this float voltage is not maintained

(continued)

BASES

SURVEILLANCE REQUIREMENTS

SR 3.8.6.1 and SR 3.8.6.2 (continued)

the Required Actions of LCO 3.8.4 ACTION D are being taken, which provide the necessary and appropriate verifications of the battery condition. Furthermore, the float current limit of 1 amp is established based on the nominal float voltage value and is not directly applicable when this voltage is not maintained.

SR 3.8.6.3 and SR 3.8.6.6

Optimal long term battery performance is obtained by maintaining a float voltage greater than or equal to the minimum established design limits provided by the battery manufacturer, which corresponds to 132 V at the battery terminals, or 2.20 Vpc. This provides adequate overpotential, which limits the formation of lead sulfate and self discharge, which could eventually render the battery inoperable. Float voltages in this range or less, but greater than 2.07 Vpc, are addressed in Specification 5.7.2.22. SRs 3.8.6.3 and 3.8.6.6 require verification that the cell float voltages are equal to or greater than the short term absolute minimum voltage of 2.07 V. The Frequency for cell voltage verification every 31 days for pilot cell and 92 days for each connected cell is consistent with IEEE-450 (Ref. 2).

SR 3.8.6.4

The limit specified for electrolyte level ensures that the plates suffer no physical damage and maintains adequate electron transfer capability. The minimum design electrolyte level is the minimum level indication mark on the battery cell jar. The Frequency is consistent with IEEE-450 (Ref. 2).

SR 3.8.6.5

This Surveillance verifies that the pilot cell temperature is greater than or equal to the minimum established design limit (i.e., 60°F for the vital batteries and 50°F for the DG batteries). Pilot cell electrolyte temperature is maintained above this temperature to assure the battery can provide the required current and voltage to meet the design requirements. Temperatures lower than assumed in battery sizing calculations act to inhibit or reduce battery capacity. The Frequency is consistent with IEEE-450 (Ref. 2).

SR 3.8.6.7

A battery performance discharge test is a test of constant current capacity of a battery, normally done in the as found condition, after having been in service, to detect any change in the capacity determined by the acceptance test. The test is intended to determine overall battery degradation due to age and usage.

Either the battery performance discharge test or the modified performance discharge test is acceptable for satisfying SR 3.8.6.7; however, only the modified

(continued)

BASES

SURVEILLANCE REQUIREMENTS

SR 3.8.6.7 (continued)

performance discharge test may be used to satisfy the battery service test requirements of SR 3.8.4.7.

A modified discharge test is a test of the battery capacity and its ability to provide a high rate, short duration load (usually the highest rate of the duty cycle). This will often confirm the battery's ability to meet the critical period of the load duty cycle, in addition to determining its percentage of rated capacity. Initial conditions for the modified performance discharge test should be identical to those specified for a service test.

It may consist of just two rates; for instance the one minute rate for the battery or the largest current load of the duty cycle, followed by the test rate employed for the performance test, both of which envelope the duty cycle of the service test. Since the ampere-hours removed by a one minute discharge represents a very small portion of the battery capacity, the test rate can be changed to that for the performance test without compromising the results of the performance discharge test. The battery terminal voltage for the modified performance discharge test must remain above the minimum battery terminal voltage specified in the battery service test for the duration of time equal to that of the service test.

The acceptance criteria for this Surveillance are consistent with IEEE-450 (Ref. 2) and IEEE-485 (Ref. 4). These references recommend that the battery be replaced if its capacity is below 80% of the manufacturer's rating. A capacity of 80% shows that the battery rate of deterioration is increasing, even if there is ample capacity to meet the load requirements. Furthermore, the battery is sized to meet the assumed duty cycle loads when the battery design capacity reaches this 80% limit.

The Surveillance Frequency for this test is normally 60 months. If the battery shows degradation, or if the battery has reached 85% of its expected life and capacity is < 100% of the manufacturer's rating, the Surveillance Frequency is reduced to 12 months. However, if the battery shows no degradation but has reached 85% of its expected life, the Surveillance Frequency is only reduced to 24 months for batteries that retain capacity ≥ 100% of the manufacturer's ratings. Degradation is indicated, according to IEEE-450 (Ref. 2), when the battery capacity drops by more than 10% relative to its capacity on the previous performance test or when it is ≥ 10% below the manufacturer's rating. These Frequencies are consistent with the recommendations in IEEE-450 (Ref. 2).

This SR is modified by a Note. The reason for the Note is that performing the Surveillance would perturb the electrical distribution system and challenge safety systems. Credit may be taken for unplanned events that satisfy this SR.

(continued)

BASES

REFERENCES

1. Watts Bar FSAR, Section 15, "Accident Analysis," and Section 6, "Engineered Safety Features."

2. IEEE-450 ~~1980/1995~~2002, "IEEE Recommended Practice for Maintenance, Testing, and Replacement of ~~Large~~ Vented Lead~~-Acid Storage~~ Batteries for ~~Generating Stations and Substations~~Stationary Applications."

3. Watts Bar FSAR, Section 8, "Electric Power."

4. IEEE-485-1983, "IEEE Recommended Practice for Sizing Large Lead Storage Batteries for Generating Stations and Substations."

WBN Unit 2 Markups of Technical Specification and Bases

3.8 ELECTRICAL POWER SYSTEMS

3.8.4 DC Sources - Operating

LCO 3.8.4 ~~Four channels of~~ The Train A and Train B vital DC electrical power subsystems and four Diesel Generator (DG) DC electrical power subsystems shall be OPERABLE.

----------NOTE----------
Vital Battery V may be substituted for any of the required vital batteries.

APPLICABILITY: MODES 1, 2, 3, and 4.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One or two required vital battery charger(s) on one subsystem inoperable.	A.1 Restore battery terminal voltage to greater than or equal to the minimum established float voltage. AND A.2 Verify battery float current ≤ 2 amps. AND A.3 Restore vital battery charger(s) to OPERABLE status.	2 hours Once per 12 hours 7 days
~~A~~B. One vital DC electrical power subsystem inoperable for reasons other than Condition A.	~~A~~B.1 Restore vital DC electrical power subsystem to OPERABLE status.	2 hours

(continued)

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
~~B~~C. Required Action and Associated Completion Time of Condition A or B not met.	~~B~~C.1 Be in MODE 3. AND ~~B~~C.2 Be in MODE 5.	6 hours 36 hours
D. One DG DC battery charger inoperable.	D.1 Restore DG battery terminal voltage to greater than or equal to the minimum established float voltage. AND D.2 Verify battery float current ≤ 1 amp. AND D.3 Restore DG battery charger to OPERABLE status.	2 hours Once per 12 hours 72 hours
~~C~~E. One DG DC electrical power subsystem inoperable for reasons other than Condition D.	~~C~~E.1 Restore DG DC electrical power subsystem to OPERABLE status.	2 hours
~~D~~F. Required Action and associated Completion Time of Condition ~~C~~D or E not met.	~~D~~F.1 Declare associated DG inoperable.	Immediately

SURVEILLANCE REQUIREMENTS

	SURVEILLANCE	FREQUENCY
SR 3.8.4.1	Verify vital battery terminal voltage is ~~≥ 128 V (132 V for vital battery V) on float charge~~ greater than or equal to the minimum established float voltage.	7 days
SR 3.8.4.2	Verify DG battery terminal voltage is ~~≥ 124 V on float charge~~ greater than or equal to the minimum established float voltage.	7 days
SR 3.8.4.3	Verify for the vital batteries that the alternate feeder breakers to each required battery charger are open.	7 days
SR 3.8.4.4	Verify correct breaker alignment and indicated power availability for each DG 125 V DC distribution panel and associated battery charger	7 days
~~SR 3.8.4.5~~	~~Verify no visible corrosion at terminals and connectors for the vital batteries.~~ ~~OR~~ ~~Verify connection resistance for the vital batteries is ≤ 80 E-6 ohm for inter-cell connections, ≤ 50 E-6 ohm for inter-rack connections, ≤ 120 E-6 ohm for inter-tier connections, and ≤ 50 E-6 ohm for terminal connections.~~	~~92 days~~
~~SR 3.8.4.6~~	~~Verify no visible corrosion at terminals and connectors for the DG batteries.~~ ~~OR~~ ~~Verify connection resistance for the DG batteries is ≤ 80 E-6 ohm for inter-cell connections, ≤ 50 E-6 ohm for inter-tier connections, and ≤ 50 E-6 ohm for terminal connections.~~	~~92 days~~
~~SR 3.8.4.7~~	~~Verify battery cells, cell plates, and racks show no visual indication of physical damage or abnormal deterioration.~~	~~12 months~~

(continued)

SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE		FREQUENCY
~~SR 3.8.4.8~~	~~Remove visible terminal corrosion and verify battery cell to cell and terminal connections are coated with anti-corrosion material.~~	~~12 months~~
~~SR 3.8.4.9~~	~~Verify connection resistance for the vital batteries is ≤ 80 E-6 ohm for inter-cell connections, ≤ 50 E-6 ohm for inter-rack connections, ≤ 120 E-6 ohm for inter-tier connections, and ≤ 50 E-6 ohm for terminal connections.~~	~~12 months~~
~~SR 3.8.4.10~~	~~Verify connection resistance for the DG batteries is ≤ 80 E-6 ohm for inter-cell connections, ≤ 50 E-6 ohm for inter-tier connections, and ≤ 50 E-6 ohm for terminal connections.~~	~~12 months~~
SR 3.8.4.~~11~~5	~~NOTE This Surveillance is normally not performed in MODE 1, 2, 3, or 4. However, credit may be taken for unplanned events that satisfy this SR.~~ Verify each vital battery charger ~~is capable of recharging its associated battery from a service or capacity discharge test while supplying normal loads~~ supplies ≥ 200 amps at greater than or equal to the minimum established float voltage for ≥ 4 hours. OR Verify each vital battery charger can recharge the battery to the fully charged state within 36 hours while supplying the largest combined demands of the various continuous steady state loads, after a battery discharge to the bounding design basis event discharge state ~~is capable of operating for ≥ 4 hours at current limit 220 – 250 amps~~.	18 months

(continued)

SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE		FREQUENCY
SR 3.8.4.~~12~~6	----------NOTE---------- Credit may be taken for unplanned events that satisfy this SR. ---------- Verify each ~~diesel generator~~ DG battery charger ~~is capable of recharging its associated battery from a service or capacity discharge test while supplying normal loads~~ supplies ≥ 20 amps at greater than or equal to the minimum established float voltage for ≥ 4 hours. OR Verify each DG battery charger can recharge the battery to the fully charged state within 24 hours while supplying the largest combined demands of the various continuous steady state loads, after a battery discharge to the bounding design basis event discharge state.	18 months
SR 3.8.4.~~13~~7	----------NOTES---------- 1. The modified performance discharge test in SR 3.8.~~4.14~~6.7 may be performed in lieu of the service test in SR 3.8.4.~~13~~7 ~~once per 60 months~~. 2. This Surveillance is not performed in MODE 1, 2, 3, or 4 for required vital batteries. Credit may be taken for unplanned events that satisfy this SR. ---------- Verify battery capacity is adequate to supply, and maintain in OPERABLE status, the required emergency loads and any connected nonsafety loads for the design duty cycle when subjected to a battery service test.	18 months

(continued)

SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE		FREQUENCY
~~SR 3.8.4.14~~	~~NOTE~~ ~~This Surveillance is not performed in MODE 1, 2, 3, or 4 for required vital batteries. Credit may be taken for unplanned events that satisfy this SR.~~ ~~Verify battery capacity is ≥ 80% of the manufacturer's rating when subjected to a performance discharge test or a modified performance discharge test.~~	~~60 months~~ ~~AND~~ ~~12 months when battery shows degradation or has reached 85% of expected life with capacity < 100% of manufacturer's rating~~ ~~AND~~ ~~24 months when battery has reached 85% of the expected life with capacity ≥ 100% of manufacturer's rating~~

3.8 ELECTRICAL POWER SYSTEMS

3.8.5 DC Sources - Shutdown

LCO 3.8.5 Vital DC and Diesel Generator (DG) DC electrical power subsystems shall be OPERABLE to support the DC electrical power distribution subsystem(s) required by LCO 3.8.10, "Distribution Systems - Shutdown" and to support the Diesel Generators (DGs) required by LCO 3.8.2, "AC Sources - Shutdown."

----------NOTES----------
Vital Battery V may be substituted for any of the required vital batteries.

APPLICABILITY: MODES 5 and 6,
During movement of irradiated fuel assemblies.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One or two required vital battery charger(s) on one subsystem inoperable. AND The redundant subsystem vital battery and charger(s) OPERABLE.	A.1 Restore battery terminal voltage to greater than or equal to the minimum established float voltage. AND A.2 Verify battery float current ≤ 2 amps. AND A.3 Restore battery charger(s) to OPERABLE status.	2 hours Once per 12 hours 7 days

(continued)

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
~~A~~B. One or more required vital DC electrical power subsystems inoperable for reasons other than Condition A. OR Required Actions and associated Completion Time of Condition A not met.	~~A~~B.1.1 Declare affected required feature(s) inoperable. OR ~~A~~B.2.1 Suspend CORE ALTERATIONS. AND ~~A~~B.2.2 Suspend movement of irradiated fuel assemblies. AND ~~A~~B.2.3 Initiate action to suspend operations involving positive reactivity additions. AND ~~A~~B.2.4 Initiate action to restore required DC electrical power subsystems to OPERABLE status.	Immediately Immediately Immediately Immediately Immediately
~~B~~C. One required DG DC electrical power subsystem inoperable.	~~B~~C.1 Declare associated DG inoperable.	Immediately

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.8.5.1	----------NOTE---------- The following SRs are not required to be performed: SR 3.8.4.~~11~~5, SR 3.8.4.~~12~~6, and SR 3.8.4.~~13~~7~~, and SR 3.8.4.14~~. ----------	
	For DC sources required to be OPERABLE, the following SRs are applicable: SR 3.8.4.1 SR 3.8.4.6 ~~SR 3.8.4.11~~ SR 3.8.4.2 SR 3.8.4.7 ~~SR 3.8.4.12~~ SR 3.8.4.3 ~~SR 3.8.4.8~~ ~~SR 3.8.4.13~~ SR 3.8.4.4 ~~SR 3.8.4.9~~ ~~SR 3.8.4.14~~ SR 3.8.4.5 ~~SR 3.8.4.10~~	In accordance with applicable SRs

3.8 ELECTRICAL POWER SYSTEMS

3.8.6 Battery ~~Cell~~ Parameters

LCO 3.8.6 Battery ~~cell~~ parameters for Train A and Train B electrical power subsystem 125 V vital batteries and 125 V diesel generator (DG) batteries shall be within ~~the~~ limits ~~of Table 3.8.6-1~~.

APPLICABILITY: When associated DC electrical power subsystems and DGs are required to be OPERABLE.

ACTIONS

----------NOTE----------
Separate Condition entry is allowed for each battery bank.

ACTIONS

CONDITION	REQUIRED ACTION		COMPLETION TIME
~~A. One or more batteries with one or more battery cell parameters not within Category A or B limits.~~	~~A.1~~	~~Verify pilot cells electrolyte level and float voltage meet Table 3.8.6-1 Category C limits.~~	~~1 hour~~
	~~AND~~		
	~~A.2~~	~~Verify battery cell parameters meet Table 3.8.6-1 Category C limits.~~	~~24 hours~~ ~~AND~~ ~~Once per 7 days thereafter~~
	~~AND~~		
	~~A.3~~	~~Restore battery cell parameters to category A and B limits of Table 3.8.6-1.~~	~~31 days~~

~~(continued)~~

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One or two required vital battery(ies) on one subsystem with one or more battery cells float voltage < 2.07 V.	A.1 Perform SR 3.8.4.1. AND A.2 Perform SR 3.8.6.1. AND A.3 Restore affected cell voltage ≥ 2.07 V.	2 hours 2 hours 24 hours
B. One or two required vital battery(ies) on one subsystem with float current > 2 amps.	B.1 Perform SR 3.8.4.1. AND B.2 Restore vital battery float current to ≤ 2 amps.	2 hours 12 hours
C. One DG battery with one or more battery cells float voltage < 2.07 V.	C.1 Perform SR 3.8.4.2. AND C.2 Perform SR 3.8.6.2. AND C.3 Restore affected cell voltage ≥ 2.07 V.	2 hours 2 hours 24 hours
D. One DG battery with float current > 1 amp.	D.1 Perform SR 3.8.4.2. AND D.2 Restore vital battery float current to ≤ 1 amp.	2 hours 12 hours

(continued)

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
----------NOTE---------- Required Action E.2 shall be completed if electrolyte level was below the top of plates. ----------	----------NOTE---------- Required Actions E.1 and E.2 are only applicable if electrolyte level was below the top of plates. ----------	
E. One or two required vital battery(ies) on one subsystem with one or more cells electrolyte level less than minimum established design limits. OR One DG battery with one or more cells electrolyte level less than minimum established design limits.	E.1 Restore electrolyte level to above top of plates. AND E.2 Verify no evidence of leakage. AND E.3 Restore electrolyte level to greater than or equal to minimum established design limits.	8 hours 12 hours 31 days
F. One or two required vital battery(ies) on one subsystem with pilot cell electrolyte temperature less than minimum established design limits. OR One DG battery with pilot cell electrolyte temperature less than minimum established design limits.	F.1 Restore battery pilot cell temperature to greater than or equal to minimum established design limits.	12 hours

(continued)

(ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
G. One or more batteries in redundant subsystems with battery parameters not within limits. OR More than one DG battery with battery parameters not within limits.	G.1 Restore battery parameters to within limits.	2 hours
~~B~~H. Required Action and associated Completion Time of Condition A, B, C, D, E, F, or G not met. OR One or two required vital battery(ies) on one subsystem with one or more battery cells float voltage < 2.07 V and float current > 2 amps. OR One DG battery with one or more battery cells float voltage < 2.07 V and float current > 1 amp. ~~One or more batteries with average electrolyte temperature of the representative cells < 60°F for vital batteries and < 50°F for DG batteries.~~ ~~OR~~ ~~One or more batteries with one or more battery cell parameters not within Category C values.~~	~~B~~H.1 Declare associated battery inoperable.	Immediately

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
~~SR 3.8.6.1~~	~~Verify battery cell parameters meet Table 3.8.6-1 Category A limits.~~	~~7 days~~
~~SR 3.8.6.2~~	~~Verify battery cell parameters meet Table 3.8.6-1 Category B limits.~~	~~92 days~~ ~~AND~~ ~~Once within 24 hours after a battery discharge < 110 V for vital batteries (113.5 V for vital battery V) or 106.5 V for DG batteries~~ ~~AND~~ ~~Once within 24 hours after a battery overcharge > 150 V for vital batteries (155 V for vital battery V) or 145 V for DG batteries~~
~~SR 3.8.6.3~~	~~Verify average electrolyte temperature of representative cells is ≥ 60°F for vital batteries and ≥ 50°F for the DG batteries.~~	~~92 days~~

Insert Surveillance Requirements from next page.

Insert the following Surveillance Requirements for LCO 3.8.6:

SURVEILLANCE		FREQUENCY
SR 3.8.6.1	----------NOTE---------- Not required to be met when vital battery terminal voltage is less than the minimum established float voltage of SR 3.8.4.1. ---------- Verify each vital battery float current is ≤ 2 amps.	7 days
SR 3.8.6.2	----------NOTE---------- Not required to be met when DG battery terminal voltage is less than the minimum established float voltage of SR 3.8.4.2. ---------- Verify each DG battery float current is ≤ 1 amp.	7 days
SR 3.8.6.3	Verify each required vital battery and each DG battery pilot cell float voltage is ≥ 2.07 V.	31 days
SR 3.8.6.4	Verify each required vital battery and each DG battery connected cell electrolyte level is greater than or equal to minimum established design limits.	31 days
SR 3.8.6.5	Verify each required vital battery and each DG battery pilot cell temperature is greater than or equal to minimum established design limits.	31 days
SR 3.8.6.6	Verify each required vital battery and each DG battery connected cell float voltage is ≥ 2.07 V.	92 days

SURVEILLANCE		FREQUENCY
SR 3.8.6.7	----------NOTES---------- This Surveillance is not performed in MODE 1, 2, 3, or 4 for required vital batteries. Credit may be taken for unplanned events that satisfy this SR. ---------- Verify battery capacity is ≥ 80% of the manufacturer's rating when subjected to a performance discharge test or a modified performance discharge test.	60 months AND 12 months when battery shows degradation or has reached 85% of expected life with capacity < 100% of manufacturer's rating AND 24 months when battery has reached 85% of the expected life with capacity ≥ 100% of manufacturer's rating

Table 3.8.6-1 (page 1 of 1)
Battery Cell Parameters Requirements

PARAMETER	CATEGORY A: LIMITS FOR EACH DESIGNATED PILOT CELL	CATEGORY B: LIMITS FOR EACH CONNECTED CELL	CATEGORY C: ALLOWABLE LIMIT FOR EACH CONNECTED CELL
Electrolyte Level	> Minimum level indication mark, and ≤ 1/4 inch above maximum level indication mark (a)	> Minimum level indication mark, and ≤ 1/4 inch above maximum level indication mark (a)	Above top of plates, and not overflowing
Float Voltage	≥ 2.13 V	≥ 2.13 V	> 2.07 V
Specific Gravity (b)(c)	≥ 1.200	≥ 1.195 AND Average of all connected cells > 1.205	Not more than 0.020 below average of all connected cells AND Average of all connected cells ≥ 1.195

(a) It is acceptable for the electrolyte level to temporarily increase above the specified maximum level during equalizing charges provided it is not overflowing.

(b) Corrected for electrolyte temperature and level. Level correction is not required, however, when battery charging is < 2 amps when on float charge for vital batteries and < 1.0 amp for DG batteries.

(c) A battery charging current of < 2 amps when on float charge for vital batteries and < 1.0 amp for DG batteries is acceptable for meeting specific gravity limits following a battery recharge, for a maximum of 31 days. When charging current is used to satisfy specific gravity requirements, specific gravity of each connected cell shall be measured prior to expiration of the 31 day allowance.

5.7.2.20 Control Room Envelope Habitability Program (continued)

c. Requirements for (i) determining the unfiltered air inleakage past the CRE boundary into the CRE in accordance with the testing methods and at the Frequencies specified in Sections C.1 and C.2 of Regulatory Guide 1.197, "Demonstrating Control Room Envelope Integrity at Nuclear Power Reactors," Revision 0, May 2003, and (ii) assessing CRE habitability at the Frequencies specified in Sections C.1 and C.2 of Regulatory Guide 1.197, Revision 0.

d. Measurement, at designated locations, of the CRE pressure relative to all external areas adjacent to the CRE boundary during the pressurization mode of operation by one train of the CREVS, operating at the flow rate defined in the Ventilation Filter Testing Program (VFTP), at a Frequency of 18 months on a STAGGERED TEST BASIS. The results shall be trended and used as part of the 18 month assessment of the CRE boundary.

e. The quantitative limits on unfiltered air inleakage into the CRE. These limits shall be stated in a manner to allow direct comparison to the unfiltered air inleakage measured by the testing described in paragraph c. The unfiltered air inleakage limit for radiological challenges is the inleakage flow rate assumed in the licensing basis analyses of DBA consequences. Unfiltered air inleakage limits for hazardous chemicals must ensure that exposure of CRE occupants to these hazards will be within the assumptions in the licensing basis.

f. The provisions of SR 3.0.2 are applicable to the frequencies for assessing CRE habitability, determining CRE unfiltered inleakage, and measuring CRE pressure and assessing the CRE boundary as required by paragraphs c and d, respectively.

Note: The addition of TS 5.7.2.21, “Spent Fuel Storage Rack Neutron Absorber Monitoring Program,” has been proposed per TVA letter CNL-17-144, dated December 20, 2017. Therefore, the proposed addition of the “Battery Monitoring and Maintenance Program” is numbered “TS 5.7.2.22,” to reflect the anticipated approval of the license amendment request associated with TVA letter CNL-17-144.

Insert TS 5.7.2.22, “Battery Monitoring and Maintenance Program”

INSERT

5.7.2.22 Battery Monitoring and Maintenance Program

This Program provides controls for battery restoration and maintenance. The program shall be in accordance with IEEE Standard (Std) 450-2002, "IEEE Recommended Practice for Maintenance, Testing, and Replacement of Vented Lead-Acid Batteries for Stationary Applications," as endorsed by Regulatory Guide 1.129, Revision 2 (RG), with RG exceptions and program provisions as identified below:

a. The program allows the following RG 1.129, Revision 2 exceptions:

1. Battery temperature correction may be performed before or after conducting discharge tests.

2. RG 1.129, Regulatory Position 1, Subsection 2, "References," is not applicable to this program.

3. In lieu of RG 1.129, Regulatory Position 2, Subsection 5.2, "Inspections," the following shall be used: "Where reference is made to the pilot cell, pilot cell selection shall be based on the lowest voltage cell in the battery."

4. In Regulatory Guide 1.129, Regulatory Position 3, Subsection 5.4.1, "State of Charge Indicator," the following statements in paragraph (d) may be omitted: "When it has been recorded that the charging current has stabilized at the charging voltage for three consecutive hourly measurements, the battery is near full charge. These measurements shall be made after the initially high charging current decreases sharply and the battery voltage rises to approach the charger output voltage."

5. In lieu of RG 1.129, Regulatory Position 7, Subsection 7.6, "Restoration", the following may be used: "Following the test, record the float voltage of each cell of the string."

b. The program shall include the following provisions:

1. Actions to restore battery cells with float voltage < 2.13 V;

2. Actions to determine whether the float voltage of the remaining battery cells is ≥ 2.13 V when the float voltage of a battery cell has been found to be < 2.13 V;

3. Actions to equalize and test battery cells that had been discovered with electrolyte level below the top of the plates;

4. Limits on average electrolyte temperature, battery connection resistance, and battery terminal voltage; and

5. A requirement to obtain specific gravity readings of all cells at each discharge test, consistent with manufacturer recommendations.

B 3.8 ELECTRICAL POWER SYSTEMS

B 3.8.4 DC Sources - Operating

BASES

BACKGROUND

The station DC electrical power system provides the AC emergency power system with control power. It also provides both motive and control power to selected safety related equipment and preferred AC vital bus power (via inverters). As required by 10 CFR 50, Appendix A, GDC 17 (Ref. 1), the DC electrical power system is designed to have sufficient independence, redundancy, and testability to perform its safety functions, assuming a single failure. The DC electrical power system also conforms to the recommendations of Regulatory Guide 1.6 (Ref. 2) and IEEE-308 (Ref. 3).

125 V Vital DC Electrical Power Subsystem

The vital 125 VDC electrical power system is a Class 1E system whose safety function is to provide control power for engineered safety features equipment, emergency lighting, vital inverters, and other safety related DC powered equipment for the entire unit. The system capacity is sufficient to supply these loads and any connected non-safety loads during normal operation and to permit safe shutdown and isolation of the reactor for the “loss of all AC power” condition. The system is designed to perform its safety function subject to a single failure.

The 125V DC vital power system is composed of the four ~~redundant~~ channels (Channels I and III are associated with Train A and Channels II and IV are associated with Train B) and consists of four lead-acid-calcium batteries, eight battery chargers (including two pairs of spare chargers), four distribution boards, battery racks, and the required cabling, instrumentation and protective features. Each channel is electrically and physically independent from the equipment of all other channels so that a single failure in one channel will not cause a failure in another channel. Each channel consists of a battery charger which supplies normal DC power, a battery for emergency DC power, and a battery board which facilitates load grouping and provides circuit protection. These four channels are used to provide emergency power to the 120V AC vital power system which furnishes control power to the reactor protection system. No automatic connections are used between the four ~~redundant~~ channels.

Battery boards I, II, III, and IV have a charger normally connected to them and also have manual access to a spare (backup) charger for use upon loss of the normal charger.

(continued)

BASES

BACKGROUND 125 V Vital DC Electrical Power Subsystem (continued)

Additionally, battery boards I, II, III, and IV have manual access to the fifth vital battery system. The fifth 125V DC Vital Battery System is intended to serve as a replacement for any one of the four 125V DC vital batteries during their testing, maintenance, and outages with no loss of system reliability under any mode of operation.

Each of the vital DC electrical power subsystems provides the control power for its associated Class 1E AC power load group, 6.9 kV switchgear, and 480 V load centers. The vital DC electrical power subsystems also provide DC electrical power to the inverters, which in turn power the AC vital buses. Additionally, they power the emergency DC lighting system.

The vital DC power distribution system is described in more detail in Bases for LCO 3.8.9, "Distribution System - Operating," and LCO 3.8.10, "Distribution Systems - Shutdown."

~~Each vital battery has adequate storage capacity to carry the required load continuously for at least 4 hours in the event of a loss of all AC power (station blackout) without an accident or for 30 minutes with an accident considering a single failure. Load shedding of non-required loads will be performed to achieve the required coping duration for station blackout conditions.~~

Each 125 VDC vital battery is separately housed in a ventilated room apart from its charger and distribution centers, except for Vital Battery V. Each subsystem is located in an area separated physically and electrically from the other subsystem to ensure that a single failure in one subsystem does not cause a failure in a redundant subsystem. There is no sharing between ~~redundant~~ Class 1E subsystems, such as batteries, battery chargers, or distribution panels.

Each battery has adequate storage capacity to meet the duty cycle(s) discussed in the FSAR, Chapter 8 (Ref 4). The battery is designed with additional capacity above that required by the design duty cycle to allow for temperature variations and other factors.

The batteries for the vital DC electrical power subsystems are sized to produce required capacity at 80% of nameplate rating, corresponding to warranted capacity at end of life cycles, ~~de-rated for minimum ambient temperature~~ and the 100% design demand. The minimum design voltage limit is 105 V.~~The voltage limit is 2.13 V per cell, which corresponds to a total minimum voltage output of 128 V per battery (132 V for Vital Battery V). The criteria for sizing large lead storage batteries are defined in IEEE-485 (Ref. 5).~~

(continued)

BASES

BACKGROUND 125 V Vital DC Electrical Power Subsystem (continued)

The battery cells are of flooded lead acid construction with a nominal specific gravity of 1.215. This specific gravity corresponds to an open circuit battery voltage of approximately 120 V for a 60 cell battery (i.e., cell voltage of 2.063 volts per cell (Vpc)). The open circuit voltage is the voltage maintained when there is no charging or discharging. Optimal long term performance however, is obtained by maintaining a float voltage 2.20 to 2.25 Vpc. This provides adequate over-potential, which limits the formation of lead sulfate and self discharge. The nominal float voltage of 2.22 Vpc corresponds to a total float voltage output of 133.2 V for a 60 cell battery as discussed in the FSAR, Chapter 8 (Ref. 4).

Each Vital DC electrical power subsystem battery charger has ample power output capacity for the steady state operation of connected loads required during normal operation, while at the same time maintaining its battery bank fully charged. Each battery charger also has sufficient excess capacity to restore the battery bank from the design minimum charge to its fully charged state within 12 hours (with accident loads being supplied) following a 30 minute AC power outage and in approximately 36 hours (while supplying normal steady state loads following a 2 hour AC power outage), (Ref. ~~6~~5).

The battery charger is normally in the float-charge mode. Float-charge is the condition in which the charger is supplying the connected loads and the battery cells are receiving adequate current to optimally charge the battery. This assures the internal losses of a battery are overcome and the battery is maintained in a fully charged state.

When desired, the charger can be placed in the equalize mode. The equalize mode is at a higher voltage than the float mode and charging current is correspondingly higher. The battery charger is operated in the equalize mode after a battery discharge or for routine maintenance. Following a battery discharge, the battery recharge characteristic accepts current at the current limit of the battery charger (if the discharge was significant, e.g., following a battery service test) until the battery terminal voltage approaches the charger voltage setpoint. Charging current then reduces exponentially during the remainder of the recharge cycle. Lead-calcium batteries have recharge efficiencies of greater than 95%, so once at least 105% of the ampere-hours discharged have been returned, the battery capacity would be restored to the same condition as it was prior to the discharge. This can be monitored by direct observation of the exponentially decaying charging current or by evaluating the amp-hours discharged from the battery and amp-hours returned to the battery.

BASES

BACKGROUND (continued)

125 V Diesel Generator (DG) DC Electrical Power Subsystem

Control power for the DGs is provided by four DG battery systems, one per DG. Each system is comprised of a battery, a battery charger, distribution center, cabling, and cable ways. The DG 125V DC control power and field-flash circuits have power supplied from their respective 125V distribution panel. The normal supply of DC current is from the associated charger. The battery provides control and field-flash power when the charger is unavailable. The charger supplies the normal DC loads, maintains the battery in a fully charged condition, and recharges (480V AC available) the battery while supplying the required loads regardless of the status of the unit. The batteries are physically and electrically independent. The battery has sufficient capacity when fully charged to supply required loads for a minimum of four hours following a loss of normal power. Each battery is normally required to supply loads during the time interval between loss of normal feed to its charger and the receipt of emergency power to the charger from its respective DG.

APPLICABLE SAFETY ANALYSES

The initial conditions of Design Basis Accident (DBA) and transient analyses in the FSAR, Section 6 (Ref. ~~7~~6), and in the FSAR, Section 15 (Ref. ~~7~~6), assume that Engineered Safety Feature (ESF) systems are OPERABLE. The vital DC electrical power system provides normal and emergency DC electrical power for the emergency auxiliaries, and control and switching during all power for the emergency auxiliaries, and control and switching during all MODES of operation. The DG battery systems provide DC power for the DGs.

The OPERABILITY of the DC sources is consistent with the initial assumptions of the accident analyses and is based upon meeting the design basis of the plant. This includes maintaining the DC sources OPERABLE during accident conditions in the event of:

a. An assumed loss of all offsite AC power or all onsite AC power; and

b. A worst case single failure.

The DC sources satisfy Criterion 3 of 10 CFR 50.36(c)(2)(ii).

BASES (continued)

LCO

~~Four~~ Two 125V vital DC electrical power subsystems (Train A and Train B), each vital subsystem consisting of two channels. Each channel consisting of a battery bank, associated battery charger and the corresponding control equipment and interconnecting cabling supplying power to the associated DC bus within the channel; and four DG DC electrical power subsystems each consisting of a battery, a dual battery charger assembly, and the corresponding control equipment and interconnecting cabling are required to be OPERABLE to ensure the availability of the required power to shut down the reactor and maintain it in a safe condition after an anticipated operational occurrence (A00) or a postulated DBA. Loss of any DC electrical power subsystem does not prevent the minimum safety function from being performed (Ref. 4).

An OPERABLE vital DC electrical power subsystem requires all required batteries and respective chargers to be operating and connected to the associated DC buses.

The LCO is modified by one Note. The Note indicates that Vital Battery V may be substituted for any of the required vital batteries. However, the fifth battery cannot be declared OPERABLE until it is connected electrically in place of another battery and it has satisfied applicable Surveillance Requirements.

APPLICABILITY

The ~~four~~ vital DC electrical power sources and ~~four~~ DG DC electrical power sources are required to be OPERABLE in MODES 1, 2, 3, and 4 to ensure safe plant operation and to ensure that:

a. Acceptable fuel design limits and reactor coolant pressure boundary limits are not exceeded as a result of AOs or abnormal transients; and

b. Adequate core cooling is provided, and containment integrity and other vital functions are maintained in the event of a postulated DBA.

The DC electrical power requirements for MODES 5 and 6 are addressed in the Bases for LCO 3.8.5, “DC Sources - Shutdown.”

BASES (continued)

ACTIONS

A.1, A.2, and A.3

Condition A represents one vital DC subsystem with one or two battery chargers inoperable (e.g., the voltage limit of SR 3.8.4.1 is not maintained). The ACTIONS provide a tiered response that focuses on returning the battery to the fully charged state and restoring a fully qualified charger to OPERABLE status in a reasonable time period. Required Action A.1 requires that the battery terminal voltage be restored to greater than or equal to the minimum established float voltage within 2 hours. This time provides for returning the inoperable charger to OPERABLE status or providing an alternate means of restoring battery terminal voltage to greater than or equal to the minimum established float voltage. Restoring the battery terminal voltage to greater than or equal to the minimum established float voltage provides good assurance that, within 12 hours, the battery will be restored to its fully charged condition (Required Action A.2) from any discharge that might have occurred due to the charger inoperability.

A discharged battery having terminal voltage of at least the minimum established float voltage indicates that the battery is on the exponential charging current portion (the second part) of its recharge cycle. The time to return a battery to its fully charged state under this condition is simply a function of the amount of the previous discharge and the recharge characteristic of the battery. Thus there is good assurance of fully recharging the battery within 12 hours, avoiding a premature shutdown with its own attendant risk.

If established battery terminal float voltage cannot be restored to greater than or equal to the minimum established float voltage within 2 hours, and the charger is not operating in the current-limiting mode, a faulty charger is indicated. A faulty charger that is incapable of maintaining established battery terminal float voltage does not provide assurance that it can revert to and operate properly in the current limit mode that is necessary during the recovery period following a battery discharge event that the DC system is designed for.

If the charger is operating in the current limit mode after 2 hours that is an indication that the battery is partially discharged and its capacity margins will be reduced. The time to return the battery to its fully charged condition in this case is a function of the battery charger capacity, the amount of loads on the associated DC system, the amount of the previous discharge, and the recharge characteristic of the battery. The charge time can be extensive, and there is not adequate assurance that it can be recharged within 12 hours (Required Action A.2).

Required Action A.2 requires that the battery float current be verified as less than or equal to 2 amps. This indicates that, if the battery had been discharged as the result of the inoperable battery charger, it is now fully capable of supplying the maximum expected load requirement.

(continued)

BASES (continued)

ACTIONS

A.1, A.2, and A.3 (continued)

The 2 amp value is based on returning the battery to 98% charge and assumes a 2% design margin for the battery. If at the expiration of the initial 12 hour period the battery float current is not less than or equal to 2 amps this indicates there may be additional battery problems and the battery must be declared inoperable.

Required Action A.3 limits the restoration time for the inoperable battery charger to 7 days. This action is applicable if an alternate means of restoring battery terminal voltage to greater than or equal to the minimum established float voltage has been used (e.g., balance of plant non-Class 1E battery charger). The 7 day Completion Time reflects a reasonable time to effect restoration of the qualified battery charger to OPERABLE status.

~~A~~B.1

Condition ~~A~~B represents one vital ~~channel~~ DC electrical power subsystem with a loss of ability to completely respond to an event, and a potential loss of ability to remain energized during normal operation. It is, therefore, imperative that the operator's attention focus on stabilizing the plant, minimizing the potential for complete loss of DC power to the affected ~~train~~ subsystem. The 2 hour limit is consistent with the allowed time for an inoperable DC distribution subsystem ~~train~~.

If one of the required vital DC electrical power subsystems is inoperable for reasons other than Condition A (e.g., ~~inoperable battery, inoperable battery charger(s), or~~ inoperable battery charger and associated inoperable battery), the remaining vital DC electrical power subsystem has the capacity to support a safe shutdown and to mitigate an accident condition. Since a subsequent worst case single failure of the OPERABLE subsystem ~~would~~ could, however, result in ~~a situation where the ability of the 125V DC electrical power subsystem to support its required ESF function is not assured,~~ the loss of the minimum necessary vital DC electrical power subsystems to mitigate a worst-case accident, continued power operation should not exceed 2 hours. The 2 hour Completion Time is based on Regulatory Guide 1.93 (Ref. ~~8~~7) and reflects a reasonable time to assess plant status as a function of the inoperable vital DC electrical power subsystem and, if the vital DC electrical power subsystem is not restored to OPERABLE status, to prepare to effect an orderly and safe plant shutdown.

(continued)

BASES

ACTIONS (continued)

~~B.1 and B.2~~C.1 and C.2

If the inoperable vital DC electrical power subsystem cannot be restored to OPERABLE status within the required Completion Time, the plant must be brought to a MODE in which the LCO does not apply. To achieve this status, the plant must be brought to at least MODE 3 within 6 hours and to MODE 5 within 36 hours. The allowed Completion Times are reasonable, based on operating experience, to reach the required plant conditions from full power conditions in an orderly manner and without challenging plant systems. The Completion Time to bring the plant to MODE 5 is consistent with the time required in Regulatory Guide 1.93 (Ref. ~~8~~7).

D.1, D.2, and D.3

Condition D represents one DG DC subsystem with one battery charger inoperable (e.g., the voltage limit of SR 3.8.4.1 is not maintained). The ACTIONS provide a tiered response that focuses on returning the battery to the fully charged state and restoring a fully qualified charger to OPERABLE status in a reasonable time period. Required Action D.1 requires that the battery terminal voltage be restored to greater than or equal to the minimum established float voltage within 2 hours. This time provides for returning the inoperable charger to OPERABLE status or providing an alternate means of restoring battery terminal voltage to greater than or equal to the minimum established float voltage.

Restoring the battery terminal voltage to greater than or equal to the minimum established float voltage provides good assurance that, within 12 hours, the battery will be restored to its fully charged condition (Required Action D.2) from any discharge that might have occurred due to the charger inoperability.

A discharged battery having terminal voltage of at least the minimum established float voltage indicates that the battery is on the exponential charging current portion (the second part) of its recharge cycle. The time to return a battery to its fully charged state under this condition is simply a function of the amount of the previous discharge and the recharge characteristic of the battery. Thus there is good assurance of fully recharging the battery within 12 hours, avoiding a premature shutdown with its own attendant risk.

If established battery terminal float voltage cannot be restored to greater than or equal to the minimum established float voltage within 2 hours, and the charger is not operating in the current-limiting mode, a faulty charger is indicated. A faulty charger that is incapable of maintaining established battery terminal float voltage does not provide assurance that it can revert to and operate properly in the current limit mode that is necessary during the recovery period following a battery discharge event that the DG DC system is designed for.

BASES

ACTIONS

D.1, D.2, and D.3 (continued)

If the charger is operating in the current limit mode after 2 hours that is an indication that the battery is partially discharged and its capacity margins will be reduced. The time to return the battery to its fully charged condition in this case is a function of the battery charger capacity, the amount of loads on the associated DC system, the amount of the previous discharge, and the recharge characteristic of the battery. The charge time can be extensive, and there is not adequate assurance that it can be recharged within 12 hours (Required Action D.2).

Required Action D.2 requires that the battery float current be verified as less than or equal to 1 amp. This indicates that, if the battery had been discharged as the result of the inoperable battery charger, it is now fully capable of supplying the maximum expected load requirement. The 1 amp value is based on returning the battery to 98% charge and assumes a 2% design margin for the battery. If at the expiration of the initial 12 hour period the battery float current is not less than or equal to 1 amp this indicates there may be additional battery problems and the battery must be declared inoperable.

Required Action D.3 limits the restoration time for the inoperable battery charger to 72 hours. The 72 hour Completion Time reflects a reasonable time to effect restoration of the qualified battery charger to OPERABLE status.

~~C.1~~E.1

Condition ~~C~~E represents one DG with a loss of ability to completely respond to an event. Since a subsequent single failure on the opposite train could result in a situation where the required ESF function is not assured, continued power operation should not exceed 2 hours. The 2 hour time limit is consistent with the allowed time for an inoperable vital DC electrical power subsystem.

~~D.1~~F.1

If the DG DC electrical power subsystem cannot be restored to OPERABLE status in the associated Completion Time, the associated DG may be incapable of performing its intended function and must be immediately declared inoperable. This declaration also requires entry into applicable Conditions and Required Actions for an inoperable DG, LCO 3.8.1, "AC Sources-Operating."

BASES (continued)

SURVEILLANCE REQUIREMENTS

SR 3.8.4.1 and SR 3.8.4.2

Verifying battery terminal voltage while on float charge for the batteries helps to ensure the effectiveness of the battery chargers, which support the ability of the batteries to perform their intended function ~~charging system and the ability of the batteries to perform their intended function~~. Float charge is the condition in which the charger is supplying the continuous charge required to overcome the internal losses of a battery ~~(or battery cell)~~ and maintain the battery ~~(or a battery cell)~~ in a fully charged state while supplying the continuous steady state loads of the associated DC subsystem. On float charge, battery cells will receive adequate current to optimally charge the battery. The voltage requirements are based on the ~~critical~~ nominal design voltage of the battery and are consistent with the ~~initial voltages assumed in the battery sizing calculations~~ minimum float voltage established by the battery manufacturer (2.20 Vpc times the number of connected cells or 132 V at the battery terminals for a 60 cell vital battery; 127.6 V at the battery terminals for a 58 cell DG battery). This voltage maintains the battery plates in a condition that supports maintaining the grid life. The 7 day Frequency is consistent with manufacturer recommendations ~~and IEEE-450 (Ref. 9)~~.

SR 3.8.4.3

Verifying that for the vital batteries that the alternate feeder breakers to each required battery charger is open ensures that independence between the power trains is maintained. The 7 day Frequency is based on engineering judgment, is consistent with procedural controls governing breaker operation, and ensures correct breaker position.

SR 3.8.4.4

This SR demonstrates that the DG 125V DC distribution panel and associated charger are functioning properly, with all required circuit breakers closed and buses energized from normal power. The 7 day Frequency takes into account the redundant DG capability and other indications available in the control room that will alert the operator to system malfunctions.

~~SR 3.8.4.5 and SR 3.8.4.6~~

~~Visual inspection to detect corrosion of the battery cells and connections, or measurement of the resistance of each intercell, interrack, intertier, and terminal connection, provides an indication of physical damage or abnormal deterioration that could potentially degrade battery performance.~~

~~The limits established for this SR must be no more than 20% above the resistance as measured during installation, or not above the ceiling value~~

(continued)

BASES

SURVEILLANCE REQUIREMENTS

SR 3.8.4.5 and SR 3.8.4.6 (continued)

established by the manufacturer.

The Surveillance Frequency for these inspections, which can detect conditions that can cause power losses due to resistance heating, is 92 days. This Frequency is considered acceptable based on operating experience related to detecting corrosion trends.

SR 3.8.4.7

Visual inspection of the battery cells, cell plates, and battery racks provides an indication of physical damage or abnormal deterioration that could potentially degrade battery performance.

The 12 month Frequency for this SR is consistent with IEEE-450 (Ref. 9), which recommends detailed visual inspection of cell condition and rack integrity on a yearly basis.

SR 3.8.4.8, SR 3.8.4.9 and SR 3.8.4.10

Visual inspection and resistance measurements of intercell, interrack, intertier, and terminal connections provide an indication of physical damage or abnormal deterioration that could indicate degraded battery condition. The anticorrosion material is used to help ensure good electrical connections and to reduce terminal deterioration. The visual inspection for corrosion is not intended to require removal of and inspection under each terminal connection. The removal of visible corrosion is a preventive maintenance SR. The presence of visible corrosion does not necessarily represent a failure of this SR provided visible corrosion is removed during performance of SR 3.8.4.8. For the purposes of trending, inter-cell (vital and DG batteries) and inter-tier (vital and DG batteries) connections are measured from battery post to battery post. Inter-rack (vital batteries), inter-tier (DG Batteries), and terminal connections (vital and DG batteries) are measured from terminal lug to battery post.

The connection resistance limits for SR 3.8.4.9 and SR 3.8.4.10 shall be no more than 20% above the resistance as measured during installation, or not above the ceiling value established by the manufacturer.

The Surveillance Frequencies of 12 months is consistent with IEEE-450 (Ref. 9), which recommends cell to cell and terminal connection resistance measurement on a yearly basis.

(continued)

BASES

SURVEILLANCE REQUIREMENTS (continued)

SR 3.8.4.~~11~~5

This SR ~~requires that each vital battery charger be capable of recharging its associated battery from a capacity or service discharge test while supplying normal loads, or alternatively, operating at current limit for a minimum of 4 hours at a nominal 125 VDC. These requirements are based on~~ verifies the design capacity of the vital battery chargers ~~(Ref. 4) and their performance characteristic of current limit operation for a substantial portion of the recharge period. Battery charger output current is limited to 110% - 125% of the 200 amp rated output. Recharging the battery or testing for a minimum of 4 hours is sufficient to verify the output capability of the charger can be sustained, that current limit adjustments are properly set and that protective devices will not inhibit performance at current limit settings~~. According to Regulatory Guide 1.32 (Ref. ~~6~~5), the battery charger supply is ~~required~~ recommended to be based on the largest combined demands of the various steady state loads and the charging capacity to restore the battery from the design minimum charge state to the fully charged state, irrespective of the status of the plant during these demand occurrences. ~~Verifying the capability of the charger to operate in a sustained current limit condition~~ The minimum required amperes and duration ensure~~s~~ that these requirements can be satisfied.

This SR provides two options. One option requires that each battery charger be capable of supplying 200 amps at the minimum established float voltage (132 V DC) for 4 hours. The ampere requirements are based on the output rating of the chargers. The voltage requirements are based on the charger voltage level after a response to a loss of AC power.

The other option requires that each vital battery charger be capable of recharging the battery after a service test coincident with supplying the largest coincident demands of the various continuous steady state loads (irrespective of the status of the plant during which these demands occur). This level of loading may not normally be available following the battery service test and will need to be supplemented with additional loads. The duration for this test may be longer than the charger sizing criteria since the battery recharge is affected by float voltage, temperature, and the exponential decay in charging current. The battery is recharged when the measured charging current is ≤ 2 amps.

The Surveillance Frequency is acceptable, given the plant conditions required to perform the test and the other administrative controls existing to ensure adequate charger performance during these 18 month intervals. In addition, this Frequency is intended to be consistent with expected fuel cycle lengths.

~~This SR is modified by a Note. The reason for the Note is that performing the Surveillance may perturb the electrical distribution system and challenge safety systems. This Surveillance is normally performed during MODES 5 and 6 since it would require the DC~~

(continued)

SURVEILLANCE REQUIREMENTS

SR 3.8.4.~~11~~5 (continued)

~~electrical power subsystem to be inoperable during performance of the test. However, this Surveillance may be performed in MODES 1, 2, 3, or 4 provided the Vital Battery V is substituted in accordance with LCO Note 1. Credit may be taken for unplanned events that satisfy this SR. Examples of unplanned events may include:~~

~~1) Unexpected operational events which cause the equipment to perform the function specified by this Surveillance, for which adequate documentation of the required performance is available; and~~

~~2) Post corrective maintenance testing that requires performance of this Surveillance in order to restore the component to OPERABLE, provided the maintenance was required, or performed in conjunction with maintenance required to maintain OPERABILITY or reliability.~~

SR 3.8.4.~~12~~6

This SR ~~requires that each diesel generator battery charger be capable of recharging its associated battery from a capacity or service discharge test while supplying normal loads, or alternatively, operating at current limit for a minimum of 4 1/2 hours at a nominal 125 VDC. This requirement is based on~~ verifies the design capacity of the DG battery chargers ~~(Ref. 13) and their performance characteristic of current limit operation for a substantial portion of the recharge period. Battery charger output current is limited to a maximum of 140% of the 20 amp rated output. Recharging the battery verifies the output capability of the charger can be sustained, that current limit adjustments are properly set and that protective devices will not inhibit performance at current limit settings~~. According to Regulatory Guide 1.32 (Ref. ~~6~~5), the battery charger supply is ~~required~~ recommended to be based on the largest combined demands of the various steady state loads and the charging capacity to restore the battery from the design minimum charge state to the fully charged state, irrespective of the status of the plant during these demand occurrences. ~~Verifying the capability of the charger to operate in a sustained current limit condition~~ The minimum required amperes and duration ensure~~s~~ that these requirements can be satisfied.

This SR provides two options. One option requires that each battery charger be capable of supplying 20 amps at the minimum established float voltage (127.6 V DC) for 4 hours. The ampere requirements are based on the output rating of the chargers. The voltage requirements are based on the charger voltage level after a response to a loss of AC power.

(continued)

BASES

SURVEILLANCE REQUIREMENTS

SR 3.8.4.~~12~~6 (continued)

The other option requires that each vital battery charger be capable of recharging the battery after a service test coincident with supplying the largest coincident demands of the various continuous steady state loads (irrespective of the status of the plant during which these demands occur). This level of loading may not normally be available following the battery service test and will need to be supplemented with additional loads. The duration for this test may be longer than the charger sizing criteria since the battery recharge is affected by float voltage, temperature, and the exponential decay in charging current. The battery is recharged when the measured charging current is ≤ 1 amp.

The Surveillance Frequency is acceptable, given the ~~plant conditions required to perform the test and the other~~ administrative controls existing to ensure adequate charger performance during these 18 month intervals. ~~In addition, this Frequency is intended to be consistent with expected fuel cycle lengths.~~

For the DG DC electrical subsystem, this Surveillance may be performed in MODES 1, 2, 3, or 4 in conjunction with LCO 3.8.1.B since the DG DC electrical power subsystem supplies loads only for the inoperable diesel generator and would not otherwise challenge safety systems supplied from vital electrical distribution systems. Additionally, credit may be taken for unplanned events that satisfy this SR. Examples of unplanned events may include:

1) Unexpected operational events which cause the equipment to perform the function specified by this Surveillance, for which adequate documentation of the required performance is available; and

2) Post corrective maintenance testing that requires performance of this Surveillance in order to restore the component to OPERABLE, provided the maintenance was required, or performed in conjunction with maintenance required to maintain OPERABILITY or reliability.

SR 3.8.4.~~13~~7

A battery service test is a special test of battery capability, as found, to satisfy the design requirements (battery duty cycle) of the DC electrical power system. The discharge rate and test length should correspond to worst case design duty cycle requirements based on References ~~10~~8 and ~~12~~10.

The Surveillance Frequency of 18 months is consistent with the recommendations of Regulatory Guide 1.32 (Ref. ~~6~~5) and Regulatory Guide 1.129 (Ref. ~~11~~9), which state that the battery service test should be

(continued)

BASES

SURVEILLANCE REQUIREMENTS

SR 3.8.4.~~13~~7 (continued)

performed during refueling operations or at some other outage, with intervals between tests, not to exceed 18 months.

This SR is modified by two Notes. Note 1 allows the performance of a modified performance discharge test in lieu of a service test ~~once per 60 months. The modified performance discharge test is a simulated duty cycle consisting of just two rates; the one minute rate published for the battery or the largest current load of the duty cycle, followed by the test rate employed for the performance test, both of which envelope the duty cycle of the service test. Since the ampere-hours removed by a rated one minute discharge represents a very small portion of the battery capacity, the test rate can be changed to that for the performance test without compromising the results of the performance discharge test. The battery terminal voltage for the modified performance discharge test should remain above the minimum battery terminal voltage specified in the battery service test for the duration of time equal to that of the service test~~.

~~A modified discharge test is a test of the battery capacity and its ability to provide a high rate, short duration load (usually the highest rate of the duty cycle.) This will often confirm the battery's ability to meet the critical period of the load duty cycle, in addition to determining its percentage of rated capacity. Initial conditions for the modified performance discharge test should be identical to those specified for a service test.~~

The reason for Note 2 is that performing the Surveillance may perturb the vital electrical distribution system and challenge safety systems. However, this Surveillance may be performed in MODES 1, 2, 3, or 4 provided that Vital Battery V is substituted in accordance with LCO Note 1. For the DG DC electrical subsystem, this surveillance may be performed in MODES 1, 2, 3, or 4 in conjunction with LCO 3.8.1.B since the supplied loads are only for the inoperable diesel generator and would not otherwise challenge safety system loads which are supplied from vital electrical distribution systems. Additionally, credit may be taken for unplanned events that satisfy this SR. Examples of unplanned events may include:

1) Unexpected operational events which cause the equipment to perform the function specified by this Surveillance, for which adequate documentation of the required performance is available; and

2) Post corrective maintenance testing that requires performance of this Surveillance in order to restore the component to OPERABLE, provided the maintenance was required, or performed in conjunction with maintenance required to maintain OPERABILITY or reliability.

(continued)

BASES

SURVEILLANCE REQUIREMENTS (continued)

~~SR 3.8.4.14~~

~~A battery performance discharge test is a test of constant current capacity of a battery, normally done in the as found condition, after having been in service, to detect any change in the capacity determined by the acceptance test. The test is intended to determine overall battery degradation due to age and usage.~~

~~A battery modified performance discharge test is described in the Bases for 3.8.4.13. Either the battery performance discharge test or the modified performance discharge test is acceptable for satisfying SR 3.8.4.14; however, only the modified performance discharge test may be used to satisfy SR 3.8.4.14 while satisfying the requirements of SR 3.8.4.13 at the same time.~~

~~The acceptance criteria for this Surveillance are consistent with IEEE-450 (Ref. 9) and IEEE-485 (Ref. 5). These references recommend that the battery be replaced if its capacity is below 80% of the manufacturer rating. A capacity of 80% shows that the battery rate of deterioration is increasing, even if there is ample capacity to meet the load requirements.~~

~~The Surveillance Frequency for this test is normally 60 months. If the battery shows degradation, or if the battery has reached 85% of its expected life and capacity is < 100% of the manufacturer's rating, the Surveillance Frequency is reduced to 12 months. However, if the battery shows no degradation but has reached 85% of its expected life, the Surveillance Frequency is only reduced to 24 months for batteries that retain capacity ≥ 100% of the manufacturer's rating. Degradation is indicated, according to IEEE-450 (Ref. 9), when the battery capacity drops by more than 10% relative to its capacity on the previous performance test or when it is ≥ 10% below the manufacturer rating. These Frequencies are consistent with the recommendations in IEEE-450 (Ref. 9).~~

~~This SR is modified by a Note. The reason for the Note is that performing the Surveillance may perturb the vital electrical distribution system and challenge safety systems. However, this Surveillance may be performed in MODES 1, 2, 3, or 4 provided that Vital Battery V is substituted in accordance with LCO Note 1. For the DG DC electrical subsystem, this surveillance may be performed in MODES 1, 2, 3, or 4 in conjunction with LCO 3.8.1.B since the supplied loads are only for the inoperable diesel generator and would not otherwise challenge safety system loads which are supplied from vital electrical distribution systems. Additionally, credit may be taken for unplanned events that satisfy this SR. Examples of unplanned events may include:~~

~~1) Unexpected operational events which cause the equipment to perform the function specified by this Surveillance, for which adequate documentation of the required performance is available;~~

(continued)

BASES

SURVEILLANCE REQUIREMENTS

~~SR 3.8.4.14 (continued)~~

~~and~~

~~2) Post corrective maintenance testing that requires performance of this Surveillance in order to restore the component to OPERABLE, provided the maintenance was required, or performed in conjunction with maintenance required to maintain OPERABILITY or reliability.~~

(continued)

BASES

REFERENCES

1. Title 10, Code of Federal Regulations, Part 50, Appendix A, General Design Criterion 17, “Electric Power System.”

2. Regulatory Guide 1.6, “Independence Between Redundant Standby (Onsite) Power Sources and Between Their Distribution Systems,” U.S. Nuclear Regulatory Commission, March 10, 1971.

3. IEEE-308-1971, “IEEE Standard Criteria for Class 1E Power Systems for Nuclear Power Generating Stations,” Institute of Electrical and Electronic Engineers.

4. Watts Bar FSAR, Section 8.3.2, “DC Power System.”

~~5. IEEE-485-1983, “Recommended Practices for Sizing Large Lead Storage Batteries for Generating Stations and Substations,” Institute of Electrical and Electronic Engineers.~~

~~6~~5. Regulatory Guide 1.32, “Criteria for Safety-Related Electric Power Systems for Nuclear Power Plants,” February 1977, U.S. Nuclear Regulatory Commission.

~~7~~6. Watts Bar FSAR, Section 15, “Accident Analysis” and Section 6 “Engineered Safety Features.”

~~8~~7. Regulatory Guide 1.93, “Availability of Electric Power Sources,” U.S. Nuclear Regulatory Commission, December 1974.

~~9. IEEE-450-1980/1995, “IEEE Recommended Practice for Maintenance, Testing and Replacement of Vented Lead - Acid Batteries for Stationary Applications,” Institute of Electrical and Electronics Engineers, Inc.~~

~~10~~8. TVA Calculation EDQ00023620070003, “125V DC Vital Battery System Analysis”

~~11~~9. Regulatory Guide 1.129, “Maintenance Testing and Replacement of Large Lead Storage Batteries for Generating Stations and Subsystems,” U.S. Nuclear Regulatory Commission, February 1978.

~~12~~10. TVA Calculation WBN EEB-EDQ00023620070003, “125V DC Vital Battery System Analysis.”

~~13. Watts Bar FSAR, Section 8.3.1, “AC Power System.”~~

B 3.8 ELECTRICAL POWER SYSTEMS

B 3.8.5 DC Sources - Shutdown

BASES

BACKGROUND

A description of the DC sources is provided in the Bases for LCO 3.8.4, "DC Sources - Operating."

APPLICABLE SAFETY ANALYSES

The initial conditions of Design Basis Accident and transient analyses in the FSAR, Section 6 (Ref. 1) and Section 15 (Ref. 1), assume that Engineered Safety Feature systems are OPERABLE. The vital DC electrical power system provides normal and emergency DC electrical power for the emergency auxiliaries, and control and switching during all MODES of operation. The DG battery systems provide DC power for the DGs.

The OPERABILITY of the DC sources is consistent with the initial assumptions of the accident analyses and the requirements for the supported systems' OPERABILITY.

The OPERABILITY of the minimum DC electrical power sources during MODES 5 and 6, and during movement of irradiated fuel assemblies ensures that:

a. The plant can be maintained in the shutdown or refueling condition for extended periods;

b. Sufficient instrumentation and control capability is available for monitoring and maintaining the plant status; and

c. Adequate DC electrical power is provided to mitigate events postulated during shutdown, such as a fuel handling accident.

The DC sources satisfy Criterion 3 of 10 CFR 50.36(c)(2)(ii).

BASES (continued)

LCO

The 125V Vital DC electrical power subsystems, each vital subsystem channel consisting of a battery bank, associated battery charger, and the corresponding control equipment and interconnecting cabling within the channel; and the DG DC electrical power subsystems, each consisting of a battery, a battery charger, and the corresponding control equipment and interconnecting cabling, are required to be OPERABLE to support required ~~trains~~ subsystems of the distribution systems required OPERABLE by LCO 3.8.10, "Distribution Systems - Shutdown" and the required DGs required OPERABLE by LCO 3.8.2, "AC Sources - Shutdown." As a minimum, one vital DC electrical power ~~train~~ subsystem (i.e., Channels I and III, or II and IV) and two DG DC electrical power subsystems (i.e., 1A-A and 2A-A or 1B-B and 2B-B) shall be OPERABLE. This ensures the availability of sufficient DC electrical power sources to operate the plant in a safe manner and to mitigate the consequences of postulated events during shutdown (e.g., fuel handling accidents).

The LCO is modified by one Note. The Note indicates that Vital Battery V may be substituted for any of the required vital batteries. However, the fifth battery cannot be declared OPERABLE until it is connected electrically in place of another battery and it has satisfied applicable Surveillance Requirements.

APPLICABILITY

The DC electrical power sources required to be OPERABLE in MODES 5 and 6, and during movement of irradiated fuel assemblies, provide assurance that:

a. Required features needed to mitigate a fuel handling accident are available;
b. Required features necessary to mitigate the effects of events that can lead to core damage during shutdown are available; and
c. Instrumentation and control capability is available for monitoring and maintaining the plant in a cold shutdown condition or refueling condition.

The DC electrical power requirements for MODES 1, 2, 3, and 4 are covered in LCO 3.8.4.

BASES (continued)

ACTIONS

A.1, A.2, and A.3

Condition A represents one subsystem with one or two battery charger(s) inoperable (e.g., the voltage limit of SR 3.8.4.1 is not maintained). The ACTIONS provide a tiered response that focuses on returning the battery to the fully charged state and restoring a fully qualified charger to OPERABLE status in a reasonable time period. Required Action A.1 requires that the battery terminal voltage be restored to greater than or equal to the minimum established float voltage within 2 hours. This time provides for returning the inoperable charger to OPERABLE status or providing an alternate means of restoring battery terminal voltage to greater than or equal to the minimum established float voltage. Restoring the battery terminal voltage to greater than or equal to the minimum established float voltage provides good assurance that, within 12 hours, the battery will be restored to its fully charged condition (Required Action A.2) from any discharge that might have occurred due to the charger inoperability.

A discharged battery having terminal voltage of at least the minimum established float voltage indicates that the battery is on the exponential charging current portion (the second part) of its recharge cycle. The time to return a battery to its fully charged state under this condition is simply a function of the amount of the previous discharge and the recharge characteristic of the battery. Thus there is good assurance of fully recharging the battery within [12] hours, avoiding a premature shutdown with its own attendant risk.

If established battery terminal float voltage cannot be restored to greater than or equal to the minimum established float voltage within 2 hours, and the charger is not operating in the current-limiting mode, a faulty charger is indicated. A faulty charger that is incapable of maintaining established battery terminal float voltage does not provide assurance that it can revert to and operate properly in the current limit mode that is necessary during the recovery period following a battery discharge event that the DC system is designed for.

If the charger is operating in the current limit mode after 2 hours that is an indication that the battery is partially discharged and its capacity margins will be reduced. The time to return the battery to its fully charged condition in this case is a function of the battery charger capacity, the amount of loads on the associated DC system, the amount of the previous discharge, and the recharge characteristic of the battery. The charge time can be extensive, and there is not adequate assurance that it can be recharged within 12 hours (Required Action A.2).

Required Action A.2 requires that the battery float current be verified as less than or equal to 2 amps. This indicates that, if the battery had been discharged as the result of the inoperable battery charger, it has now been fully recharged. If at the expiration of the initial 12 hour period the battery float current is not less than or equal to 2 amps this indicates

BASES (continued)

ACTIONS

A.1, A.2, and A.3 (continued)

there may be additional battery problems and the battery must be declared inoperable.

Required Action A.3 limits the restoration time for the inoperable battery charger to 7 days. This action is applicable if an alternate means of restoring battery terminal voltage to greater than or equal to the minimum established float voltage has been used (e.g., balance of plant non-Class 1E battery charger). The 7 day Completion Time reflects a reasonable time to effect restoration of the qualified battery charger to OPERABLE status.

~~A~~B.1, ~~A~~B.2.1, ~~A~~B.2.2, ~~A~~B.2.3, and ~~A~~B.2.4

If two ~~trains~~ subsystems are required by LCO 3.8.10, the remaining ~~train~~ subsystem with DC power available may be capable of supporting sufficient systems to allow continuation of CORE ALTERATIONS and fuel movement. By allowing the option to declare required features inoperable with the associated vital DC power source(s) inoperable, appropriate restrictions will be implemented in accordance with the affected required features LCO ACTIONS. In many instances, this option may involve undesired administrative efforts. Therefore, the allowance for sufficiently conservative actions is made (i.e., to suspend CORE ALTERATIONS, movement of irradiated fuel assemblies, and operations involving positive reactivity additions). The Required Action to suspend positive reactivity additions does not preclude actions to maintain or increase reactor vessel inventory, provided the required SDM is maintained.

Suspension of these activities shall not preclude completion of actions to establish a safe conservative condition. These actions minimize probability of the occurrence of postulated events. It is further required to immediately initiate action to restore the required vital DC electrical power subsystems and to continue this action until restoration is accomplished in order to provide the necessary DC electrical power to the plant safety systems.

The Completion Time of immediately is consistent with the required times for actions requiring prompt attention. The restoration of the required vital DC electrical power subsystems should be completed as quickly as possible in order to minimize the time during which the plant safety systems may be without sufficient power.

~~B~~C.1

If one or more DG DC electrical power subsystem cannot be restored to OPERABLE status in the associated Completion Time, the associated DG may be incapable of performing its intended function and must be immediately declared inoperable. This declaration also requires entry into applicable Conditions and Required Actions for an inoperable DG, LCO 3.8.2, “AC Sources - Shutdown.”

BASES (continued)

SURVEILLANCE REQUIREMENTS

SR 3.8.5.1

SR 3.8.5.1 requires performance of all Surveillances required by SR 3.8.4.1 through SR 3.8.4.~~14~~7. Therefore, see the corresponding Bases for LCO 3.8.4 for a discussion of each SR.

This SR is modified by a Note. The reason for the Note is to preclude requiring the OPERABLE DC sources from being discharged below their capability to provide the required power supply or otherwise rendered inoperable during the performance of SRs. It is the intent that these SRs must still be capable of being met, but actual performance is not required.

REFERENCES

1. Watts Bar FSAR, Section 15, “Accident Analysis” and Section 6, “Engineered Safety Features.”
2. Watts Bar FSAR, Section 8.0, “Electric Power.”

B 3.8 ELECTRICAL POWER SYSTEMS

B 3.8.6 Battery ~~Cell~~ Parameters

BASES

BACKGROUND

This LCO delineates the limits on battery float current, electrolyte temperature, electrolyte level, and ~~cell~~ float voltage for the 125V vital DC electrical power subsystem and the diesel generator (DG) batteries. A discussion of these batteries and their OPERABILITY requirements is provided in the Bases for LCO 3.8.4, "DC Sources - Operating," and LCO 3.8.5, "DC Sources - Shutdown." In addition to the limitations of this Specification, the Battery Monitoring and Maintenance Program also implements a program specified in Specification 5.7.2.22 for monitoring various battery parameters.

The battery cells are of flooded lead acid construction with a nominal specific gravity of 1.215. This specific gravity corresponds to an open circuit battery voltage of approximately 120 V for 60 cell battery (i.e., cell voltage of 2.063 volts per cell (Vpc)). The open circuit voltage is the voltage maintained when there is no charging or discharging. Optimal long term performance however, is obtained by maintaining a float voltage 2.20 to 2.25 Vpc. This provides adequate over-potential which limits the formation of lead sulfate and self discharge. The nominal float voltage of 2.22 Vpc corresponds to a total float voltage output of 133.2 V for a 60 cell battery as discussed in the FSAR, Chapter 8 (Ref. 3).

APPLICABLE SAFETY ANALYSES

The initial conditions of Design Basis Accident (DBA) and transient analyses in the FSAR, Section 6 (Ref. 1) and Section 15 (Ref. 1), assume Engineered Safety Feature systems are OPERABLE. The vital DC electrical power system provides normal and emergency DC electrical power for the emergency auxiliaries, and control and switching during all MODES of operation. The DG battery systems provide DC power for the DGs.

The OPERABILITY of the DC subsystems is consistent with the initial assumptions of the accident analyses and is based upon meeting the design basis of the plant. This includes maintaining at least one ~~train~~ subsystem of DC sources OPERABLE during accident conditions, in the event of:

a. An assumed loss of all offsite AC power or all onsite AC power; and

b. A worst case single failure.

Battery parameters satisfy the Criterion 3 of 10 CFR 50.36(c)(2)(ii).

BASES (continued)

LCO

Battery parameters must remain within acceptable limits to ensure availability of the required DC power to shut down the reactor and maintain it in a safe condition after an anticipated operational occurrence or a postulated DBA. ~~Electrolyte~~ Battery parameter limits are conservatively established, allowing continued DC electrical system function even with ~~Category A and B~~ limits not met. Additional preventative maintenance, testing, and monitoring performed in accordance with the Battery Monitoring and Maintenance Program is conducted as specified in Specification 5.7.2.22.

APPLICABILITY

The battery ~~cell~~ parameters are required solely for the support of the associated vital DC and DG DC electrical power subsystems. Therefore, battery ~~electrolyte is~~ parameter limits are only required when the DC power source is required to be OPERABLE. Refer to the Applicability discussion in Bases for LCO 3.8.4 and LCO 3.8.5.

ACTIONS

~~A.1, A.2, and A.3~~

~~With one or more cells in one or more batteries not within limits (i.e., Category A limits not met, Category B limits not met, or Category A and B limits not met) but within the Category C limits specified in Table 3.8.6-1 in the accompanying LCO, the battery is degraded but there is still sufficient capacity to perform the intended function. Therefore, the affected battery is not required to be considered inoperable solely as a result of Category A or B limits not met, and operation is permitted for a limited period.~~

~~The pilot cell electrolyte level and float voltage are required to be verified to meet the Category C limits within 1 hour (Required Action A.1). This check will provide a quick indication of the status of the remainder of the battery cells. One hour provides time to inspect the electrolyte level and to confirm the float voltage of the pilot cells. One hour is considered a reasonable amount of time to perform the required verification.~~

~~Verification that the Category C limits are met (Required Action A.2) provides assurance that during the time needed to restore the parameters to the Category A and B limits, the battery is still capable of performing its intended function. A period of 24 hours is allowed to complete the initial verification because specific gravity measurements must be obtained for each connected cell. Taking into consideration both the time required to perform the required verification and the assurance that the battery cell parameters are not severely degraded, this time is considered reasonable. The verification is repeated at 7 day intervals until the parameters are restored to Category A and B limits. This periodic verification is consistent with the normal Frequency of pilot cell surveillances.~~

(continued)

BASES

ACTIONS

~~A.1, A.2, and A.3 (continued)~~

~~Continued operation is only permitted for 31 days before battery cell parameters must be restored to within Category A and B limits. With the consideration that, while battery capacity is degraded, sufficient capacity exists to perform the intended function and to allow time to fully restore the battery cell parameters to normal limits, this time is acceptable prior to declaring the battery inoperable.~~

A.1, A.2, and A.3

With one or more cells in one or more batteries in one vital DC subsystem < 2.07 V, the battery cell is degraded. Within 2 hours verification of the required battery charger OPERABILITY is made by monitoring the battery terminal voltage (SR 3.8.4.1) and of the overall battery state of charge by monitoring the battery float charge current (SR 3.8.6.1). This assures that there is still sufficient battery capacity to perform the intended function. Therefore, the affected battery is not required to be considered inoperable solely as a result of one or more cells in one or more batteries < 2.07 V, and continued operation is permitted for a limited period up to 24 hours.

Since the Required Actions only specify "perform," a failure of SR 3.8.4.1 or SR 3.8.6.1 acceptance criteria does not result in this Required Action not met. However, if one of the SRs is failed the appropriate Condition(s), depending on the cause of the failures, is entered. If SR 3.8.6.1 is failed then there is not assurance that there is still sufficient battery capacity to perform the intended function and the battery must be declared inoperable immediately.

B.1 and B.2

One or more batteries in one vital DC subsystem with float current > 2 amps indicates that a partial discharge of the battery capacity has occurred. This may be due to a temporary loss of a battery charger or possibly due to one or more battery cells in a low voltage condition reflecting some loss of capacity. Within 2 hours verification of the required battery charger OPERABILITY is made by monitoring the battery terminal voltage. If the terminal voltage is found to be less than the minimum established float voltage there are two possibilities, the battery charger is inoperable or is operating in the current limit mode. Condition A addresses charger inoperability. If the charger is operating in the current limit mode after 2 hours that is an indication that the battery has been substantially discharged and likely cannot perform its required design functions. The time to return the battery to its fully charged condition in this case is a function of the battery charger capacity, the amount of loads on the associated DC system, the amount of the previous discharge, and

(continued)

BASES

ACTIONS

B.1 and B.2 (continued)

the recharge characteristic of the battery. The charge time can be extensive, and there is not adequate assurance that it can be recharged within 12 hours (Required Action B.2). The battery must therefore be declared inoperable.

If the float voltage is found to be satisfactory but there are one or more battery cells with float voltage less than 2.07 V, the associated "OR" statement in Condition H is applicable and the battery must be declared inoperable immediately. If float voltage is satisfactory and there are no cells less than 2.07 V there is good assurance that, within 12 hours, the battery will be restored to its fully charged condition (Required Action B.2) from any discharge that might have occurred due to a temporary loss of the battery charger.

A discharged battery with float voltage (the charger setpoint) across its terminals indicates that the battery is on the exponential charging current portion (the second part) of its recharge cycle. The time to return a battery to its fully charged state under this condition is simply a function of the amount of the previous discharge and the recharge characteristic of the battery. Thus there is good assurance of fully recharging the battery within 12 hours, avoiding a premature shutdown with its own attendant risk.

If the condition is due to one or more cells in a low voltage condition but still greater than 2.07 V and float voltage is found to be satisfactory, this is not indication of a substantially discharged battery and 12 hours is a reasonable time prior to declaring the battery inoperable.

Since Required Action B.1 only specifies "perform," a failure of SR 3.8.4.1 acceptance criteria does not result in the Required Action not met. However, if SR 3.8.4.1 is failed, the appropriate Condition(s), depending on the cause of the failure, is entered.

C.1, C.2, and C.3

With one or more cells in one or more batteries in one DG DC subsystem < 2.07 V, the battery cell is degraded. Within 2 hours verification of the required battery charger OPERABILITY is made by monitoring the battery terminal voltage (SR 3.8.4.2) and of the overall battery state of charge by monitoring the battery float charge current (SR 3.8.6.2). This assures that there is still sufficient battery capacity to perform the intended function.

Therefore, the affected battery is not required to be considered inoperable solely as a result of one or more cells in one or more batteries < 2.07 V, and continued operation is permitted for a limited period up to 24 hours.

(continued)

BASES

ACTIONS

C.1, C.2, and C.3 (continued)

Since the Required Actions only specify "perform," a failure of SR 3.8.4.2 or SR 3.8.6.2 acceptance criteria does not result in this Required Action not met. However, if one of the SRs is failed the appropriate Condition(s), depending on the cause of the failures, is entered. If SR 3.8.6.2 is failed then there is not assurance that there is still sufficient battery capacity to perform the intended function and the battery must be declared inoperable immediately.

D.1 and D.2

One or more batteries in one DG DC subsystem with float current > 1 amps indicates that a partial discharge of the battery capacity has occurred. This may be due to a temporary loss of a battery charger or possibly due to one or more battery cells in a low voltage condition reflecting some loss of capacity. Within 2 hours verification of the required battery charger OPERABILITY is made by monitoring the battery terminal voltage. If the terminal voltage is found to be less than the minimum established float voltage there are two possibilities, the battery charger is inoperable or is operating in the current limit mode. Condition B addresses charger inoperability. If the charger is operating in the current limit mode after 2 hours that is an indication that the battery has been substantially discharged and likely cannot perform its required design functions. The time to return the battery to its fully charged condition in this case is a function of the battery charger capacity, the amount of loads on the associated DC system, the amount of the previous discharge, and the recharge characteristic of the battery. The charge time can be extensive, and there is not adequate assurance that it can be recharged within 12 hours (Required Action D.2). The battery must therefore be declared inoperable.

If the float voltage is found to be satisfactory but there are one or more battery cells with float voltage less than 2.07 V, the associated "OR" statement in Condition H is applicable and the battery must be declared inoperable immediately. If float voltage is satisfactory and there are no cells less than 2.07 V there is good assurance that, within 12 hours, the battery will be restored to its fully charged condition (Required Action D.2) from any discharge that might have occurred due to a temporary loss of the battery charger.

A discharged battery with float voltage (the charger setpoint) across its terminals indicates that the battery is on the exponential charging current portion (the second part) of its recharge cycle. The time to return a battery to its fully charged state under this condition is simply a function of the amount of the previous discharge and the recharge characteristic of the battery. Thus there is good assurance of fully recharging the battery within 12 hours, avoiding a premature shutdown with its own attendant risk.

(continued)

BASES

ACTIONS

D.1 and D.2 (continued)

If the condition is due to one or more cells in a low voltage condition but still greater than 2.07 V and float voltage is found to be satisfactory, this is not indication of a substantially discharged battery and 12 hours is a reasonable time prior to declaring the battery inoperable.

Since Required Action D.1 only specifies "perform," a failure of SR 3.8.4.2 acceptance criteria does not result in the Required Action not met. However, if SR 3.8.4.2 is failed, the appropriate Condition(s), depending on the cause of the failure, is entered.

E.1, E.2, and E.3

With one or more required batteries in one vital DC subsystem or one DG battery with one or more cells electrolyte level above the top of the plates, but below the minimum established design limits, the battery still retains sufficient capacity to perform the intended function. Therefore, the affected battery is not required to be considered inoperable solely as a result of electrolyte level not met. Within 31 days the minimum established design limits for electrolyte level must be re-established.

With electrolyte level below the top of the plates there is a potential for dryout and plate degradation. Required Actions E.1 and E.2 address this potential (as well as provisions in Specification 5.7.2.22, Battery Monitoring and Maintenance Program). They are modified by a Note that indicates they are only applicable if electrolyte level is below the top of the plates. Within 8 hours level is required to be restored to above the top of the plates. The Required Action E.2 requirement to verify that there is no leakage by visual inspection and the Specification 5.7.2.22.b item to initiate action to equalize and test in accordance with manufacturer's recommendation. They are performed following the restoration of the electrolyte level to above the top of the plates. Based on the results of the manufacturer's recommended testing the battery(ies) may have to be declared inoperable and the affected cell(s) replaced.

F.1

With one or more batteries in one vital DC subsystem or one DG battery with pilot cell temperature less than the minimum established design limits, 12 hours is allowed to restore the temperature to within limits. A low electrolyte temperature limits the current and power available. Since the battery is sized with margin, while battery capacity is degraded, sufficient capacity exists to perform the intended function and the affected battery is not required to be considered inoperable solely as a result of the pilot cell temperature not met.

(continued)

BASES

ACTIONS (continued)

G.1

With one or more batteries in redundant vital DC subsystems with battery parameters not within limits there is not sufficient assurance that battery capacity has not been affected to the degree that the batteries can still perform their required function, given that redundant batteries are involved. With redundant batteries involved this potential could result in a total loss of function on multiple systems that rely upon the batteries. With more than one DG battery with battery parameters not within limits there is not sufficient assurance that battery capacity has not been affected to the degree that the batteries can still perform their required function.

The longer Completion Times specified for battery parameters on non-redundant batteries not within limits are therefore not appropriate, and the parameters must be restored to within limits on at least one subsystem within 2 hours.

~~B~~H.1

With one or more batteries with ~~one or more~~ any battery ~~cell~~ parameter~~s~~ outside the ~~Category C limits for any connected cell,~~ allowances of the Required Actions for Condition A, B, C, D, E, F, or G, sufficient capacity to supply the maximum expected load requirement is not assured and the corresponding ~~vital DC or DG DC electrical power subsystem~~ battery must be declared inoperable. Additionally, ~~other potentially extreme conditions, such as not completing the Required Actions of Condition A within the required Completion Time or average electrolyte temperature of representative cells falling below 60°F for the vital batteries or 50°F for DG batteries, are also cause for immediately declaring the associated vital DC or DG DC electrical power subsystem inoperable.~~ discovering one or more vital DC batteries in one subsystem with one or more battery cells float voltage less than 2.07 V and float current greater than 2 amps, or one DG battery cells float voltage greater than or equal to 2.07 V and float current greater than 1 amp, indicates that the battery capacity may not be sufficient to perform the intended functions. The battery must therefore be declared inoperable immediately.

~~SURVEILLANCE REQUIREMENTS~~

~~SR 3.8.6.1~~

~~This SR verifies that Category A battery cell parameters are consistent with IEEE-450 (Ref. 2), which recommends regular battery inspections (at least one per month) including voltage, specific gravity, and electrolyte temperature of pilot cells.~~

(continued)

BASES

SURVEILLANCE REQUIREMENTS (continued)

SR 3.8.6.2

The quarterly inspection of specific gravity and voltage is consistent with IEEE-450 (Ref. 2). In addition, within 24 hours of a battery discharge < 110 V (113.5V for Vital Battery V or 106.5 for DG batteries) or a battery overcharge > 150 V (155 V for Vital Battery V or 145 V for DG batteries), the battery must be demonstrated to meet Category B limits. Transients, such as motor starting transients, which may momentarily cause battery voltage to drop to ≤ 110 V (113.5 V for Vital Battery V or 106.5 V for DG batteries), do not constitute a battery discharge provided the battery terminal voltage and float current return to pre-transient values. This inspection is also consistent with IEEE-450 (Ref. 2), which recommends special inspections following a severe discharge or overcharge, to ensure that no significant degradation of the battery occurs as a consequence of such discharge or overcharge.

SR 3.8.6.3

This Surveillance verification that the average temperature of representative cells is ≥ 60°F for the vital batteries and ≥ 50°F for the DG batteries, is consistent with a recommendation of IEEE-450 (Ref. 2), that states that the temperature of electrolytes in representative cells should be determined on a quarterly basis.

Lower than normal temperatures act to inhibit or reduce battery capacity. This SR ensures that the operating temperatures remain within an acceptable operating range. This limit is based on manufacturer recommendations.

Table 3.8.6-1

This table delineates the limits on electrolyte level, float voltage, and specific gravity for three different categories. The meaning of each category is discussed below.

Category A defines the normal parameter limit for each designated pilot cell in each battery. The cells selected as pilot cells are those whose temperature, voltage, and electrolyte specific gravity approximate the state of charge of the entire battery.

The Category A limits specified for electrolyte level are based on manufacturer recommendations and are consistent with the guidance in IEEE-450 (Ref. 2), with the extra ¼ inch allowance above the high water level indication for operating margin to account for temperatures and charge effects. In addition to this allowance, footnote a to Table 3.8.6-1 permits the electrolyte level to be above the specified maximum level during equalizing charge, provided it is not overflowing. These limits ensure that the plates suffer no physical damage, and that adequate

(continued)

BASES

~~SURVEILLANCE REQUIREMENTS (continued)~~

~~electron transfer capability is maintained in the event of transient conditions. IEEE-450 (Ref. 2) recommends that electrolyte level readings should be made only after the battery has been at float charge for at least 72 hours.~~

~~The Category A limit specified for float voltage is ≥ 2.13 V per cell. This value is based on the recommendations of IEEE-450 (Ref. 2), which states that prolonged operation of cells < 2.13 V can reduce the life expectancy of cells.~~

~~The Category A limit specified for specific gravity for each pilot cell is ≥ 1.200 (0.015 below the manufacturer fully charged nominal specific gravity or a battery charging current that had stabilized at a low value). This value is characteristic of a charged cell with adequate capacity. According to IEEE-450 (Ref. 2), the specific gravity readings are based on a temperature of 77°F (25°C).~~

~~The specific gravity readings are corrected for actual electrolyte temperature and level. For each 3°F (1.67°C) above 77°F (25°C), 1 point (0.001) is added to the reading; 1 point is subtracted for each 3°F below 77°F. The specific gravity of the electrolyte in a cell increases with a loss of water due to electrolysis or evaporation.~~

~~Category B defines the normal parameter limits for each connected cell. The term "connected cell" excludes any battery cell that may be jumpered out.~~

~~The Category B limits specified for electrolyte level and float voltage are the same as those specified for Category A and have been discussed above. The Category B limit specified for specific gravity for each connected cell is ≥ 1.195 (0.020 below the manufacturer fully charged, nominal specific gravity) with the average of all connected cells > 1.205 (0.010 below the manufacturer fully charged, nominal specific gravity). These values are based on manufacturer's recommendations. The minimum specific gravity value required for each cell ensures that the effects of a highly charged or newly installed cell will not mask overall degradation of the battery.~~

~~Category C defines the limits for each connected cell. These values, although reduced, provide assurance that sufficient capacity exists to perform the intended function and maintain a margin of safety. When any battery parameter is outside the Category C limits, the assurance of sufficient capacity described above no longer exists, and the battery must be declared inoperable.~~

~~The Category C limits specified for electrolyte level (above the top of the plates and not overflowing) ensure that the plates suffer no physical~~

(continued)

SURVEILLANCE REQUIREMENTS (continued)

damage and maintain adequate electron transfer capability. The Category C limits for float voltage is based on IEEE-450 (Ref. 2), which states that a cell voltage of 2.07 V or below, under float conditions and not caused by elevated temperature of the cell, indicates internal cell problems and may require cell replacement.

The Category C limits of average specific gravity ≥ 1.195 is based on manufacturer recommendations (0.020 below the manufacturer recommended fully charged, nominal specific gravity). In addition to that limit, it is required that the specific gravity for each connected cell must be no less than 0.020 below the average of all connected cells. This limit ensures that the effect of a highly charged or new cell does not mask overall degradation of the battery.

The footnotes to Table 3.8.6-1 are applicable to Category A, B, and C specific gravity. Footnote b to Table 3.8.6-1 requires the above mentioned correction for electrolyte level and temperature, with the exception that level correction is not required when battery charging current is < 2 amps on float charge for vital batteries and < 1.0 amps for DG batteries. This current provides, in general, an indication of overall battery condition.

Because of specific gravity gradients that are produced during the recharging process, delays of several days may occur while waiting for the specific gravity to stabilize. A stabilized charger current is an acceptable alternative to specific gravity measurement for determining the state of charge. This phenomenon is discussed in IEEE-450 (Ref. 2). Footnote c to Table 3.8.6-1 allows the float charge current to be used as an alternate to specific gravity for up to 31 days following a battery recharge. Within 31 days each connected cell's specific gravity must be measured to confirm the state of charge. Following a minor battery recharge (such as equalizing charge that does not follow a deep discharge) specific gravity gradients are not significant, and confirming measurements may be made in less than 31 days.

SURVEILLANCE REQUIREMENTS

SR 3.8.6.1 and SR 3.8.6.2

Verifying battery float current while on float charge is used to determine the state of charge of the battery. Float charge is the condition in which the charger is supplying the continuous charge required to overcome the internal losses of a battery and maintain the battery in a charged state. The equipment used to monitor float current must have the necessary accuracy and capability to measure electrical currents in the expected range. The float current requirements are based on the float current indicative of a charged battery. The 7 day Frequency is consistent with IEEE-450 (Ref. 2).

SR 3.8.6.1 is modified by a Note that states the float current requirement is not required to be met when battery terminal voltage is less than the minimum established float voltage of SR 3.8.4.1. When this float voltage is not maintained the Required Actions of LCO 3.8.4 ACTION A are being taken, which provide the necessary and appropriate verifications of the battery condition. Furthermore, the float current limit of 2 amps is established based on the nominal float voltage value and is not directly applicable when this voltage is not maintained.

SR 3.8.6.2 is modified by a Note that states the float current requirement is not required to be met when battery terminal voltage is less than the minimum established float voltage of SR 3.8.4.2. When this float voltage is not maintained the Required Actions of LCO 3.8.4 ACTION D are being taken, which provide the necessary and appropriate verifications of the battery condition. Furthermore, the float current limit of 1 amp is established based on the nominal float voltage value and is not directly applicable when this voltage is not maintained.

SR 3.8.6.3 and SR 3.8.6.6

Optimal long term battery performance is obtained by maintaining a float voltage greater than or equal to the minimum established design limits provided by the battery manufacturer, which corresponds to 132 V at the battery terminals, or 2.20 Vpc. This provides adequate overpotential, which limits the formation of lead sulfate and self discharge, which could eventually render the battery inoperable. Float voltages in this range or less, but greater than 2.07 Vpc, are addressed in Specification 5.7.2.22. SRs 3.8.6.3 and 3.8.6.6 require verification that the cell float voltages are equal to or greater than the short term absolute minimum voltage of 2.07 V. The Frequency for cell voltage verification every 31 days for pilot cell and 92 days for each connected cell is consistent with IEEE-450 (Ref. 2).

SR 3.8.6.4

The limit specified for electrolyte level ensures that the plates suffer no physical damage and maintains adequate electron transfer capability. The minimum design electrolyte level is the minimum level indication mark on the battery cell jar. The Frequency is consistent with IEEE-450 (Ref. 2).

SURVEILLANCE REQUIREMENTS (continued)

SR 3.8.6.5

This Surveillance verifies that the pilot cell temperature is greater than or equal to the minimum established design limit (i.e., 60°F for vital batteries and 50°F for DG batteries). Pilot cell electrolyte temperature is maintained above this temperature to assure the battery can provide the required current and voltage to meet the design requirements. Temperatures lower than assumed in battery sizing calculations act to inhibit or reduce battery capacity. The Frequency is consistent with IEEE-450 (Ref. 2).

SR 3.8.6.7

A battery performance discharge test is a test of constant current capacity of a battery, normally done in the as found condition, after having been in service, to detect any change in the capacity determined by the acceptance test. The test is intended to determine overall battery degradation due to age and usage.

Either the battery performance discharge test or the modified performance discharge test is acceptable for satisfying SR 3.8.6.7; however, only the modified performance discharge test may be used to satisfy the battery service test requirements of SR 3.8.4.7.

A modified discharge test is a test of the battery capacity and its ability to provide a high rate, short duration load (usually the highest rate of the duty cycle). This will often confirm the battery's ability to meet the critical period of the load duty cycle, in addition to determining its percentage of rated capacity. Initial conditions for the modified performance discharge test should be identical to those specified for a service test.

It may consist of just two rates; for instance the one minute rate for the battery or the largest current load of the duty cycle, followed by the test rate employed for the performance test, both of which envelope the duty cycle of the service test. Since the ampere-hours removed by a one minute discharge represents a very small portion of the battery capacity, the test rate can be changed to that for the performance test without compromising the results of the performance discharge test. The battery terminal voltage for the modified performance discharge test must remain above the minimum battery terminal voltage specified in the battery service test for the duration of time equal to that of the service test.

The acceptance criteria for this Surveillance are consistent with IEEE-450 (Ref. 2) and IEEE-485 (Ref. 4). These references recommend that the battery be replaced if its capacity is below 80% of the manufacturer's rating. A capacity of 80% shows that the battery rate of deterioration is increasing, even if there is ample capacity to meet the load requirements. Furthermore, the battery is sized to meet the assumed duty cycle loads when the battery design capacity reaches this 80% limit.

SURVEILLANCE REQUIREMENTS

SR 3.8.6.7 (continued)

The Surveillance Frequency for this test is normally 60 months. If the battery shows degradation, or if the battery has reached 85% of its expected life and capacity is < 100% of the manufacturer's rating, the Surveillance Frequency is reduced to 12 months. However, if the battery shows no degradation but has reached 85% of its expected life, the Surveillance Frequency is only reduced to 24 months for batteries that retain capacity ≥ 100% of the manufacturer's ratings. Degradation is indicated, according to IEEE-450 (Ref. 2), when the battery capacity drops by more than 10% relative to its capacity on the previous performance test or when it is ≥ 10% below the manufacturer's rating. These Frequencies are consistent with the recommendations in IEEE-450 (Ref. 2).

This SR is modified by a Note. The reason for the Note is that performing the Surveillance would perturb the electrical distribution system and challenge safety systems. Credit may be taken for unplanned events that satisfy this SR.

REFERENCES

1. Watts Bar FSAR, Section 15, “Accident Analysis,” and Section 6, “Engineered Safety Features.”

2. IEEE-450~~-1980/1995~~2002, "IEEE Recommended Practice for Maintenance, Testing, and Replacement of ~~Large~~ Vented Lead-Acid ~~Storage~~ Batteries for ~~Generating Stations and Substations~~Stationary Applications."

3. Watts Bar FSAR, Section 8, “Electric Power.”

4. IEEE-485-1983, "IEEE Recommended Practice for Sizing Large Lead Storage Batteries for Generating Stations and Substations."

Enclosure 3

Clean Technical Specification and Bases Changes

3.8 ELECTRICAL POWER SYSTEMS

3.8.4 DC Sources - Operating

LCO 3.8.4 The Train A and Train B vital DC electrical power subsystems and four Diesel Generator (DG) DC electrical power subsystems shall be OPERABLE.

----------NOTE----------
Vital Battery V may be substituted for any of the required vital batteries.

APPLICABILITY: MODES 1, 2, 3, and 4.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One or two required vital battery charger(s) on one subsystem inoperable.	A.1 Restore battery terminal voltage to greater than or equal to the minimum established float voltage. AND A.2 Verify battery float current ≤ 2 amps. AND A.3 Restore vital battery charger(s) to OPERABLE status.	2 hours Once per 12 hours 7 days
B. One vital DC electrical power subsystem inoperable for reasons other than Condition A.	B.1 Restore vital DC electrical power subsystem to OPERABLE status.	2 hours

(continued)

ACTIONS (continued)

CONDITION		REQUIRED ACTION		COMPLETION TIME
C.	Required Action and Associated Completion Time of Condition A or B not met.	C.1	Be in MODE 3.	6 hours
		AND		
		C.2	Be in MODE 5.	36 hours
D.	One DG DC battery charger inoperable.	D.1	Restore DG battery terminal voltage to greater than or equal to the minimum established float voltage.	2 hours
		AND		
		D.2	Verify battery float current ≤ 1 amp.	Once per 12 hours
		AND		
		D.3	Restore DG battery charger to OPERABLE status.	72 hours
E.	One DG DC electrical power subsystem inoperable for reasons other than Condition D.	E.1	Restore DG DC electrical power subsystem to OPERABLE status.	2 hours
F.	Required Action and associated Completion Time of Condition D or E not met.	F.1	Declare associated DG inoperable.	Immediately

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.8.4.1	Verify vital battery terminal voltage is greater than or equal to the minimum established float voltage.	7 days
SR 3.8.4.2	Verify DG battery terminal voltage is greater than or equal to the minimum established float voltage.	7 days
SR 3.8.4.3	Verify for the vital batteries that the alternate feeder breakers to each required battery charger are open.	7 days
SR 3.8.4.4	Verify correct breaker alignment and indicated power availability for each DG 125 V DC distribution panel and associated battery charger.	7 days
SR 3.8.4.5	Verify each vital battery charger supplies ≥ 200 amps at greater than or equal to the minimum established float voltage for ≥ 4 hours. OR Verify each vital battery charger can recharge the battery to the fully charged state within 36 hours while supplying the largest combined demands of the various continuous steady state loads, after a battery discharge to the bounding design basis event discharge state.	18 months

(continued)

SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE		FREQUENCY
SR 3.8.4.6	----------NOTE---------- Credit may be taken for unplanned events that satisfy this SR. ---------- Verify each DG battery charger supplies ≥ 20 amps at greater than or equal to the minimum established float voltage for ≥ 4 hours. OR Verify each DG battery charger can recharge the battery to the fully charged state within 24 hours while supplying the largest combined demands of the various continuous steady state loads, after a battery discharge to the bounding design basis event discharge state.	18 months
SR 3.8.4.7	----------NOTES---------- 1. The modified performance discharge test in SR 3.8.6.7 may be performed in lieu of the service test in SR 3.8.4.7. 2. This Surveillance is not performed in MODE 1, 2, 3, or 4 for required vital batteries. Credit may be taken for unplanned events that satisfy this SR. ---------- Verify battery capacity is adequate to supply, and maintain in OPERABLE status, the required emergency loads and any connected nonsafety loads for the design duty cycle when subjected to a battery service test.	18 months

3.8 ELECTRICAL POWER SYSTEMS

3.8.5 DC Sources - Shutdown

LCO 3.8.5 Vital DC and Diesel Generator (DG) DC electrical power subsystems shall be OPERABLE to support the DC electrical power distribution subsystem(s) required by LCO 3.8.10, "Distribution Systems - Shutdown" and to support the Diesel Generators (DGs) required by LCO 3.8.2, "AC Sources - Shutdown."

----------NOTE----------
Vital Battery V may be substituted for any of the required vital batteries.

APPLICABILITY: MODES 5 and 6,
During movement of irradiated fuel assemblies.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One or two required vital battery charger(s) on one subsystem inoperable. AND The redundant subsystem vital battery and charger(s) OPERABLE.	A.1 Restore battery terminal voltage to greater than or equal to the minimum established float voltage. AND A.2 Verify battery float current ≤ 2 amps. AND A.3 Restore battery charger(s) to OPERABLE status.	2 hours Once per 12 hours 7 days

(continued)

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
B. One or more required vital DC electrical power subsystems inoperable for reasons other than Condition A. OR Required Actions and associated Completion Time of Condition A not met.	B.1.1 Declare affected required feature(s) inoperable. OR B.2.1 Suspend CORE ALTERATIONS. AND B.2.2 Suspend movement of irradiated fuel assemblies. AND B.2.3 Initiate action to suspend operations involving positive reactivity additions. AND B.2.4 Initiate action to restore required DC electrical power subsystems to OPERABLE status.	Immediately Immediately Immediately Immediately Immediately
C. One required DG DC electrical power subsystem inoperable.	C.1 Declare associated DG inoperable.	Immediately

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.8.5.1	----------NOTE---------- The following SRs are not required to be performed: SR 3.8.4.5, SR 3.8.4.6, and SR 3.8.4.7. ----------	
	For DC sources required to be OPERABLE, the following SRs are applicable: SR 3.8.4.1 SR 3.8.4.5 SR 3.8.4.2 SR 3.8.4.6 SR 3.8.4.3 SR 3.8.4.7 SR 3.8.4.4	In accordance with applicable SRs

3.8 ELECTRICAL POWER SYSTEMS

3.8.6 Battery Parameters

LCO 3.8.6 Battery parameters for Train A and Train B electrical power subsystem 125 V vital batteries and 125 V diesel generator (DG) batteries shall be within limits.

APPLICABILITY: When associated DC electrical power subsystems and DGs are required to be OPERABLE.

ACTIONS

----------NOTE----------
Separate Condition entry is allowed for each battery bank.

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One or two required vital battery(ies) on one subsystem with one or more battery cells float voltage < 2.07 V.	A.1 Perform SR 3.8.4.1. AND A.2 Perform SR 3.8.6.1. AND A.3 Restore affected cell voltage ≥ 2.07 V.	2 hours 2 hours 24 hours
B. One or two required vital battery(ies) on one subsystem with float current > 2 amps.	B.1 Perform SR 3.8.4.1. AND B.2 Restore vital battery float current to ≤ 2 amps.	2 hours 12 hours

(continued)

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
C. One DG battery with one or more battery cells float voltage < 2.07 V.	C.1 Perform SR 3.8.4.2. AND C.2 Perform SR 3.8.6.2. AND C.3 Restore affected cell voltage ≥ 2.07 V.	2 hours 2 hours 24 hours
D. One DG battery with float current > 1 amp.	D.1 Perform SR 3.8.4.2. AND D.2 Restore vital battery float current to ≤ 1 amp.	2 hours 12 hours
----------NOTE---------- Required Action E.2 shall be completed if electrolyte level was below the top of plates. ----------	----------NOTE---------- Required Actions E.1 and E.2 are only applicable if electrolyte level was below the top of plates. ----------	
E. One or two required vital battery(ies) on one subsystem with one or more cells electrolyte level less than minimum established design limits. OR One DG battery with one or more cells electrolyte level less than minimum established design limits.	E.1 Restore electrolyte level to above top of plates. AND E.2 Verify no evidence of leakage. AND E.3 Restore electrolyte level to greater than or equal to minimum established design limits.	8 hours 12 hours 31 days

(continued)

ACTIONS (continued)

CONDITION		REQUIRED ACTION		COMPLETION TIME
F.	One or two required vital battery(ies) on one subsystem with pilot cell electrolyte temperature less than minimum established design limits. OR One DG battery with pilot cell electrolyte temperature less than minimum established design limits.	F.1	Restore battery pilot cell temperature to greater than or equal to minimum established design limits.	12 hours
G.	One or more batteries in redundant subsystems with battery parameters not within limits. OR More than one DG battery with battery parameters not within limits.	G.1	Restore battery parameters to within limits.	2 hours

(continued)

ACTIONS (continued)

CONDITION		REQUIRED ACTION		COMPLETION TIME
H.	Required Action and associated Completion Time of Condition A, B, C, D, E, F, or G not met. OR One or two required vital battery(ies) on one subsystem with one or more battery cells float voltage < 2.07 V and float current > 2 amps. OR One DG battery with one or more battery cells float voltage < 2.07 V and float current > 1 amp.	H.1	Declare associated battery inoperable.	Immediately

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.8.6.1	----------NOTE---------- Not required to be met when vital battery terminal voltage is less than the minimum established float voltage of SR 3.8.4.1. ---------- Verify each vital battery float current is ≤ 2 amps.	7 days

(continued)

SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE		FREQUENCY
SR 3.8.6.2	----------NOTE---------- Not required to be met when DG battery terminal voltage is less than the minimum established float voltage of SR 3.8.4.2. ---------- Verify each DG battery float current is ≤ 1 amp.	7 days
SR 3.8.6.3	Verify each required vital battery and each DG battery pilot cell float voltage is ≥ 2.07 V.	31 days
SR 3.8.6.4	Verify each required vital battery and each DG battery connected cell electrolyte level is greater than or equal to minimum established design limits.	31 days
SR 3.8.6.5	Verify each required vital battery and each DG battery pilot cell temperature is greater than or equal to minimum established design limits.	31 days
SR 3.8.6.6	Verify each required vital battery and each DG battery connected cell float voltage is ≥ 2.07 V.	92 days

(continued)

SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE		FREQUENCY
SR 3.8.6.7	----------NOTES---------- This Surveillance is not performed in MODE 1, 2, 3, or 4 for required vital batteries. Credit may be taken for unplanned events that satisfy this SR. ----------	
	Verify battery capacity is ≥ 80% of the manufacturer's rating when subjected to a performance discharge test or a modified performance discharge test.	60 months AND 12 months when battery shows degradation or has reached 85% of expected life with capacity < 100% of manufacturer's rating AND 24 months when battery has reached 85% of the expected life with capacity ≥ 100% of manufacturer's rating

5.7 Procedures, Programs, and Manuals

5.7.2.22 Battery Monitoring and Maintenance Program

This Program provides controls for battery restoration and maintenance. The program shall be in accordance with IEEE Standard (Std) 450-2002, "IEEE Recommended Practice for Maintenance, Testing, and Replacement of Vented Lead-Acid Batteries for Stationary Applications," as endorsed by Regulatory Guide 1.129, Revision 2 (RG), with RG exceptions and program provisions as identified below:

a. The program allows the following RG 1.129, Revision 2 exceptions:

1. Battery temperature correction may be performed before or after conducting discharge tests.

2. RG 1.129, Regulatory Position 1, Subsection 2, "References," is not applicable to this program.

3. In lieu of RG 1.129, Regulatory Position 2, Subsection 5.2, "Inspections," the following shall be used: "Where reference is made to the pilot cell, pilot cell selection shall be based on the lowest voltage cell in the battery."

4. In Regulatory Guide 1.129, Regulatory Position 3, Subsection 5.4.1, "State of Charge Indicator," the following statements in paragraph (d) may be omitted: "When it has been recorded that the charging current has stabilized at the charging voltage for three consecutive hourly measurements, the battery is near full charge. These measurements shall be made after the initially high charging current decreases sharply and the battery voltage rises to approach the charger output voltage."

5. In lieu of RG 1.129, Regulatory Position 7, Subsection 7.6, "Restoration", the following may be used: "Following the test, record the float voltage of each cell of the string."

b. The program shall include the following provisions:

1. Actions to restore battery cells with float voltage < 2.13 V;

2. Actions to determine whether the float voltage of the remaining battery cells is ≥ 2.13 V when the float voltage of a battery cell has been found to be < 2.13 V;

3. Actions to equalize and test battery cells that had been discovered with electrolyte level below the top of the plates;

4. Limits on average electrolyte temperature, battery connection resistance, and battery terminal voltage; and

5. A requirement to obtain specific gravity readings of all cells at each discharge test, consistent with manufacturer recommendations.

B 3.8 ELECTRICAL POWER SYSTEMS

B 3.8.4 DC Sources - Operating

BASES

BACKGROUND

The station DC electrical power system provides the AC emergency power system with control power. It also provides both motive and control power to selected safety related equipment and preferred AC vital bus power (via inverters). As required by 10 CFR 50, Appendix A, GDC 17 (Ref. 1), the DC electrical power system is designed to have sufficient independence, redundancy, and testability to perform its safety functions, assuming a single failure. The DC electrical power system also conforms to the recommendations of Regulatory Guide 1.6 (Ref. 2) and IEEE-308 (Ref. 3).

125 V Vital DC Electrical Power Subsystem

The vital 125 VDC electrical power system is a Class IE system whose safety function is to provide control power for engineered safety features equipment, emergency lighting, vital inverters, and other safety-related DC powered equipment for the entire unit. The system capacity is sufficient to supply these loads and any connected nonsafety loads during normal operation and to permit safe shutdown and isolation of the reactor for the "loss of all AC power" condition. The system is designed to perform its safety function subject to a single failure.

The 125V DC vital power system is composed of the four channels (Channels I and III are associated with Train A and Channels II and IV are associated with Train B) and consists of four lead-acid-calcium batteries, eight battery chargers (including two pairs of spare chargers), four distribution boards, battery racks, and the required cabling, instrumentation and protective features. Each channel is electrically and physically independent from the equipment of all other channels so that a single failure in one channel will not cause a failure in another channel. Each channel consists of a battery charger which supplies normal DC power, a battery for emergency DC power, and a battery board which facilitates load grouping and provides circuit protection. These four channels are used to provide emergency power to the 120V AC vital power system which furnishes control power to the reactor protection system. No automatic connections are used between the four channels.

Battery boards I, II, III, and IV have a charger normally connected to them and also have manual access to a spare (backup) charger for use upon loss of the normal charger.

(continued)

BASES

BACKGROUND

125 V Vital DC Electrical Power Subsystem (continued)

Additionally, battery boards I, II, III, and IV have manual access to the fifth vital battery system. The fifth 125V DC Vital Battery System is intended to serve as a replacement for any one of the four 125V DC vital batteries during their testing, maintenance, and outages with no loss of system reliability under any mode of operation.

Each of the vital DC electrical power subsystems provide the control power for its associated Class 1E AC power load group, 6.9 kV switchgear, and 480 V load centers. The vital DC electrical power subsystems also provide DC electrical power to the inverters, which in turn power the AC vital buses. Additionally, they power the emergency DC lighting system.

The vital DC power distribution system is described in more detail in Bases for LCO 3.8.9, "Distribution System - Operating," and LCO 3.8.10, "Distribution Systems - Shutdown."

Each 125 VDC vital battery is separately housed in a ventilated room apart from its charger and distribution centers, except for Vital Battery V. Each subsystem is located in an area separated physically and electrically from the other subsystem to ensure that a single failure in one subsystem does not cause a failure in a redundant subsystem. There is no sharing between Class 1E subsystems, such as batteries, battery chargers, or distribution panels.

Each battery has adequate storage capacity to meet the duty cycle(s) discussed in the FSAR, Chapter 8 (Ref 4). The battery is designed with additional capacity above that required by the design duty cycle to allow for temperature variations and other factors.

The batteries for the vital DC electrical power subsystems are sized to produce required capacity at 80% of nameplate rating, corresponding to warranted capacity at end of life cycles and the 100% design demand. The minimum design voltage limit is 105 V.

The battery cells are of flooded lead acid construction with a nominal specific gravity of 1.215. This specific gravity corresponds to an open circuit battery voltage of approximately 120 V for a 60 cell battery (i.e., cell voltage of 2.063 volts per cell (Vpc)). The open circuit voltage is the voltage maintained when there is no charging or discharging. Optimal long term performance however, is obtained by maintaining a float voltage 2.20 to 2.25 Vpc. This provides adequate over-potential, which limits the formation of lead sulfate and self discharge. The nominal float voltage of 2.22 Vpc corresponds to a total float voltage output of 132 V for a 60 cell battery as discussed in the FSAR, Chapter 8 (Ref. 4).

(continued)

BASES

BACKGROUND

125 V Vital DC Electrical Power Subsystem (continued)

Each Vital DC electrical power subsystem battery charger has ample power output capacity for the steady state operation of connected loads required during normal operation, while at the same time maintaining its battery bank fully charged. Each battery charger also has sufficient excess capacity to restore the battery bank from the design minimum charge to its fully charged state within 12 hours (with accident loads being supplied) following a 30 minute AC power outage and in approximately 36 hours (while supplying normal steady state loads following a 2 hour AC power outage), (Ref. 5).

The battery charger is normally in the float-charge mode. Float-charge is the condition in which the charger is supplying the connected loads and the battery cells are receiving adequate current to optimally charge the battery. This assures the internal losses of a battery are overcome and the battery is maintained in a fully charged state.

When desired, the charger can be placed in the equalize mode. The equalize mode is at a higher voltage than the float mode and charging current is correspondingly higher. The battery charger is operated in the equalize mode after a battery discharge or for routine maintenance. Following a battery discharge, the battery recharge characteristic accepts current at the current limit of the battery charger (if the discharge was significant, e.g., following a battery service test) until the battery terminal voltage approaches the charger voltage setpoint. Charging current then reduces exponentially during the remainder of the recharge cycle. Lead-calcium batteries have recharge efficiencies of greater than 95%, so once at least 105% of the ampere-hours discharged have been returned, the battery capacity would be restored to the same condition as it was prior to the discharge. This can be monitored by direct observation of the exponentially decaying charging current or by evaluating the amp-hours discharged from the battery and amp-hours returned to the battery.

(continued)

BASES (continued)

BACKGROUND

125 V Diesel Generator (DG) DC Electrical Power Subsystem

Control power for the DGs is provided by five DG battery systems, one per DG. Each system is comprised of a battery, a dual battery charger assembly, distribution center, cabling, and cable ways. The DG 125V DC control power and field-flash circuits have power supplied from their respective 125V distribution panel. The normal supply of DC current is from the associated charger. The battery provides control and field-flash power when the charger is unavailable. The charger supplies the normal DC loads, maintains the battery in a fully charged condition, and recharges (480V AC available) the battery while supplying the required loads regardless of the status of the unit. The batteries are physically and electrically independent. The battery has sufficient capacity when fully charged to supply required loads for a minimum of 30 minutes following a loss of normal power. Each battery is normally required to supply loads during the time interval between loss of normal feed to its charger and the receipt of emergency power to the charger from its respective DG.

APPLICABLE SAFETY ANALYSES

The initial conditions of Design Basis Accident (DBA) and transient analyses in the FSAR, Section 6 (Ref. 6), and in the FSAR, Section 15 (Ref. 6), assume that Engineered Safety Feature (ESF) systems are OPERABLE. The vital DC electrical power system provides normal and emergency DC electrical power for the emergency auxiliaries, and control and switching during all power for the emergency auxiliaries, and control and switching during all MODES of operation. The DG battery systems provide DC power for the DGs.

The OPERABILITY of the DC sources is consistent with the initial assumptions of the accident analyses and is based upon meeting the design basis of the plant. This includes maintaining the DC sources OPERABLE during accident conditions in the event of:

a. An assumed loss of all offsite AC power or all onsite AC power; and

b. A worst case single failure.

The DC sources satisfy Criterion 3 of the NRC Policy Statement.

(continued)

BASES (continued)

LCO

Two 125V vital DC electrical power subsystems (Train A and Train B), each vital subsystem consisting of two channels. Each channel consisting of a battery bank, associated battery charger and the corresponding control equipment and interconnecting cabling supplying power to the associated DC bus within the channel; and four DG DC electrical power subsystems each consisting of a battery, a dual battery charger assembly, and the corresponding control equipment and interconnecting cabling are required to be OPERABLE to ensure the availability of the required power to shut down the reactor and maintain it in a safe condition after an anticipated operational occurrence (A00) or a postulated DBA. Loss of any DC electrical power subsystem does not prevent the minimum safety function from being performed (Ref. 4).

An OPERABLE vital DC electrical power subsystem requires all required batteries and respective chargers to be operating and connected to the associated DC buses.

The LCO is modified by a Note. The Note indicates that Vital Battery V may be substituted for any of the required vital batteries. However, the fifth battery cannot be declared OPERABLE until it is connected electrically in place of another battery and it has satisfied applicable Surveillance Requirements.

APPLICABILITY

The vital DC electrical power sources and DG DC electrical power sources are required to be OPERABLE in MODES 1, 2, 3, and 4 to ensure safe plant operation and to ensure that:

a. Acceptable fuel design limits and reactor coolant pressure boundary limits are not exceeded as a result of AOs or abnormal transients; and

b. Adequate core cooling is provided, and containment integrity and other vital functions are maintained in the event of a postulated DBA.

The DC electrical power requirements for MODES 5 and 6 are addressed in the Bases for LCO 3.8.5, "DC Sources - Shutdown."

(continued)

BASES (continued)

ACTIONS

A.1, A.2, and A.3

Condition A represents one vital DC subsystem with one or two battery chargers inoperable (e.g., the voltage limit of SR 3.8.4.1 is not maintained). The ACTIONS provide a tiered response that focuses on returning the battery to the fully charged state and restoring a fully qualified charger to OPERABLE status in a reasonable time period. Required Action A.1 requires that the battery terminal voltage be restored to greater than or equal to the minimum established float voltage within 2 hours. This time provides for returning the inoperable charger to OPERABLE status or providing an alternate means of restoring battery terminal voltage to greater than or equal to the minimum established float voltage. Restoring the battery terminal voltage to greater than or equal to the minimum established float voltage provides good assurance that, within 12 hours, the battery will be restored to its fully charged condition (Required Action A.2) from any discharge that might have occurred due to the charger inoperability.

A discharged battery having terminal voltage of at least the minimum established float voltage indicates that the battery is on the exponential charging current portion (the second part) of its recharge cycle. The time to return a battery to its fully charged state under this condition is simply a function of the amount of the previous discharge and the recharge characteristic of the battery. Thus there is good assurance of fully recharging the battery within 12 hours, avoiding a premature shutdown with its own attendant risk.

If established battery terminal float voltage cannot be restored to greater than or equal to the minimum established float voltage within 2 hours, and the charger is not operating in the current-limiting mode, a faulty charger is indicated. A faulty charger that is incapable of maintaining established battery terminal float voltage does not provide assurance that it can revert to and operate properly in the current limit mode that is necessary during the recovery period following a battery discharge event that the DC system is designed for.

If the charger is operating in the current limit mode after 2 hours that is an indication that the battery is partially discharged and its capacity margins will be reduced. The time to return the battery to its fully charged condition in this case is a function of the battery charger capacity, the amount of loads on the associated DC system, the amount of the previous discharge, and the recharge characteristic of the battery. The charge time can be extensive, and there is not adequate assurance that it can be recharged within 12 hours (Required Action A.2).

Required Action A.2 requires that the battery float current be verified as less than or equal to 2 amps. This indicates that, if the battery had been discharged as the result of the inoperable battery charger, it is now fully capable of supplying the maximum expected load requirement. The 2 amp value is based on returning the battery to 98% charge and assumes a 2% design margin for the battery. If at the

(continued)

BASES

ACTIONS

A.1, A.2, and A.3 (continued)

expiration of the initial 12 hour period the battery float current is not less than or equal to 2 amps this indicates there may be additional battery problems and the battery must be declared inoperable.

Required Action A.3 limits the restoration time for the inoperable battery charger to 7 days. This action is applicable if an alternate means of restoring battery terminal voltage to greater than or equal to the minimum established float voltage has been used (e.g., balance of plant non-Class 1E battery charger). The 7 day Completion Time reflects a reasonable time to effect restoration of the qualified battery charger to OPERABLE status.

B.1

Condition B represents one vital DC electrical power subsystem with a loss of ability to completely respond to an event, and a potential loss of ability to remain energized during normal operation. It is, therefore, imperative that the operator's attention focus on stabilizing the plant, minimizing the potential for complete loss of DC power to the affected subsystem. The 2 hour limit is consistent with the allowed time for an inoperable DC distribution subsystem.

If one of the required vital DC electrical power subsystems is inoperable for reasons other than Condition A (e.g., inoperable battery charger and associated inoperable battery), the remaining vital DC electrical power subsystem has the capacity to support a safe shutdown and to mitigate an accident condition. Since a subsequent worst case single failure of the OPERABLE subsystem could, however, result in the loss of the minimum necessary vital DC electrical power subsystems to mitigate a worst-case accident, continued power operation should not exceed 2 hours. The 2 hour Completion Time is based on Regulatory Guide 1.93 (Ref. 7) and reflects a reasonable time to assess plant status as a function of the inoperable vital DC electrical power subsystem and, if the vital DC electrical power subsystem is not restored to OPERABLE status, to prepare to effect an orderly and safe plant shutdown.

C.1 and C.2

If the inoperable vital DC electrical power subsystem cannot be restored to OPERABLE status within the required Completion Time, the plant must be brought to a MODE in which the LCO does not apply. To achieve this status, the plant must be brought to at least MODE 3 within 6 hours and to MODE 5 within 36 hours. The allowed Completion Times are reasonable, based on operating experience, to reach the required plant conditions from full power conditions in an orderly manner and without challenging plant systems. The Completion Time to bring the plant to MODE 5 is consistent with the time required in Regulatory Guide 1.93 (Ref. 7).

(continued)

BASES (continued)

ACTIONS

D.1, D.2, and D.3

Condition D represents one DG DC subsystem with one battery charger inoperable (e.g., the voltage limit of SR 3.8.4.1 is not maintained). The ACTIONS provide a tiered response that focuses on returning the battery to the fully charged state and restoring a fully qualified charger to OPERABLE status in a reasonable time period. Required Action D.1 requires that the battery terminal voltage be restored to greater than or equal to the minimum established float voltage within 2 hours. This time provides for returning the inoperable charger to OPERABLE status or providing an alternate means of restoring battery terminal voltage to greater than or equal to the minimum established float voltage.

Restoring the battery terminal voltage to greater than or equal to the minimum established float voltage provides good assurance that, within 12 hours, the battery will be restored to its fully charged condition (Required Action D.2) from any discharge that might have occurred due to the charger inoperability.

A discharged battery having terminal voltage of at least the minimum established float voltage indicates that the battery is on the exponential charging current portion (the second part) of its recharge cycle. The time to return a battery to its fully charged state under this condition is simply a function of the amount of the previous discharge and the recharge characteristic of the battery. Thus there is good assurance of fully recharging the battery within 12 hours, avoiding a premature shutdown with its own attendant risk.

If established battery terminal float voltage cannot be restored to greater than or equal to the minimum established float voltage within 2 hours, and the charger is not operating in the current-limiting mode, a faulty charger is indicated. A faulty charger that is incapable of maintaining established battery terminal float voltage does not provide assurance that it can revert to and operate properly in the current limit mode that is necessary during the recovery period following a battery discharge event that the DG DC system is designed for.

If the charger is operating in the current limit mode after 2 hours that is an indication that the battery is partially discharged and its capacity margins will be reduced. The time to return the battery to its fully charged condition in this case is a function of the battery charger capacity, the amount of loads on the associated DC system, the amount of the previous discharge, and the recharge characteristic of the battery. The charge time can be extensive, and there is not adequate assurance that it can be recharged within 12 hours (Required Action D.2).

(continued)

BASES

ACTIONS

D.1, D.2, and D.3 (continued)

Required Action D.2 requires that the battery float current be verified as less than or equal to 1 amp. This indicates that, if the battery had been discharged as the result of the inoperable battery charger, it is now fully capable of supplying the maximum expected load requirement. The 1 amp value is based on returning the battery to 98% charge and assumes a 2% design margin for the battery. If at the expiration of the initial 12 hour period the battery float current is not less than or equal to 1 amp this indicates there may be additional battery problems and the battery must be declared inoperable.

Required Action D.3 limits the restoration time for the inoperable battery charger to 72 hours. The 72 hour Completion Time reflects a reasonable time to effect restoration of the qualified battery charger to OPERABLE status.

E.1

Condition E represents one DG with a loss of ability to completely respond to an event. Since a subsequent single failure on the opposite train could result in a situation where the required ESF function is not assured, continued power operation should not exceed 2 hours. The 2 hour time limit is consistent with the allowed time for an inoperable vital DC electrical power subsystem.

F.1

If the DG DC electrical power subsystem cannot be restored to OPERABLE status in the associated Completion Time, the associated DG may be incapable of performing its intended function and must be immediately declared inoperable. This declaration also requires entry into applicable Conditions and Required Actions for an inoperable DG, LCO 3.8.1, "AC Sources-Operating."

(continued)

BASES (continued)

SURVEILLANCE REQUIREMENTS

SR 3.8.4.1 and SR 3.8.4.2

Verifying battery terminal voltage while on float charge for the batteries helps to ensure the effectiveness of the battery chargers, which support the ability of the batteries to perform their intended function. Float charge is the condition in which the charger is supplying the continuous charge required to overcome the internal losses of a battery and maintain the battery in a fully charged state while supplying the continuous steady state loads of the associated DC subsystem. On float charge, battery cells will receive adequate current to optimally charge the battery. The voltage requirements are based on the nominal design voltage of the battery and are consistent with the minimum float voltage established by the battery manufacturer (2.20 Vpc times the number of connected cells or 132 V at the battery terminals for a 60 cell vital battery; 127.6 V at the battery terminals for a 58 cell DG battery). This voltage maintains the battery plates in a condition that supports maintaining the grid life. The 7 day Frequency is consistent with manufacturer recommendations.

SR 3.8.4.3

Verifying that for the vital batteries that the alternate feeder breakers to each required battery charger is open ensures that independence between the power trains is maintained. The 7-day Frequency is based on engineering judgement, is consistent with procedural controls governing breaker operation, and ensures correct breaker position.

SR 3.8.4.4

This SR demonstrates that the DG 125V DC distribution panel and associated charger are functioning properly, with all required circuit breakers closed and buses energized from normal power. The 7 day Frequency takes into account the redundant DG capability and other indications available in the control room that will alert the operator to system malfunctions.

(continued)

BASES (continued)

SURVEILLANCE REQUIREMENTS

SR 3.8.4.5

This SR verifies the design capacity of the vital battery chargers. According to Regulatory Guide 1.32 (Ref. 5), the battery charger supply is recommended to be based on the largest combined demands of the various steady state loads and the charging capacity to restore the battery from the design minimum charge state to the fully charged state, irrespective of the status of the plant during these demand occurrences. The minimum required amperes and duration ensure that these requirements can be satisfied.

This SR provides two options. One option requires that each battery charger be capable of supplying 200 amps at the minimum established float voltage (132 V DC) for 4 hours. The ampere requirements are based on the output rating of the chargers. The voltage requirements are based on the charger voltage level after a response to a loss of AC power.

The other option requires that each vital battery charger be capable of recharging the battery after a service test coincident with supplying the largest coincident demands of the various continuous steady state loads (irrespective of the status of the plant during which these demands occur). This level of loading may not normally be available following the battery service test and will need to be supplemented with additional loads. The duration for this test may be longer than the charger sizing criteria since the battery recharge is affected by float voltage, temperature, and the exponential decay in charging current. The battery is recharged when the measured charging current is ≤ 2 amps.

The Surveillance Frequency is acceptable, given the plant conditions required to perform the test and the other administrative controls existing to ensure adequate charger performance during these 18 month intervals. In addition, this Frequency is intended to be consistent with expected fuel cycle lengths.

SR 3.8.4.6

This SR verifies the design capacity of the DG battery chargers. According to Regulatory Guide 1.32 (Ref. 5), the battery charger supply is recommended to be based on the largest combined demands of the various steady state loads and the charging capacity to restore the battery from the design minimum charge state to the fully charged state, irrespective of the status of the plant during these demand occurrences. The minimum required amperes and duration ensure that these requirements can be satisfied.

(continued)

BASES

SURVEILLANCE REQUIREMENTS

SR 3.8.4.6 (continued)

This SR provides two options. One option requires that each battery charger be capable of supplying 20 amps at the minimum established float voltage (127.6 V DC) for 4 hours. The ampere requirements are based on the output rating of the chargers. The voltage requirements are based on the charger voltage level after a response to a loss of AC power.

The other option requires that each vital battery charger be capable of recharging the battery after a service test coincident with supplying the largest coincident demands of the various continuous steady state loads (irrespective of the status of the plant during which these demands occur). This level of loading may not normally be available following the battery service test and will need to be supplemented with additional loads. The duration for this test may be longer than the charger sizing criteria since the battery recharge is affected by float voltage, temperature, and the exponential decay in charging current. The battery is recharged when the measured charging current is ≤ 1 amp.

The Surveillance Frequency is acceptable, given the administrative controls existing to ensure adequate charger performance during these 18 month intervals.

For the DG DC electrical subsystem, this Surveillance may be performed in MODES 1, 2, 3, or 4 in conjunction with LCO 3.8.1.B since the DG DC electrical power subsystem supplies loads only for the inoperable diesel generator and would not otherwise challenge safety systems supplied from vital electrical distribution systems. If available, the C-S DG and its associated DC electrical power subsystem may be substituted in accordance with LCO Note 2. Additionally, credit may be taken for unplanned events that satisfy this SR. Examples of unplanned events may include:

1) Unexpected operational events which cause the equipment to perform the function specified by this Surveillance, for which adequate documentation of the required performance is available; and

2) Post corrective maintenance testing that requires performance of this Surveillance in order to restore the component to OPERABLE, provided the maintenance was required, or performed in conjunction with maintenance required to maintain OPERABILITY or reliability.

SR 3.8.4.7

A battery service test is a special test of battery capability, as found, to satisfy the design requirements (battery duty cycle) of the DC electrical power system. The discharge rate and test length should correspond to worst case design duty cycle requirements based on References 8 and 10.

(continued)

BASES

SURVEILLANCE REQUIREMENTS

SR 3.8.4.7 (continued)

The Surveillance Frequency of 18 months is consistent with the recommendations of Regulatory Guide 1.32 (Ref. 5) and Regulatory Guide 1.129 (Ref. 9), which state that the battery service test should be performed during refueling operations or at some other outage, with intervals between tests, not to exceed 18 months.

This SR is modified by two Notes. Note 1 allows the performance of a modified performance discharge test in lieu of a service test.

The reason for Note 2 is that performing the Surveillance may perturb the vital electrical distribution system and challenge safety systems. However, this Surveillance may be performed in MODES l, 2, 3, or 4 provided that Vital Battery V is substituted in accordance with LCO Note l. For the DG DC electrical subsystem, this surveillance may be performed in MODES l, 2, 3, or 4 in conjunction with LCO 3.8.l.B since the supplied loads are only for the inoperable diesel generator and would not otherwise challenge safety system loads which are supplied from vital electrical distribution systems. If available, the C-S DG and its associated DC electrical power subsystem may be substituted in accordance with LCO Note 2. Additionally, credit may be taken for unplanned events that satisfy this SR. Examples of unplanned events may include:

1) Unexpected operational events which cause the equipment to perform the function specified by this Surveillance, for which adequate documentation of the required performance is available; and

2) Post corrective maintenance testing that requires performance of this Surveillance in order to restore the component to OPERABLE, provided the maintenance was required, or performed in conjunction with maintenance required to maintain OPERABILITY or reliability.

(continued)

BASES (continued)

REFERENCES

1. Title 10, Code of Federal Regulations, Part 50, Appendix A, General Design Criterion 17, “Electric Power System.”

2. Regulatory Guide 1.6, “Independence Between Redundant Standby (Onsite) Power Sources and Between Their Distribution Systems,” U.S. Nuclear Regulatory Commission, March 10, 1971.

3. IEEE-308-1971, “IEEE Standard Criteria for Class 1E Power Systems for Nuclear Power Generating Stations,” Institute of Electrical and Electronic Engineers.

4. Watts Bar FSAR, Section 8.3.2, “DC Power System.”

5. Regulatory Guide 1.32, “Criteria for Safety-Related Electric Power Systems for Nuclear Power Plants,” February 1977, U.S. Nuclear Regulatory Commission.

6. Watts Bar FSAR, Section 15, “Accident Analysis” and Section 6 “Engineered Safety Features.”

7. Regulatory Guide 1.93, “Availability of Electric Power Sources,” U.S. Nuclear Regulatory Commission, December 1974.

8. TVA Calculation WBN EEB-MS-TI11-0003, “125 VDC Vital Battery and Charger Evaluation.”

9. Regulatory Guide 1.129, “Maintenance Testing and Replacement of Large Lead Storage Batteries for Generating Stations and Subsystems,” U.S. Nuclear Regulatory Commission, February 1978.

10. TVA Calculation WBN EEB-MS-TI11-0062, "125 V DC Diesel Generator Control Power System Evaluation."

B 3.8 ELECTRICAL POWER SYSTEMS

B 3.8.5 DC Sources - Shutdown

BASES

BACKGROUND

A description of the DC sources is provided in the Bases for LCO 3.8.4, "DC Sources - Operating."

APPLICABLE SAFETY ANALYSES

The initial conditions of Design Basis Accident and transient analyses in the FSAR, Section 6 (Ref. 1) and Section 15 (Ref. 1), assume that Engineered Safety Feature systems are OPERABLE. The vital DC electrical power system provides normal and emergency DC electrical power for the emergency auxiliaries, and control and switching during all MODES of operation. The DG battery systems provide DC power for the DGs.

The OPERABILITY of the DC sources is consistent with the initial assumptions of the accident analyses and the requirements for the supported systems' OPERABILITY.

The OPERABILITY of the minimum DC electrical power sources during MODES 5 and 6, and during movement of irradiated fuel assemblies ensures that:

a. The plant can be maintained in the shutdown or refueling condition for extended periods;

b. Sufficient instrumentation and control capability is available for monitoring and maintaining the plant status; and

c. Adequate DC electrical power is provided to mitigate events postulated during shutdown, such as a fuel handling accident.

The DC sources satisfy Criterion 3 of the NRC Policy Statement.

(continued)

BASES (continued)

LCO

The 125V Vital DC electrical power subsystems, each vital subsystem channel consisting of a battery bank, associated battery charger, and the corresponding control equipment and interconnecting cabling within the channel; and the DG DC electrical power subsystems, each consisting of a battery, a battery charger, and the corresponding control equipment and interconnecting cabling, are required to be OPERABLE to support required subsystems of the distribution systems required OPERABLE by LCO 3.8.10, "Distribution Systems - Shutdown" and the required DGs required OPERABLE by LCO 3.8.2, "AC Sources-Shutdown." As a minimum, one vital DC electrical power subsystem (i.e., Channels I and III, or II and IV) and two DG DC electrical power subsystems (i.e., 1A-A and 2A-A or 1B-B and 2B-B) shall be OPERABLE. This ensures the availability of sufficient DC electrical power sources to operate the plant in a safe manner and to mitigate the consequences of postulated events during shutdown (e.g., fuel handling accidents).

The LCO is modified by a Note. The Note indicates that Vital Battery V may be substituted for any of the required vital batteries. However, the fifth battery cannot be declared OPERABLE until it is connected electrically in place of another battery and it has satisfied applicable Surveillance Requirements.

APPLICABILITY

The DC electrical power sources required to be OPERABLE in MODES 5 and 6, and during movement of irradiated fuel assemblies, provide assurance that:

a. Required features needed to mitigate a fuel handling accident are available;

(continued)

BASES

APPLICABILITY (continued)

b. Required features necessary to mitigate the effects of events that can lead to core damage during shutdown are available; and

c. Instrumentation and control capability is available for monitoring and maintaining the plant in a cold shutdown condition or refueling condition.

The DC electrical power requirements for MODES 1, 2, 3, and 4 are covered in LCO 3.8.4.

ACTIONS

A.1, A.2, and A.3

Condition A represents one subsystem with one or two battery charger(s) inoperable (e.g., the voltage limit of SR 3.8.4.1 is not maintained). The ACTIONS provide a tiered response that focuses on returning the battery to the fully charged state and restoring a fully qualified charger to OPERABLE status in a reasonable time period. Required Action A.1 requires that the battery terminal voltage be restored to greater than or equal to the minimum established float voltage within 2 hours. This time provides for returning the inoperable charger to OPERABLE status or providing an alternate means of restoring battery terminal voltage to greater than or equal to the minimum established float voltage. Restoring the battery terminal voltage to greater than or equal to the minimum established float voltage provides good assurance that, within 12 hours, the battery will be restored to its fully charged condition (Required Action A.2) from any discharge that might have occurred due to the charger inoperability.

A discharged battery having terminal voltage of at least the minimum established float voltage indicates that the battery is on the exponential charging current portion (the second part) of its recharge cycle. The time to return a battery to its fully charged state under this condition is simply a function of the amount of the previous discharge and the recharge characteristic of the battery. Thus there is good assurance of fully recharging the battery within [12] hours, avoiding a premature shutdown with its own attendant risk.

If established battery terminal float voltage cannot be restored to greater than or equal to the minimum established float voltage within 2 hours, and the charger is not operating in the current-limiting mode, a faulty charger is indicated. A faulty charger that is incapable of maintaining established battery terminal float voltage does not provide assurance that it can revert to and operate properly in the current limit mode that is necessary during the recovery period following a battery discharge event that the DC system is designed for.

If the charger is operating in the current limit mode after 2 hours that is an indication that the battery is partially discharged and its capacity margins will be reduced. The time to return the battery to its fully charged condition in this case

(continued)

BASES

ACTIONS

A.1, A.2, and A.3 (continued)

is a function of the battery charger capacity, the amount of loads on the associated DC system, the amount of the previous discharge, and the recharge characteristic of the battery. The charge time can be extensive, and there is not adequate assurance that it can be recharged within 12 hours (Required Action A.2).

Required Action A.2 requires that the battery float current be verified as less than or equal to 2 amps. This indicates that, if the battery had been discharged as the result of the inoperable battery charger, it has now been fully recharged. If at the expiration of the initial 12 hour period the battery float current is not less than or equal to 2 amps this indicates there may be additional battery problems and the battery must be declared inoperable.

Required Action A.3 limits the restoration time for the inoperable battery charger to 7 days. This action is applicable if an alternate means of restoring battery terminal voltage to greater than or equal to the minimum established float voltage has been used (e.g., balance of plant non-Class 1E battery charger). The 7 day Completion Time reflects a reasonable time to effect restoration of the qualified battery charger to OPERABLE status.

B.1, B.2.1, B.2.2, B.2.3, and B.2.4

If two subsystems are required by LCO 3.8.10, the remaining subsystem with DC power available may be capable of supporting sufficient systems to allow continuation of CORE ALTERATIONS and fuel movement. By allowing the option to declare required features inoperable with the associated vital DC power source(s) inoperable, appropriate restrictions will be implemented in accordance with the affected required features LCO ACTIONS. In many instances, this option may involve undesired administrative efforts. Therefore, the allowance for sufficiently conservative actions is made (i.e., to suspend CORE ALTERATIONS, movement of irradiated fuel assemblies, and operations involving positive reactivity additions). The Required Action to suspend positive reactivity additions does not preclude actions to maintain or increase reactor vessel inventory, provided the required SDM is maintained.

Suspension of these activities shall not preclude completion of actions to establish a safe conservative condition. These actions minimize probability of the occurrence of postulated events. It is further required to immediately initiate action to restore the required vital DC electrical power subsystems and to continue this action until restoration is accomplished in order to provide the necessary DC electrical power to the plant safety systems.

(continued)

BASES

ACTIONS

B.1, B.2.1, B.2.2, B.2.3, and B.2.4 (continued)

The Completion Time of immediately is consistent with the required times for actions requiring prompt attention. The restoration of the required vital DC electrical power subsystems should be completed as quickly as possible in order to minimize the time during which the plant safety systems may be without sufficient power.

C.1

If the DG DC electrical power subsystem cannot be restored to OPERABLE status in the associated Completion Time, the associated DG may be incapable of performing its intended function and must be immediately declared inoperable. This declaration also requires entry into applicable Conditions and Required Actions for an inoperable DG, LCO 3.8.2, "AC Sources-Shutdown."

SURVEILLANCE REQUIREMENTS

SR 3.8.5.1

SR 3.8.5.1 requires performance of all Surveillances required by SR 3.8.4.1 through SR 3.8.4.7. Therefore, see the corresponding Bases for LCO 3.8.4 for a discussion of each SR.

This SR is modified by a Note. The reason for the Note is to preclude requiring the OPERABLE DC sources from being discharged below their capability to provide the required power supply or otherwise rendered inoperable during the performance of SRs. It is the intent that these SRs must still be capable of being met, but actual performance is not required.

REFERENCES

1. Watts Bar FSAR, Section 15, "Accident Analysis" and Section 6, "Engineered Safety Features."

2. Watts Bar FSAR, Section 8.0, "Electric Power."

B 3.8 ELECTRICAL POWER SYSTEMS

B 3.8.6 Battery Parameters

BASES

BACKGROUND

This LCO delineates the limits on battery float current as well as electrolyte temperature, level, and float voltage for the 125V vital DC electrical power subsystem and diesel generator (DG) batteries. A discussion of these batteries and their OPERABILITY requirements is provided in the Bases for LCO 3.8.4, "DC Sources - Operating," and LCO 3.8.5, "DC Sources - Shutdown." In addition to the limitations of this Specification, the Battery Monitoring and Maintenance Program also implements a program specified in Specification 5.7.2.22 for monitoring various battery parameters.

The battery cells are of flooded lead acid construction with a nominal specific gravity of 1.215. This specific gravity corresponds to an open circuit battery voltage of approximately 120 V for 60 cell battery (i.e., cell voltage of 2.063 volts per cell (Vpc)). The open circuit voltage is the voltage maintained when there is no charging or discharging. Optimal long term performance however, is obtained by maintaining a float voltage 2.20 to 2.25 Vpc. This provides adequate over-potential which limits the formation of lead sulfate and self discharge. The nominal float voltage of 2.22 Vpc corresponds to a total float voltage output of 133.2 V for a 60 cell battery as discussed in the FSAR, Chapter 8 (Ref. 3).

APPLICABLE SAFETY ANALYSES

The initial conditions of Design Basis Accident (DBA) and transient analyses in the FSAR, Section 6 (Ref. 1) and Section 15 (Ref. 1), assume Engineered Safety Feature systems are OPERABLE. The vital DC electrical power system provides normal and emergency DC electrical power for the emergency auxiliaries, and control and switching during all MODES of operation. The DG battery systems provide DC power for the DGs.

The OPERABILITY of the DC subsystems is consistent with the initial assumptions of the accident analyses and is based upon meeting the design basis of the plant. This includes maintaining at least one subsystem of DC sources OPERABLE during accident conditions, in the event of:

a. An assumed loss of all offsite AC power or all onsite AC power; and

b. A worst case single failure.

Battery parameters satisfy the Criterion 3 of the NRC Policy Statement.

(continued)

BASES (continued)

LCO

Battery parameters must remain within acceptable limits to ensure availability of the required DC power to shut down the reactor and maintain it in a safe condition after an anticipated operational occurrence or a postulated DBA. Battery parameter limits are conservatively established, allowing continued DC electrical system function even with limits not met. Additional preventative maintenance, testing, and monitoring performed in accordance with the Battery Monitoring and Maintenance Program is conducted as specified in Specification 5.7.2.22.

APPLICABILITY

The battery parameters are required solely for the support of the associated vital DC and DG DC electrical power subsystems. Therefore, battery parameter limits are only required when the DC power source is required to be OPERABLE. Refer to the Applicability discussion in Bases for LCO 3.8.4 and LCO 3.8.5.

ACTIONS

A.1, A.2, and A.3

With one or more cells in one or more batteries in one vital DC subsystem < 2.07 V, the battery cell is degraded. Within 2 hours verification of the required battery charger OPERABILITY is made by monitoring the battery terminal voltage (SR 3.8.4.1) and of the overall battery state of charge by monitoring the battery float charge current (SR 3.8.6.1). This assures that there is still sufficient battery capacity to perform the intended function. Therefore, the affected battery is not required to be considered inoperable solely as a result of one or more cells in one or more batteries < 2.07 V, and continued operation is permitted for a limited period up to 24 hours.

Since the Required Actions only specify "perform," a failure of SR 3.8.4.1 or SR 3.8.6.1 acceptance criteria does not result in this Required Action not met. However, if one of the SRs is failed the appropriate Condition(s), depending on the cause of the failures, is entered. If SR 3.8.6.1 is failed then there is not assurance that there is still sufficient battery capacity to perform the intended function and the battery must be declared inoperable immediately.

B.1 and B.2

One or more batteries in one vital DC subsystem with float current > 2 amps indicates that a partial discharge of the battery capacity has occurred. This may be due to a temporary loss of a battery charger or possibly due to one or more battery cells in a low voltage condition reflecting some loss of capacity. Within 2 hours verification of the required battery charger OPERABILITY is made by monitoring the battery terminal voltage. If the terminal voltage is found to be less than the minimum established float voltage there are two possibilities, the battery charger is inoperable or is operating in the current limit mode. Condition A

(continued)

BASES

ACTIONS

B.1 and B.2 (continued)

addresses charger inoperability. If the charger is operating in the current limit mode after 2 hours that is an indication that the battery has been substantially discharged and likely cannot perform its required design functions. The time to return the battery to its fully charged condition in this case is a function of the battery charger capacity, the amount of loads on the associated DC system, the amount of the previous discharge, and the recharge characteristic of the battery. The charge time can be extensive, and there is not adequate assurance that it can be recharged within 12 hours (Required Action B.2). The battery must therefore be declared inoperable.

If the float voltage is found to be satisfactory but there are one or more battery cells with float voltage less than 2.07 V, the associated "OR" statement in Condition H is applicable and the battery must be declared inoperable immediately. If float voltage is satisfactory and there are no cells less than 2.07 V there is good assurance that, within 12 hours, the battery will be restored to its fully charged condition (Required Action B.2) from any discharge that might have occurred due to a temporary loss of the battery charger.

A discharged battery with float voltage (the charger setpoint) across its terminals indicates that the battery is on the exponential charging current portion (the second part) of its recharge cycle. The time to return a battery to its fully charged state under this condition is simply a function of the amount of the previous discharge and the recharge characteristic of the battery. Thus there is good assurance of fully recharging the battery within 12 hours, avoiding a premature shutdown with its own attendant risk.

If the condition is due to one or more cells in a low voltage condition but still greater than 2.07 V and float voltage is found to be satisfactory, this is not indication of a substantially discharged battery and 12 hours is a reasonable time prior to declaring the battery inoperable.

Since Required Action B.1 only specifies "perform," a failure of SR 3.8.4.1 acceptance criteria does not result in the Required Action not met. However, if SR 3.8.4.1 is failed, the appropriate Condition(s), depending on the cause of the failure, is entered.

C.1, C.2, and C.3

With one or more cells in one or more batteries in one DG DC subsystem < 2.07 V, the battery cell is degraded. Within 2 hours verification of the required battery charger OPERABILITY is made by monitoring the battery terminal voltage (SR 3.8.4.2) and of the overall battery state of charge by monitoring the battery float charge current (SR 3.8.6.2). This assures that there is still sufficient battery capacity to perform the intended function.

(continued)

BASES

ACTIONS

C.1, C.2, and C.3 (continued)

Therefore, the affected battery is not required to be considered inoperable solely as a result of one or more cells in one or more batteries < 2.07 V, and continued operation is permitted for a limited period up to 24 hours.

Since the Required Actions only specify "perform," a failure of SR 3.8.4.2 or SR 3.8.6.2 acceptance criteria does not result in this Required Action not met. However, if one of the SRs is failed the appropriate Condition(s), depending on the cause of the failures, is entered. If SR 3.8.6.2 is failed then there is not assurance that there is still sufficient battery capacity to perform the intended function and the battery must be declared inoperable immediately.

D.1 and D.2

One or more batteries in one DG DC subsystem with float current > 1 amps indicates that a partial discharge of the battery capacity has occurred. This may be due to a temporary loss of a battery charger or possibly due to one or more battery cells in a low voltage condition reflecting some loss of capacity. Within 2 hours verification of the required battery charger OPERABILITY is made by monitoring the battery terminal voltage. If the terminal voltage is found to be less than the minimum established float voltage there are two possibilities, the battery charger is inoperable or is operating in the current limit mode. Condition B addresses charger inoperability. If the charger is operating in the current limit mode after 2 hours that is an indication that the battery has been substantially discharged and likely cannot perform its required design functions. The time to return the battery to its fully charged condition in this case is a function of the battery charger capacity, the amount of loads on the associated DC system, the amount of the previous discharge, and the recharge characteristic of the battery. The charge time can be extensive, and there is not adequate assurance that it can be recharged within 12 hours (Required Action D.2). The battery must therefore be declared inoperable.

If the float voltage is found to be satisfactory but there are one or more battery cells with float voltage less than 2.07 V, the associated "OR" statement in Condition H is applicable and the battery must be declared inoperable immediately. If float voltage is satisfactory and there are no cells less than 2.07 V there is good assurance that, within 12 hours, the battery will be restored to its fully charged condition (Required Action D.2) from any discharge that might have occurred due to a temporary loss of the battery charger.

A discharged battery with float voltage (the charger setpoint) across its terminals indicates that the battery is on the exponential charging current portion (the second part) of its recharge cycle. The time to return a battery to its fully charged state under this condition is simply a function of the amount of the previous discharge and the recharge characteristic of the battery. Thus there is good assurance of fully recharging the battery within 12 hours, avoiding a premature shutdown with its own attendant risk.

(continued)

BASES

ACTIONS

D.1 and D.2 (continued)

If the condition is due to one or more cells in a low voltage condition but still greater than 2.07 V and float voltage is found to be satisfactory, this is not indication of a substantially discharged battery and 12 hours is a reasonable time prior to declaring the battery inoperable.

Since Required Action D.1 only specifies "perform," a failure of SR 3.8.4.2 acceptance criteria does not result in the Required Action not met. However, if SR 3.8.4.2 is failed, the appropriate Condition(s), depending on the cause of the failure, is entered.

E.1, E.2, and E.3

With one or more required batteries in one vital DC subsystem or one DG battery with one or more cells electrolyte level above the top of the plates, but below the minimum established design limits, the battery still retains sufficient capacity to perform the intended function. Therefore, the affected battery is not required to be considered inoperable solely as a result of electrolyte level not met. Within 31 days the minimum established design limits for electrolyte level must be re-established.

With electrolyte level below the top of the plates there is a potential for dryout and plate degradation. Required Actions E.1 and E.2 address this potential (as well as provisions in Specification 5.7.2.22, Battery Monitoring and Maintenance Program). They are modified by a Note that indicates they are only applicable if electrolyte level is below the top of the plates. Within 8 hours level is required to be restored to above the top of the plates. The Required Action E.2 requirement to verify that there is no leakage by visual inspection and the Specification 5.7.2.22.b item to initiate action to equalize and test in accordance with manufacturer's recommendation. They are performed following the restoration of the electrolyte level to above the top of the plates. Based on the results of the manufacturer's recommended testing the battery(ies) may have to be declared inoperable and the affected cell(s) replaced.

F.1

With one or more batteries in one vital DC subsystem or one DG battery with pilot cell temperature less than the minimum established design limits, 12 hours is allowed to restore the temperature to within limits. A low electrolyte temperature limits the current and power available. Since the battery is sized with margin, while battery capacity is degraded, sufficient capacity exists to perform the intended function and the affected battery is not required to be considered inoperable solely as a result of the pilot cell temperature not met.

(continued)

BASES

ACTIONS (continued)

G.1

With one or more batteries in redundant vital DC subsystems with battery parameters not within limits there is not sufficient assurance that battery capacity has not been affected to the degree that the batteries can still perform their required function, given that redundant batteries are involved. With redundant batteries involved this potential could result in a total loss of function on multiple systems that rely upon the batteries. With more than one DG battery with battery parameters not within limits there is not sufficient assurance that battery capacity has not been affected to the degree that the batteries can still perform their required function.

The longer Completion Times specified for battery parameters on non-redundant batteries not within limits are therefore not appropriate, and the parameters must be restored to within limits on at least one subsystem within 2 hours.

H.1

With one or more batteries with any battery parameter outside the allowances of the Required Actions for Condition A, B, C, D, E, F, or G, sufficient capacity to supply the maximum expected load requirement is not assured and the corresponding battery must be declared inoperable. Additionally, discovering one or more vital DC batteries in one subsystem with one or more battery cells float voltage less than 2.07 V and float current greater than 2 amps, or one DG battery cells float voltage greater than or equal to 2.07 V and float current greater than 1 amp, indicates that the battery capacity may not be sufficient to perform the intended functions. The battery must therefore be declared inoperable immediately.

SURVEILLANCE REQUIREMENTS

SR 3.8.6.1 and SR 3.8.6.2

Verifying battery float current while on float charge is used to determine the state of charge of the battery. Float charge is the condition in which the charger is supplying the continuous charge required to overcome the internal losses of a battery and maintain the battery in a charged state. The equipment used to monitor float current must have the necessary accuracy and capability to measure electrical currents in the expected range. The float current requirements are based on the float current indicative of a charged battery. The 7 day Frequency is consistent with IEEE-450 (Ref. 2).

SR 3.8.6.1 is modified by a Note that states the float current requirement is not required to be met when battery terminal voltage is less than the minimum established float voltage of SR 3.8.4.1. When this float voltage is not maintained the Required Actions of LCO 3.8.4 ACTION A are being taken, which provide the necessary and appropriate verifications of the battery condition. Furthermore, the float current limit of 2 amps is established based on the nominal float voltage value and is not directly applicable when this voltage is not maintained.

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BASES

SURVEILLANCE REQUIREMENTS

SR 3.8.6.1 and SR 3.8.6.2 (continued)

SR 3.8.6.2 is modified by a Note that states the float current requirement is not required to be met when battery terminal voltage is less than the minimum established float voltage of SR 3.8.4.2. When this float voltage is not maintained the Required Actions of LCO 3.8.4 ACTION D are being taken, which provide the necessary and appropriate verifications of the battery condition. Furthermore, the float current limit of 1 amp is established based on the nominal float voltage value and is not directly applicable when this voltage is not maintained.

SR 3.8.6.3 and SR 3.8.6.6

Optimal long term battery performance is obtained by maintaining a float voltage greater than or equal to the minimum established design limits provided by the battery manufacturer, which corresponds to 132 V at the battery terminals, or 2.20 Vpc. This provides adequate overpotential, which limits the formation of lead sulfate and self discharge, which could eventually render the battery inoperable. Float voltages in this range or less, but greater than 2.07 Vpc, are addressed in Specification 5.7.2.22. SRs 3.8.6.3 and 3.8.6.6 require verification that the cell float voltages are equal to or greater than the short term absolute minimum voltage of 2.07 V. The Frequency for cell voltage verification every 31 days for pilot cell and 92 days for each connected cell is consistent with IEEE-450 (Ref. 2).

SR 3.8.6.4

The limit specified for electrolyte level ensures that the plates suffer no physical damage and maintains adequate electron transfer capability. The minimum design electrolyte level is the minimum level indication mark on the battery cell jar. The Frequency is consistent with IEEE-450 (Ref. 2).

SR 3.8.6.5

This Surveillance verifies that the pilot cell temperature is greater than or equal to the minimum established design limit (i.e., 60°F for the vital batteries and 50°F for the DG batteries). Pilot cell electrolyte temperature is maintained above this temperature to assure the battery can provide the required current and voltage to meet the design requirements. Temperatures lower than assumed in battery sizing calculations act to inhibit or reduce battery capacity. The Frequency is consistent with IEEE-450 (Ref. 2).

SR 3.8.6.7

A battery performance discharge test is a test of constant current capacity of a battery, normally done in the as found condition, after having been in service, to detect any change in the capacity determined by the acceptance test. The test is intended to determine overall battery degradation due to age and usage.

(continued)

BASES

SURVEILLANCE REQUIREMENTS

SR 3.8.6.7 (continued)

Either the battery performance discharge test or the modified performance discharge test is acceptable for satisfying SR 3.8.6.7; however, only the modified performance discharge test may be used to satisfy the battery service test requirements of SR 3.8.4.7.

A modified discharge test is a test of the battery capacity and its ability to provide a high rate, short duration load (usually the highest rate of the duty cycle). This will often confirm the battery's ability to meet the critical period of the load duty cycle, in addition to determining its percentage of rated capacity. Initial conditions for the modified performance discharge test should be identical to those specified for a service test.

It may consist of just two rates; for instance the one minute rate for the battery or the largest current load of the duty cycle, followed by the test rate employed for the performance test, both of which envelope the duty cycle of the service test. Since the ampere-hours removed by a one minute discharge represents a very small portion of the battery capacity, the test rate can be changed to that for the performance test without compromising the results of the performance discharge test. The battery terminal voltage for the modified performance discharge test must remain above the minimum battery terminal voltage specified in the battery service test for the duration of time equal to that of the service test.

The acceptance criteria for this Surveillance are consistent with IEEE-450 (Ref. 2) and IEEE-485 (Ref. 4). These references recommend that the battery be replaced if its capacity is below 80% of the manufacturer's rating. A capacity of 80% shows that the battery rate of deterioration is increasing, even if there is ample capacity to meet the load requirements. Furthermore, the battery is sized to meet the assumed duty cycle loads when the battery design capacity reaches this 80% limit.

The Surveillance Frequency for this test is normally 60 months. If the battery shows degradation, or if the battery has reached 85% of its expected life and capacity is < 100% of the manufacturer's rating, the Surveillance Frequency is reduced to 12 months. However, if the battery shows no degradation but has reached 85% of its expected life, the Surveillance Frequency is only reduced to 24 months for batteries that retain capacity ≥ 100% of the manufacturer's ratings. Degradation is indicated, according to IEEE-450 (Ref. 2), when the battery capacity drops by more than 10% relative to its capacity on the previous performance test or when it is ≥ 10% below the manufacturer's rating. These Frequencies are consistent with the recommendations in IEEE-450 (Ref. 2).

This SR is modified by a Note. The reason for the Note is that performing the Surveillance would perturb the electrical distribution system and challenge safety systems. Credit may be taken for unplanned events that satisfy this SR.

(continued)

BASES

REFERENCES

1. Watts Bar FSAR, Section 15, "Accident Analysis," and Section 6, "Engineered Safety Features."

2. IEEE-450-2002, "IEEE Recommended Practice for Maintenance, Testing, and Replacement of Vented Lead-Acid Batteries for Stationary Applications."

3. Watts Bar FSAR, Section 8, "Electric Power."

4. IEEE-485-1983, "IEEE Recommended Practice for Sizing Large Lead Storage Batteries for Generating Stations and Substations."

3.8 ELECTRICAL POWER SYSTEMS

3.8.4 DC Sources - Operating

LCO 3.8.4 The Train A and Train B vital DC electrical power subsystems and four Diesel Generator (DG) DC electrical power subsystems shall be OPERABLE.

----------NOTE----------
Vital Battery V may be substituted for any of the required vital batteries.

APPLICABILITY: MODES 1, 2, 3, and 4.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One or two required vital battery charger(s) on one subsystem inoperable.	A.1 Restore battery terminal voltage to greater than or equal to the minimum established float voltage. AND A.2 Verify battery float current ≤ 2 amps. AND A.3 Restore vital battery charger(s) to OPERABLE status.	2 hours Once per 12 hours 7 days
B. One vital DC electrical power subsystem inoperable for reasons other than Condition A.	B.1 Restore vital DC electrical power subsystem to OPERABLE status.	2 hours

(continued)

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
C. Required Action and Associated Completion Time of Condition A or B not met.	C.1 Be in MODE 3. AND C.2 Be in MODE 5.	6 hours 36 hours
D. One DG DC battery charger inoperable.	D.1 Restore DG battery terminal voltage to greater than or equal to the minimum established float voltage. AND D.2 Verify battery float current ≤ 1 amp. AND D.3 Restore DG battery charger to OPERABLE status.	2 hours Once per 12 hours 72 hours
E. One DG DC electrical power subsystem inoperable for reasons other than Condition D.	E.1 Restore DG DC electrical power subsystem to OPERABLE status.	2 hours
F. Required Action and associated Completion Time of Condition D or E not met.	F.1 Declare associated DG inoperable.	Immediately

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.8.4.1	Verify vital battery terminal voltage is greater than or equal to the minimum established float voltage.	7 days
SR 3.8.4.2	Verify DG battery terminal voltage is greater than or equal to the minimum established float voltage.	7 days
SR 3.8.4.3	Verify for the vital batteries that the alternate feeder breakers to each required battery charger are open.	7 days
SR 3.8.4.4	Verify correct breaker alignment and indicated power availability for each DG 125 V DC distribution panel and associated battery charger	7 days
SR 3.8.4.5	Verify each vital battery charger supplies ≥ 200 amps at greater than or equal to the minimum established float voltage for ≥ 4 hours. OR Verify each vital battery charger can recharge the battery to the fully charged state within 36 hours while supplying the largest combined demands of the various continuous steady state loads, after a battery discharge to the bounding design basis event discharge state.	18 months

(continued)

SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE		FREQUENCY
SR 3.8.4.6	----------NOTE---------- Credit may be taken for unplanned events that satisfy this SR. ---------- Verify each DG battery charge supplies ≥ 20 amps at greater than or equal to the minimum established float voltage for ≥ 4 hours. OR Verify each DG battery charger can recharge the battery to the fully charged state within 24 hours while supplying the largest combined demands of the various continuous steady state loads, after a battery discharge to the bounding design basis event discharge state.	18 months
SR 3.8.4.7	----------NOTES---------- 1. The modified performance discharge test in SR 3.8.6.7 may be performed in lieu of the service test in SR 3.8.4.7. 2. This Surveillance is not performed in MODE 1, 2, 3, or 4 for required vital batteries. Credit may be taken for unplanned events that satisfy this SR. ---------- Verify battery capacity is adequate to supply, and maintain in OPERABLE status, the required emergency loads and any connected nonsafety loads for the design duty cycle when subjected to a battery service test.	18 months

3.8 ELECTRICAL POWER SYSTEMS

3.8.5 DC Sources - Shutdown

LCO 3.8.5 Vital DC and Diesel Generator (DG) DC electrical power subsystems shall be OPERABLE to support the DC electrical power distribution subsystem(s) required by LCO 3.8.10, "Distribution Systems - Shutdown" and to support the Diesel Generators (DGs) required by LCO 3.8.2, "AC Sources - Shutdown."

----------NOTES----------
Vital Battery V may be substituted for any of the required vital batteries.

APPLICABILITY: MODES 5 and 6,
During movement of irradiated fuel assemblies.

ACTIONS

CONDITION		REQUIRED ACTION		COMPLETION TIME
A.	One or two required vital battery charger(s) on one subsystem inoperable. AND The redundant subsystem vital battery and charger(s) OPERABLE.	A.1 AND A.2 AND A.3	Restore battery terminal voltage to greater than or equal to the minimum established float voltage. Verify battery float current ≤ 2 amps. Restore battery charger(s) to OPERABLE status.	2 hours Once per 12 hours 7 days

(continued)

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
B. One or more required vital DC electrical power subsystems inoperable for reasons other than Condition A. OR Required Actions and associated Completion Time of Condition A not met.	B.1.1 Declare affected required feature(s) inoperable. OR B.2.1 Suspend CORE ALTERATIONS. AND B.2.2 Suspend movement of irradiated fuel assemblies. AND B.2.3 Initiate action to suspend operations involving positive reactivity additions. AND B.2.4 Initiate action to restore required DC electrical power subsystems to OPERABLE status.	Immediately Immediately Immediately Immediately Immediately
C. One required DG DC electrical power subsystem inoperable.	C.1 Declare associated DG inoperable.	Immediately

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.8.5.1	----------NOTE---------- The following SRs are not required to be performed: SR 3.8.4.5, SR 3.8.4.6, and SR 3.8.4.7. ----------	
	For DC sources required to be OPERABLE, the following SRs are applicable: SR 3.8.4.1 SR 3.8.4.5 SR 3.8.4.2 SR 3.8.4.6 SR 3.8.4.3 SR 3.8.4.7 SR 3.8.4.4	In accordance with applicable SRs

3.8 ELECTRICAL POWER SYSTEMS

3.8.6 Battery Parameters

LCO 3.8.6 Battery parameters for Train A and Train B electrical power subsystem 125 V vital batteries and 125 V diesel generator (DG) batteries shall be within limits.

APPLICABILITY: When associated DC electrical power subsystems and DGs are required to be OPERABLE.

ACTIONS

----------NOTE----------
Separate Condition entry is allowed for each battery bank.

ACTIONS

CONDITION		REQUIRED ACTION		COMPLETION TIME
A.	One or two required vital battery(ies) on one subsystem with one or more battery cells float voltage < 2.07 V.	A.1	Perform SR 3.8.4.1.	2 hours
		AND		
		A.2	Perform SR 3.8.6.1.	2 hours
		AND		
		A.3	Restore affected cell voltage ≥ 2.07 V.	24 hours
B.	One or two required vital battery(ies) on one subsystem with float current > 2 amps.	B.1	Perform SR 3.8.4.1.	2 hours
		AND		
		B.2	Restore vital battery float current to ≤ 2 amps.	12 hours

(continued)

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
C. One DG battery with one or more battery cells float voltage < 2.07 V.	C.1 Perform SR 3.8.4.2. AND C.2 Perform SR 3.8.6.2. AND C.3 Restore affected cell voltage ≥ 2.07 V.	2 hours 2 hours 24 hours
D. One DG battery with float current > 1 amp.	D.1 Perform SR 3.8.4.2. AND D.2 Restore vital battery float current to ≤ 1 amp.	2 hours 12 hours
----------NOTE---------- Required Action E.2 shall be completed if electrolyte level was below the top of plates. ----------	----------NOTE---------- Required Actions E.1 and E.2 are only applicable if electrolyte level was below the top of plates. ----------	
E. One or two required vital battery(ies) on one subsystem with one or more cells electrolyte level less than minimum established design limits. OR One DG battery with one or more cells electrolyte level less than minimum established design limits.	E.1 Restore electrolyte level to above top of plates. AND E.2 Verify no evidence of leakage. AND E.3 Restore electrolyte level to greater than or equal to minimum established design limits.	8 hours 12 hours 31 days

(continued)

ACTIONS (continued)

CONDITION		REQUIRED ACTION		COMPLETION TIME
F.	One or two required vital battery(ies) on one subsystem with pilot cell electrolyte temperature less than minimum established design limits. OR One DG battery with pilot cell electrolyte temperature less than minimum established design limits.	F.1	Restore battery pilot cell temperature to greater than or equal to minimum established design limits.	12 hours
G.	One or more batteries in redundant subsystems with battery parameters not within limits. OR More than one DG battery with battery parameters not within limits.	G.1	Restore battery parameters to within limits.	2 hours

(continued)

(ACTIONS (continued)

CONDITION		REQUIRED ACTION		COMPLETION TIME
H.	Required Action and associated Completion Time of Condition A, B, C, D, E, F, or G not met. OR One or two required vital battery(ies) on one subsystem with one or more battery cells float voltage < 2.07 V and float current > 2 amps. OR One DG battery with one or more battery cells float voltage < 2.07 V and float current > 1 amp.	H.1	Declare associated battery inoperable.	Immediately

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.8.6.1	----------NOTE---------- Not required to be met when vital battery terminal voltage is less than the minimum established float voltage of SR 3.8.4.1. ---------- Verify each vital battery float current is ≤ 2 amps.	7 days
SR 3.8.6.2	----------NOTE---------- Not required to be met when DG battery terminal voltage is less than the minimum established float voltage of SR 3.8.4.2. ---------- Verify each DG battery float current is ≤ 1 amp.	7 days
SR 3.8.6.3	Verify each required vital battery and each DG battery pilot cell float voltage is ≥ 2.07 V.	31 days
SR 3.8.6.4	Verify each required vital battery and each DG battery connected cell electrolyte level is greater than or equal to minimum established design limits.	31 days
SR 3.8.6.5	Verify each required vital battery and each DG battery pilot cell temperature is greater than or equal to minimum established design limits.	31 days
SR 3.8.6.6	Verify each required vital battery and each DG battery connected cell float voltage is ≥ 2.07 V.	92 days

(continued)

SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE		FREQUENCY
SR 3.8.6.7	----------NOTES---------- This Surveillance is not performed in MODE 1, 2, 3, or 4 for required vital batteries. Credit may be taken for unplanned events that satisfy this SR. ----------	
	Verify battery capacity is ≥ 80% of the manufacturer's rating when subjected to a performance discharge test or a modified performance discharge test.	60 months AND 12 months when battery shows degradation or has reached 85% of expected life with capacity < 100% of manufacturer's rating AND 24 months when battery has reached 85% of the expected life with capacity ≥ 100% of manufacturer's rating

5.7.2.22 Battery Monitoring and Maintenance Program

This Program provides controls for battery restoration and maintenance. The program shall be in accordance with IEEE Standard (Std) 450-2002, "IEEE Recommended Practice for Maintenance, Testing, and Replacement of Vented Lead-Acid Batteries for Stationary Applications," as endorsed by Regulatory Guide 1.129, Revision 2 (RG), with RG exceptions and program provisions as identified below:

a. The program allows the following RG 1.129, Revision 2 exceptions:

1. Battery temperature correction may be performed before or after conducting discharge tests.

2. RG 1.129, Regulatory Position 1, Subsection 2, "References," is not applicable to this program.

3. In lieu of RG 1.129, Regulatory Position 2, Subsection 5.2, "Inspections," the following shall be used: "Where reference is made to the pilot cell, pilot cell selection shall be based on the lowest voltage cell in the battery."

4. In Regulatory Guide 1.129, Regulatory Position 3, Subsection 5.4.1, "State of Charge Indicator," the following statements in paragraph (d) may be omitted: "When it has been recorded that the charging current has stabilized at the charging voltage for three consecutive hourly measurements, the battery is near full charge. These measurements shall be made after the initially high charging current decreases sharply and the battery voltage rises to approach the charger output voltage."

5. In lieu of RG 1.129, Regulatory Position 7, Subsection 7.6, "Restoration", the following may be used: "Following the test, record the float voltage of each cell of the string."

b. The program shall include the following provisions:

1. Actions to restore battery cells with float voltage < 2.13 V;

2. Actions to determine whether the float voltage of the remaining battery cells is ≥ 2.13 V when the float voltage of a battery cell has been found to be < 2.13 V;

5.7 Procedures, Programs, and Manuals

5.7.2.22 Battery Monitoring and Maintenance Program (continued)

3. Actions to equalize and test battery cells that had been discovered with electrolyte level below the top of the plates;

4. Limits on average electrolyte temperature, battery connection resistance, and battery terminal voltage; and

5. A requirement to obtain specific gravity readings of all cells at each discharge test, consistent with manufacturer recommendations.

B 3.8 ELECTRICAL POWER SYSTEMS

B 3.8.4 DC Sources - Operating

BASES

BACKGROUND

The station DC electrical power system provides the AC emergency power system with control power. It also provides both motive and control power to selected safety related equipment and preferred AC vital bus power (via inverters). As required by 10 CFR 50, Appendix A, GDC 17 (Ref. 1), the DC electrical power system is designed to have sufficient independence, redundancy, and testability to perform its safety functions, assuming a single failure. The DC electrical power system also conforms to the recommendations of Regulatory Guide 1.6 (Ref. 2) and IEEE-308 (Ref. 3).

125 V Vital DC Electrical Power Subsystem

The vital 125 VDC electrical power system is a Class 1E system whose safety function is to provide control power for engineered safety features equipment, emergency lighting, vital inverters, and other safety related DC powered equipment for the entire unit. The system capacity is sufficient to supply these loads and any connected non-safety loads during normal operation and to permit safe shutdown and isolation of the reactor for the “loss of all AC power” condition. The system is designed to perform its safety function subject to a single failure.

The 125V DC vital power system is composed of the four channels (Channels I and III are associated with Train A and Channels II and IV are associated with Train B) and consists of four lead-acid-calcium batteries, eight battery chargers (including two pairs of spare chargers), four distribution boards, battery racks, and the required cabling, instrumentation and protective features. Each channel is electrically and physically independent from the equipment of all other channels so that a single failure in one channel will not cause a failure in another channel. Each channel consists of a battery charger which supplies normal DC power, a battery for emergency DC power, and a battery board which facilitates load grouping and provides circuit protection. These four channels are used to provide emergency power to the 120V AC vital power system which furnishes control power to the reactor protection system. No automatic connections are used between the four channels.

Battery boards I, II, III, and IV have a charger normally connected to them and also have manual access to a spare (backup) charger for use upon loss of the normal charger.

(continued)

BASES

BACKGROUND 125 V Vital DC Electrical Power Subsystem (continued)

Additionally, battery boards I, II, III, and IV have manual access to the fifth vital battery system. The fifth 125V DC Vital Battery System is intended to serve as a replacement for any one of the four 125V DC vital batteries during their testing, maintenance, and outages with no loss of system reliability under any mode of operation.

Each of the vital DC electrical power subsystems provides the control power for its associated Class 1E AC power load group, 6.9 kV switchgear, and 480 V load centers. The vital DC electrical power subsystems also provide DC electrical power to the inverters, which in turn power the AC vital buses. Additionally, they power the emergency DC lighting system.

The vital DC power distribution system is described in more detail in Bases for LCO 3.8.9, “Distribution System - Operating,” and LCO 3.8.10, “Distribution Systems - Shutdown.”

Each 125 VDC vital battery is separately housed in a ventilated room apart from its charger and distribution centers, except for Vital Battery V. Each subsystem is located in an area separated physically and electrically from the other subsystem to ensure that a single failure in one subsystem does not cause a failure in a redundant subsystem. There is no sharing between Class 1E subsystems, such as batteries, battery chargers, or distribution panels.

Each battery has adequate storage capacity to meet the duty cycle(s) discussed in the FSAR, Chapter 8 (Ref 4). The battery is designed with additional capacity above that required by the design duty cycle to allow for temperature variations and other factors.

The batteries for the vital DC electrical power subsystems are sized to produce required capacity at 80% of nameplate rating, corresponding to warranted capacity at end of life cycles, and the 100% design demand. The minimum design voltage limit is 105 V.

(continued)

BASES

BACKGROUND 125 V Vital DC Electrical Power Subsystem (continued)

The battery cells are of flooded lead acid construction with a nominal specific gravity of 1.215. This specific gravity corresponds to an open circuit battery voltage of approximately 120 V for a 60 cell battery (i.e., cell voltage of 2.063 volts per cell (Vpc)). The open circuit voltage is the voltage maintained when there is no charging or discharging. Optimal long term performance however, is obtained by maintaining a float voltage 2.20 to 2.25 Vpc. This provides adequate over-potential, which limits the formation of lead sulfate and self discharge. The nominal float voltage of 2.22 Vpc corresponds to a total float voltage output of 133.2 V for a 60 cell battery as discussed in the FSAR, Chapter 8 (Ref. 4).

Each Vital DC electrical power subsystem battery charger has ample power output capacity for the steady state operation of connected loads required during normal operation, while at the same time maintaining its battery bank fully charged. Each battery charger also has sufficient excess capacity to restore the battery bank from the design minimum charge to its fully charged state within 12 hours (with accident loads being supplied) following a 30 minute AC power outage and in approximately 36 hours (while supplying normal steady state loads following a 2 hour AC power outage), (Ref. 5).

The battery charger is normally in the float-charge mode. Float-charge is the condition in which the charger is supplying the connected loads and the battery cells are receiving adequate current to optimally charge the battery. This assures the internal losses of a battery are overcome and the battery is maintained in a fully charged state.

When desired, the charger can be placed in the equalize mode. The equalize mode is at a higher voltage than the float mode and charging current is correspondingly higher. The battery charger is operated in the equalize mode after a battery discharge or for routine maintenance. Following a battery discharge, the battery recharge characteristic accepts current at the current limit of the battery charger (if the discharge was significant, e.g., following a battery service test) until the battery terminal voltage approaches the charger voltage setpoint. Charging current then reduces exponentially during the remainder of the recharge cycle. Lead-calcium batteries have recharge efficiencies of greater than 95%, so once at least 105% of the ampere-hours discharged have been returned, the battery capacity would be restored to the same condition as it was prior to the discharge. This can be monitored by direct observation of the exponentially decaying charging current or by evaluating the amp-hours discharged from the battery and amp-hours returned to the battery.

(continued)

BASES

BACKGROUND (continued)

125 V Diesel Generator (DG) DC Electrical Power Subsystem

Control power for the DGs is provided by four DG battery systems, one per DG. Each system is comprised of a battery, a battery charger, distribution center, cabling, and cable ways. The DG 125V DC control power and field-flash circuits have power supplied from their respective 125V distribution panel. The normal supply of DC current is from the associated charger. The battery provides control and field-flash power when the charger is unavailable. The charger supplies the normal DC loads, maintains the battery in a fully charged condition, and recharges (480V AC available) the battery while supplying the required loads regardless of the status of the unit. The batteries are physically and electrically independent. The battery has sufficient capacity when fully charged to supply required loads for a minimum of four hours following a loss of normal power. Each battery is normally required to supply loads during the time interval between loss of normal feed to its charger and the receipt of emergency power to the charger from its respective DG.

APPLICABLE SAFETY ANALYSES

The initial conditions of Design Basis Accident (DBA) and transient analyses in the FSAR, Section 6 (Ref. 6), and in the FSAR, Section 15 (Ref. 6), assume that Engineered Safety Feature (ESF) systems are OPERABLE. The vital DC electrical power system provides normal and emergency DC electrical power for the emergency auxiliaries, and control and switching during all power for the emergency auxiliaries, and control and switching during all MODES of operation. The DG battery systems provide DC power for the DGs.

The OPERABILITY of the DC sources is consistent with the initial assumptions of the accident analyses and is based upon meeting the design basis of the plant. This includes maintaining the DC sources OPERABLE during accident conditions in the event of:

a. An assumed loss of all offsite AC power or all onsite AC power; and

b. A worst case single failure.

The DC sources satisfy Criterion 3 of 10 CFR 50.36(c)(2)(ii).

(continued)

BASES (continued)

LCO

Two 125V vital DC electrical power subsystems (Train A and Train B), each vital subsystem consisting of two channels. Each channel consisting of a battery bank, associated battery charger and the corresponding control equipment and interconnecting cabling supplying power to the associated DC bus within the channel; and four DG DC electrical power subsystems each consisting of a battery, a dual battery charger assembly, and the corresponding control equipment and interconnecting cabling are required to be OPERABLE to ensure the availability of the required power to shut down the reactor and maintain it in a safe condition after an anticipated operational occurrence (A00) or a postulated DBA. Loss of any DC electrical power subsystem does not prevent the minimum safety function from being performed (Ref. 4).

An OPERABLE vital DC electrical power subsystem requires all required batteries and respective chargers to be operating and connected to the associated DC buses.

The LCO is modified by one Note. The Note indicates that Vital Battery V may be substituted for any of the required vital batteries. However, the fifth battery cannot be declared OPERABLE until it is connected electrically in place of another battery and it has satisfied applicable Surveillance Requirements.

APPLICABILITY

The vital DC electrical power sources and DG DC electrical power sources are required to be OPERABLE in MODES 1, 2, 3, and 4 to ensure safe plant operation and to ensure that:

a. Acceptable fuel design limits and reactor coolant pressure boundary limits are not exceeded as a result of AOs or abnormal transients; and

b. Adequate core cooling is provided, and containment integrity and other vital functions are maintained in the event of a postulated DBA.

The DC electrical power requirements for MODES 5 and 6 are addressed in the Bases for LCO 3.8.5, “DC Sources - Shutdown.”

(continued)

BASES (continued)

ACTIONS

A.1, A.2, and A.3

Condition A represents one vital DC subsystem with one or two battery chargers inoperable (e.g., the voltage limit of SR 3.8.4.1 is not maintained). The ACTIONS provide a tiered response that focuses on returning the battery to the fully charged state and restoring a fully qualified charger to OPERABLE status in a reasonable time period. Required Action A.1 requires that the battery terminal voltage be restored to greater than or equal to the minimum established float voltage within 2 hours. This time provides for returning the inoperable charger to OPERABLE status or providing an alternate means of restoring battery terminal voltage to greater than or equal to the minimum established float voltage. Restoring the battery terminal voltage to greater than or equal to the minimum established float voltage provides good assurance that, within 12 hours, the battery will be restored to its fully charged condition (Required Action A.2) from any discharge that might have occurred due to the charger inoperability.

A discharged battery having terminal voltage of at least the minimum established float voltage indicates that the battery is on the exponential charging current portion (the second part) of its recharge cycle. The time to return a battery to its fully charged state under this condition is simply a function of the amount of the previous discharge and the recharge characteristic of the battery. Thus there is good assurance of fully recharging the battery within 12 hours, avoiding a premature shutdown with its own attendant risk.

If established battery terminal float voltage cannot be restored to greater than or equal to the minimum established float voltage within 2 hours, and the charger is not operating in the current-limiting mode, a faulty charger is indicated. A faulty charger that is incapable of maintaining established battery terminal float voltage does not provide assurance that it can revert to and operate properly in the current limit mode that is necessary during the recovery period following a battery discharge event that the DC system is designed for.

If the charger is operating in the current limit mode after 2 hours that is an indication that the battery is partially discharged and its capacity margins will be reduced. The time to return the battery to its fully charged condition in this case is a function of the battery charger capacity, the amount of loads on the associated DC system, the amount of the previous discharge, and the recharge characteristic of the battery. The charge time can be extensive, and there is not adequate assurance that it can be recharged within 12 hours (Required Action A.2).

Required Action A.2 requires that the battery float current be verified as less than or equal to 2 amps. This indicates that, if the battery had been discharged as the result of the inoperable battery charger, it is now fully capable of supplying the maximum expected load requirement.

(continued)

BASES (continued)

ACTIONS

A.1, A.2, and A.3 (continued)

The 2 amp value is based on returning the battery to 98% charge and assumes a 2% design margin for the battery. If at the expiration of the initial 12 hour period the battery float current is not less than or equal to 2 amps this indicates there may be additional battery problems and the battery must be declared inoperable.

Required Action A.3 limits the restoration time for the inoperable battery charger to 7 days. This action is applicable if an alternate means of restoring battery terminal voltage to greater than or equal to the minimum established float voltage has been used (e.g., balance of plant non-Class 1E battery charger). The 7 day Completion Time reflects a reasonable time to effect restoration of the qualified battery charger to OPERABLE status.

B.1

Condition B represents one vital DC electrical power subsystem with a loss of ability to completely respond to an event, and a potential loss of ability to remain energized during normal operation. It is, therefore, imperative that the operator's attention focus on stabilizing the plant, minimizing the potential for complete loss of DC power to the affected subsystem. The 2 hour limit is consistent with the allowed time for an inoperable DC distribution subsystem.

If one of the required vital DC electrical power subsystems is inoperable for reasons other than Condition A (e.g., inoperable battery charger and associated inoperable battery), the remaining vital DC electrical power subsystem has the capacity to support a safe shutdown and to mitigate an accident condition. Since a subsequent worst case single failure of the OPERABLE subsystem could, however, result in the loss of the minimum necessary vital DC electrical power subsystems to mitigate a worst-case accident, continued power operation should not exceed 2 hours. The 2 hour Completion Time is based on Regulatory Guide 1.93 (Ref. 7) and reflects a reasonable time to assess plant status as a function of the inoperable vital DC electrical power subsystem and, if the vital DC electrical power subsystem is not restored to OPERABLE status, to prepare to effect an orderly and safe plant shutdown.

(continued)

BASES

ACTIONS (continued)

C.1 and C.2

If the inoperable vital DC electrical power subsystem cannot be restored to OPERABLE status within the required Completion Time, the plant must be brought to a MODE in which the LCO does not apply. To achieve this status, the plant must be brought to at least MODE 3 within 6 hours and to MODE 5 within 36 hours. The allowed Completion Times are reasonable, based on operating experience, to reach the required plant conditions from full power conditions in an orderly manner and without challenging plant systems. The Completion Time to bring the plant to MODE 5 is consistent with the time required in Regulatory Guide 1.93 (Ref. 7).

D.1, D.2, and D.3

Condition D represents one DG DC subsystem with one battery charger inoperable (e.g., the voltage limit of SR 3.8.4.1 is not maintained). The ACTIONS provide a tiered response that focuses on returning the battery to the fully charged state and restoring a fully qualified charger to OPERABLE status in a reasonable time period. Required Action D.1 requires that the battery terminal voltage be restored to greater than or equal to the minimum established float voltage within 2 hours. This time provides for returning the inoperable charger to OPERABLE status or providing an alternate means of restoring battery terminal voltage to greater than or equal to the minimum established float voltage.

Restoring the battery terminal voltage to greater than or equal to the minimum established float voltage provides good assurance that, within 12 hours, the battery will be restored to its fully charged condition (Required Action D.2) from any discharge that might have occurred due to the charger inoperability.

A discharged battery having terminal voltage of at least the minimum established float voltage indicates that the battery is on the exponential charging current portion (the second part) of its recharge cycle. The time to return a battery to its fully charged state under this condition is simply a function of the amount of the previous discharge and the recharge characteristic of the battery. Thus there is good assurance of fully recharging the battery within 12 hours, avoiding a premature shutdown with its own attendant risk.

If established battery terminal float voltage cannot be restored to greater than or equal to the minimum established float voltage within 2 hours, and the charger is not operating in the current-limiting mode, a faulty charger is indicated. A faulty charger that is incapable of maintaining established battery terminal float voltage does not provide assurance that it can revert to and operate properly in the current limit mode that is necessary during the recovery period following a battery discharge event that the DG DC system is designed for.

(continued)

BASES

ACTIONS

D.1, D.2, and D.3 (continued)

If the charger is operating in the current limit mode after 2 hours that is an indication that the battery is partially discharged and its capacity margins will be reduced. The time to return the battery to its fully charged condition in this case is a function of the battery charger capacity, the amount of loads on the associated DC system, the amount of the previous discharge, and the recharge characteristic of the battery. The charge time can be extensive, and there is not adequate assurance that it can be recharged within 12 hours (Required Action D.2).

Required Action D.2 requires that the battery float current be verified as less than or equal to 1 amp. This indicates that, if the battery had been discharged as the result of the inoperable battery charger, it is now fully capable of supplying the maximum expected load requirement. The 1 amp value is based on returning the battery to 98% charge and assumes a 2% design margin for the battery. If at the expiration of the initial 12 hour period the battery float current is not less than or equal to 1 amp this indicates there may be additional battery problems and the battery must be declared inoperable.

Required Action D.3 limits the restoration time for the inoperable battery charger to 72 hours. The 72 hour Completion Time reflects a reasonable time to effect restoration of the qualified battery charger to OPERABLE status.

E.1

Condition E represents one DG with a loss of ability to completely respond to an event. Since a subsequent single failure on the opposite train could result in a situation where the required ESF function is not assured, continued power operation should not exceed 2 hours. The 2 hour time limit is consistent with the allowed time for an inoperable vital DC electrical power subsystem.

F.1

If the DG DC electrical power subsystem cannot be restored to OPERABLE status in the associated Completion Time, the associated DG may be incapable of performing its intended function and must be immediately declared inoperable. This declaration also requires entry into applicable Conditions and Required Actions for an inoperable DG, LCO 3.8.1, "AC Sources-Operating."

(continued)

BASES (continued)

SURVEILLANCE REQUIREMENTS

SR 3.8.4.1 and SR 3.8.4.2

Verifying battery terminal voltage while on float charge for the batteries helps to ensure the effectiveness of the battery chargers, which support the ability of the batteries to perform their intended function. Float charge is the condition in which the charger is supplying the continuous charge required to overcome the internal losses of a battery and maintain the battery in a fully charged state while supplying the continuous steady state loads of the associated DC subsystem. On float charge, battery cells will receive adequate current to optimally charge the battery. The voltage requirements are based on the nominal design voltage of the battery and are consistent with the minimum float voltage established by the battery manufacturer (2.20 Vpc times the number of connected cells or 132 V at the battery terminals for a 60 cell vital battery; 127.6 V at the battery terminals for a 58 cell DG battery). This voltage maintains the battery plates in a condition that supports maintaining the grid life. The 7 day Frequency is consistent with manufacturer recommendations.

SR 3.8.4.3

Verifying that for the vital batteries that the alternate feeder breakers to each required battery charger is open ensures that independence between the power trains is maintained. The 7 day Frequency is based on engineering judgment, is consistent with procedural controls governing breaker operation, and ensures correct breaker position.

SR 3.8.4.4

This SR demonstrates that the DG 125V DC distribution panel and associated charger are functioning properly, with all required circuit breakers closed and buses energized from normal power. The 7 day Frequency takes into account the redundant DG capability and other indications available in the control room that will alert the operator to system malfunctions.

SR 3.8.4.5

This SR verifies the design capacity of the vital battery chargers. According to Regulatory Guide 1.32 (Ref. 5), the battery charger supply is recommended to be based on the largest combined demands of the various steady state loads and the charging capacity to restore the battery from the design minimum charge state to the fully charged state, irrespective of the status of the plant during these demand occurrences. The minimum required amperes and duration ensure that these requirements can be satisfied.

(continued)

BASES

SURVEILLANCE REQUIREMENTS

SR 3.8.4.5 (continued)

This SR provides two options. One option requires that each battery charger be capable of supplying 200 amps at the minimum established float voltage (132 V DC) for 4 hours. The ampere requirements are based on the output rating of the chargers. The voltage requirements are based on the charger voltage level after a response to a loss of AC power.

The other option requires that each vital battery charger be capable of recharging the battery after a service test coincident with supplying the largest coincident demands of the various continuous steady state loads (irrespective of the status of the plant during which these demands occur). This level of loading may not normally be available following the battery service test and will need to be supplemented with additional loads. The duration for this test may be longer than the charger sizing criteria since the battery recharge is affected by float voltage, temperature, and the exponential decay in charging current. The battery is recharged when the measured charging current is ≤ 2 amps.

The Surveillance Frequency is acceptable, given the plant conditions required to perform the test and the other administrative controls existing to ensure adequate charger performance during these 18 month intervals. In addition, this Frequency is intended to be consistent with expected fuel cycle lengths.

SR 3.8.4.6

This SR verifies the design capacity of the DG battery chargers. According to Regulatory Guide 1.32 (Ref. 5), the battery charger supply is recommended to be based on the largest combined demands of the various steady state loads and the charging capacity to restore the battery from the design minimum charge state to the fully charged state, irrespective of the status of the plant during these demand occurrences. The minimum required amperes and duration ensure that these requirements can be satisfied.

This SR provides two options. One option requires that each battery charger be capable of supplying 20 amps at the minimum established float voltage (127.6 V DC) for 4 hours. The ampere requirements are based on the output rating of the chargers. The voltage requirements are based on the charger voltage level after a response to a loss of AC power.

(continued)

BASES

SURVEILLANCE REQUIREMENTS

SR 3.8.4.6 (continued)

The other option requires that each vital battery charger be capable of recharging the battery after a service test coincident with supplying the largest coincident demands of the various continuous steady state loads (irrespective of the status of the plant during which these demands occur). This level of loading may not normally be available following the battery service test and will need to be supplemented with additional loads. The duration for this test may be longer than the charger sizing criteria since the battery recharge is affected by float voltage, temperature, and the exponential decay in charging current. The battery is recharged when the measured charging current is ≤ 1 amp.

The Surveillance Frequency is acceptable, given the administrative controls existing to ensure adequate charger performance during these 18 month intervals.

For the DG DC electrical subsystem, this Surveillance may be performed in MODES 1, 2, 3, or 4 in conjunction with LCO 3.8.1.B since the DG DC electrical power subsystem supplies loads only for the inoperable diesel generator and would not otherwise challenge safety systems supplied from vital electrical distribution systems. Additionally, credit may be taken for unplanned events that satisfy this SR. Examples of unplanned events may include:

1) Unexpected operational events which cause the equipment to perform the function specified by this Surveillance, for which adequate documentation of the required performance is available; and

2) Post corrective maintenance testing that requires performance of this Surveillance in order to restore the component to OPERABLE, provided the maintenance was required, or performed in conjunction with maintenance required to maintain OPERABILITY or reliability.

SR 3.8.4.7

A battery service test is a special test of battery capability, as found, to satisfy the design requirements (battery duty cycle) of the DC electrical power system. The discharge rate and test length should correspond to worst case design duty cycle requirements based on References 8 and 10.

The Surveillance Frequency of 18 months is consistent with the recommendations of Regulatory Guide 1.32 (Ref. 5) and Regulatory Guide 1.129 (Ref. 9), which state that the battery service test should be

(continued)

BASES

SURVEILLANCE REQUIREMENTS

SR 3.8.4.7 (continued)

performed during refueling operations or at some other outage, with intervals between tests, not to exceed 18 months.

This SR is modified by two Notes. Note 1 allows the performance of a modified performance discharge test in lieu of a service test.

The reason for Note 2 is that performing the Surveillance may perturb the vital electrical distribution system and challenge safety systems. However, this Surveillance may be performed in MODES 1, 2, 3, or 4 provided that Vital Battery V is substituted in accordance with LCO Note 1. For the DG DC electrical subsystem, this surveillance may be performed in MODES 1, 2, 3, or 4 in conjunction with LCO 3.8.1.B since the supplied loads are only for the inoperable diesel generator and would not otherwise challenge safety system loads which are supplied from vital electrical distribution systems. Additionally, credit may be taken for unplanned events that satisfy this SR. Examples of unplanned events may include:

1) Unexpected operational events which cause the equipment to perform the function specified by this Surveillance, for which adequate documentation of the required performance is available; and

2) Post corrective maintenance testing that requires performance of this Surveillance in order to restore the component to OPERABLE, provided the maintenance was required, or performed in conjunction with maintenance required to maintain OPERABILITY or reliability.

(continued)

BASES

REFERENCES

1. Title 10, Code of Federal Regulations, Part 50, Appendix A, General Design Criterion 17, “Electric Power System.”

2. Regulatory Guide 1.6, “Independence Between Redundant Standby (Onsite) Power Sources and Between Their Distribution Systems,” U.S. Nuclear Regulatory Commission, March 10, 1971.

3. IEEE-308-1971, “IEEE Standard Criteria for Class 1E Power Systems for Nuclear Power Generating Stations,” Institute of Electrical and Electronic Engineers.

4. Watts Bar FSAR, Section 8.3.2, “DC Power System.”

5. Regulatory Guide 1.32, “Criteria for Safety-Related Electric Power Systems for Nuclear Power Plants,” February 1977, U.S. Nuclear Regulatory Commission.

6. Watts Bar FSAR, Section 15, “Accident Analysis” and Section 6 “Engineered Safety Features.”

7. Regulatory Guide 1.93, “Availability of Electric Power Sources,” U.S. Nuclear Regulatory Commission, December 1974.

8. TVA Calculation EDQ00023620070003, “125V DC Vital Battery System Analysis”

9. Regulatory Guide 1.129, “Maintenance Testing and Replacement of Large Lead Storage Batteries for Generating Stations and Subsystems,” U.S. Nuclear Regulatory Commission, February 1978.

10. TVA Calculation WBN EEB-EDQ00023620070003, “125V DC Vital Battery System Analysis.”

B 3.8 ELECTRICAL POWER SYSTEMS

B 3.8.5 DC Sources - Shutdown

BASES

BACKGROUND

A description of the DC sources is provided in the Bases for LCO 3.8.4, "DC Sources - Operating."

APPLICABLE SAFETY ANALYSES

The initial conditions of Design Basis Accident and transient analyses in the FSAR, Section 6 (Ref. 1) and Section 15 (Ref. 1), assume that Engineered Safety Feature systems are OPERABLE. The vital DC electrical power system provides normal and emergency DC electrical power for the emergency auxiliaries, and control and switching during all MODES of operation. The DG battery systems provide DC power for the DGs.

The OPERABILITY of the DC sources is consistent with the initial assumptions of the accident analyses and the requirements for the supported systems' OPERABILITY.

The OPERABILITY of the minimum DC electrical power sources during MODES 5 and 6, and during movement of irradiated fuel assemblies ensures that:

a. The plant can be maintained in the shutdown or refueling condition for extended periods;

b. Sufficient instrumentation and control capability is available for monitoring and maintaining the plant status; and

c. Adequate DC electrical power is provided to mitigate events postulated during shutdown, such as a fuel handling accident.

The DC sources satisfy Criterion 3 of 10 CFR 50.36(c)(2)(ii).

(continued)

BASES (continued)

LCO

The 125V Vital DC electrical power subsystems, each vital subsystem channel consisting of a battery bank, associated battery charger, and the corresponding control equipment and interconnecting cabling within the channel; and the DG DC electrical power subsystems, each consisting of a battery, a battery charger, and the corresponding control equipment and interconnecting cabling, are required to be OPERABLE to support required subsystems of the distribution systems required OPERABLE by LCO 3.8.10, “Distribution Systems - Shutdown” and the required DGs required OPERABLE by LCO 3.8.2, “AC Sources - Shutdown.” As a minimum, one vital DC electrical power subsystem (i.e., Channels I and III, or II and IV) and two DG DC electrical power subsystems (i.e., 1A-A and 2A-A or 1B-B and 2B-B) shall be OPERABLE. This ensures the availability of sufficient DC electrical power sources to operate the plant in a safe manner and to mitigate the consequences of postulated events during shutdown (e.g., fuel handling accidents).

The LCO is modified by one Note. The Note indicates that Vital Battery V may be substituted for any of the required vital batteries. However, the fifth battery cannot be declared OPERABLE until it is connected electrically in place of another battery and it has satisfied applicable Surveillance Requirements.

APPLICABILITY

The DC electrical power sources required to be OPERABLE in MODES 5 and 6, and during movement of irradiated fuel assemblies, provide assurance that:

a. Required features needed to mitigate a fuel handling accident are available;
b. Required features necessary to mitigate the effects of events that can lead to core damage during shutdown are available; and
c. Instrumentation and control capability is available for monitoring and maintaining the plant in a cold shutdown condition or refueling condition.

The DC electrical power requirements for MODES 1, 2, 3, and 4 are covered in LCO 3.8.4.

(continued)

BASES (continued)

ACTIONS

A.1, A.2, and A.3

Condition A represents one subsystem with one or two battery charger(s) inoperable (e.g., the voltage limit of SR 3.8.4.1 is not maintained). The ACTIONS provide a tiered response that focuses on returning the battery to the fully charged state and restoring a fully qualified charger to OPERABLE status in a reasonable time period. Required Action A.1 requires that the battery terminal voltage be restored to greater than or equal to the minimum established float voltage within 2 hours. This time provides for returning the inoperable charger to OPERABLE status or providing an alternate means of restoring battery terminal voltage to greater than or equal to the minimum established float voltage. Restoring the battery terminal voltage to greater than or equal to the minimum established float voltage provides good assurance that, within 12 hours, the battery will be restored to its fully charged condition (Required Action A.2) from any discharge that might have occurred due to the charger inoperability.

A discharged battery having terminal voltage of at least the minimum established float voltage indicates that the battery is on the exponential charging current portion (the second part) of its recharge cycle. The time to return a battery to its fully charged state under this condition is simply a function of the amount of the previous discharge and the recharge characteristic of the battery. Thus there is good assurance of fully recharging the battery within [12] hours, avoiding a premature shutdown with its own attendant risk.

If established battery terminal float voltage cannot be restored to greater than or equal to the minimum established float voltage within 2 hours, and the charger is not operating in the current-limiting mode, a faulty charger is indicated. A faulty charger that is incapable of maintaining established battery terminal float voltage does not provide assurance that it can revert to and operate properly in the current limit mode that is necessary during the recovery period following a battery discharge event that the DC system is designed for.

If the charger is operating in the current limit mode after 2 hours that is an indication that the battery is partially discharged and its capacity margins will be reduced. The time to return the battery to its fully charged condition in this case is a function of the battery charger capacity, the amount of loads on the associated DC system, the amount of the previous discharge, and the recharge characteristic of the battery. The charge time can be extensive, and there is not adequate assurance that it can be recharged within 12 hours (Required Action A.2).

Required Action A.2 requires that the battery float current be verified as less than or equal to 2 amps. This indicates that, if the battery had been discharged as the result of the inoperable battery charger, it has now

BASES (continued)

ACTIONS

A.1, A.2, and A.3 (continued)

been fully recharged. If at the expiration of the initial 12 hour period the battery float current is not less than or equal to 2 amps this indicates there may be additional battery problems and the battery must be declared inoperable.

Required Action A.3 limits the restoration time for the inoperable battery charger to 7 days. This action is applicable if an alternate means of restoring battery terminal voltage to greater than or equal to the minimum established float voltage has been used (e.g., balance of plant non-Class 1E battery charger). The 7 day Completion Time reflects a reasonable time to effect restoration of the qualified battery charger to OPERABLE status.

B.1, B.2.1, B.2.2, B.2.3, and B.2.4

If two subsystems are required by LCO 3.8.10, the remaining subsystem with DC power available may be capable of supporting sufficient systems to allow continuation of CORE ALTERATIONS and fuel movement. By allowing the option to declare required features inoperable with the associated vital DC power source(s) inoperable, appropriate restrictions will be implemented in accordance with the affected required features LCO ACTIONS. In many instances, this option may involve undesired administrative efforts. Therefore, the allowance for sufficiently conservative actions is made (i.e., to suspend CORE ALTERATIONS, movement of irradiated fuel assemblies, and operations involving positive reactivity additions). The Required Action to suspend positive reactivity additions does not preclude actions to maintain or increase reactor vessel inventory, provided the required SDM is maintained.

Suspension of these activities shall not preclude completion of actions to establish a safe conservative condition. These actions minimize probability of the occurrence of postulated events. It is further required to immediately initiate action to restore the required vital DC electrical power subsystems and to continue this action until restoration is accomplished in order to provide the necessary DC electrical power to the plant safety systems.

The Completion Time of immediately is consistent with the required times for actions requiring prompt attention. The restoration of the required vital DC electrical power subsystems should be completed as quickly as possible in order to minimize the time during which the plant safety systems may be without sufficient power.

BASES (continued)

ACTIONS

C.1

If one or more DG DC electrical power subsystem cannot be restored to OPERABLE status in the associated Completion Time, the associated DG may be incapable of performing its intended function and must be immediately declared inoperable. This declaration also requires entry into applicable Conditions and Required Actions for an inoperable DG, LCO 3.8.2, "AC Sources - Shutdown."

SURVEILLANCE REQUIREMENTS

SR 3.8.5.1

SR 3.8.5.1 requires performance of all Surveillances required by SR 3.8.4.1 through SR 3.8.4.7. Therefore, see the corresponding Bases for LCO 3.8.4 for a discussion of each SR.

This SR is modified by a Note. The reason for the Note is to preclude requiring the OPERABLE DC sources from being discharged below their capability to provide the required power supply or otherwise rendered inoperable during the performance of SRs. It is the intent that these SRs must still be capable of being met, but actual performance is not required.

REFERENCES

1. Watts Bar FSAR, Section 15, "Accident Analysis" and Section 6, "Engineered Safety Features."
2. Watts Bar FSAR, Section 8.0, "Electric Power."

B 3.8 ELECTRICAL POWER SYSTEMS

B 3.8.6 Battery Parameters

BASES

BACKGROUND

This LCO delineates the limits on battery float current, electrolyte temperature, electrolyte level, and float voltage for the 125V vital DC electrical power subsystem and the diesel generator (DG) batteries. A discussion of these batteries and their OPERABILITY requirements is provided in the Bases for LCO 3.8.4, "DC Sources - Operating," and LCO 3.8.5, "DC Sources - Shutdown." In addition to the limitations of this Specification, the Battery Monitoring and Maintenance Program also implements a program specified in Specification 5.7.2.22 for monitoring various battery parameters.

The battery cells are of flooded lead acid construction with a nominal specific gravity of 1.215. This specific gravity corresponds to an open circuit battery voltage of approximately 120 V for 60 cell battery (i.e., cell voltage of 2.063 volts per cell (Vpc)). The open circuit voltage is the voltage maintained when there is no charging or discharging. Optimal long term performance however, is obtained by maintaining a float voltage 2.20 to 2.25 Vpc. This provides adequate over-potential which limits the formation of lead sulfate and self discharge. The nominal float voltage of 2.22 Vpc corresponds to a total float voltage output of 133.2 V for a 60 cell battery as discussed in the FSAR, Chapter 8 (Ref. 3).

APPLICABLE SAFETY ANALYSES

The initial conditions of Design Basis Accident (DBA) and transient analyses in the FSAR, Section 6 (Ref. 1) and Section 15 (Ref. 1), assume Engineered Safety Feature systems are OPERABLE. The vital DC electrical power system provides normal and emergency DC electrical power for the emergency auxiliaries, and control and switching during all MODES of operation. The DG battery systems provide DC power for the DGs.

The OPERABILITY of the DC subsystems is consistent with the initial assumptions of the accident analyses and is based upon meeting the design basis of the plant. This includes maintaining at least one subsystem of DC sources OPERABLE during accident conditions, in the event of:

a. An assumed loss of all offsite AC power or all onsite AC power; and

b. A worst case single failure.

Battery parameters satisfy the Criterion 3 of 10 CFR 50.36(c)(2)(ii).

(continued)

BASES (continued)

LCO

Battery parameters must remain within acceptable limits to ensure availability of the required DC power to shut down the reactor and maintain it in a safe condition after an anticipated operational occurrence or a postulated DBA. Battery parameter limits are conservatively established, allowing continued DC electrical system function even with limits not met. Additional preventative maintenance, testing, and monitoring performed in accordance with the Battery Monitoring and Maintenance Program is conducted as specified in Specification 5.7.2.22.

APPLICABILITY

The battery parameters are required solely for the support of the associated vital DC and DG DC electrical power subsystems. Therefore, battery parameter limits are only required when the DC power source is required to be OPERABLE. Refer to the Applicability discussion in Bases for LCO 3.8.4 and LCO 3.8.5.

ACTIONS

A.1, A.2, and A.3

With one or more cells in one or more batteries in one vital DC subsystem < 2.07 V, the battery cell is degraded. Within 2 hours verification of the required battery charger OPERABILITY is made by monitoring the battery terminal voltage (SR 3.8.4.1) and of the overall battery state of charge by monitoring the battery float charge current (SR 3.8.6.1). This assures that there is still sufficient battery capacity to perform the intended function. Therefore, the affected battery is not required to be considered inoperable solely as a result of one or more cells in one or more batteries < 2.07 V, and continued operation is permitted for a limited period up to 24 hours.

Since the Required Actions only specify "perform," a failure of SR 3.8.4.1 or SR 3.8.6.1 acceptance criteria does not result in this Required Action not met. However, if one of the SRs is failed the appropriate Condition(s), depending on the cause of the failures, is entered. If SR 3.8.6.1 is failed then there is not assurance that there is still sufficient battery capacity to perform the intended function and the battery must be declared inoperable immediately.

B.1 and B.2

One or more batteries in one vital DC subsystem with float current > 2 amps indicates that a partial discharge of the battery capacity has occurred. This may be due to a temporary loss of a battery charger or possibly due to one or more battery cells in a low voltage condition reflecting some loss of capacity. Within 2 hours verification of the required battery charger OPERABILITY is made by monitoring the battery terminal voltage. If the terminal voltage is found to be less than the minimum established float voltage there are two possibilities, the battery charger is inoperable or is operating in the current limit mode. Condition A

(continued)

BASES

ACTIONS

B.1 and B.2 (continued)

addresses charger inoperability. If the charger is operating in the current limit mode after 2 hours that is an indication that the battery has been substantially discharged and likely cannot perform its required design functions. The time to return the battery to its fully charged condition in this case is a function of the battery charger capacity, the amount of loads on the associated DC system, the amount of the previous discharge, and the recharge characteristic of the battery. The charge time can be extensive, and there is not adequate assurance that it can be recharged within 12 hours (Required Action B.2). The battery must therefore be declared inoperable.

If the float voltage is found to be satisfactory but there are one or more battery cells with float voltage less than 2.07 V, the associated "OR" statement in Condition H is applicable and the battery must be declared inoperable immediately. If float voltage is satisfactory and there are no cells less than 2.07 V there is good assurance that, within 12 hours, the battery will be restored to its fully charged condition (Required Action B.2) from any discharge that might have occurred due to a temporary loss of the battery charger.

A discharged battery with float voltage (the charger setpoint) across its terminals indicates that the battery is on the exponential charging current portion (the second part) of its recharge cycle. The time to return a battery to its fully charged state under this condition is simply a function of the amount of the previous discharge and the recharge characteristic of the battery. Thus there is good assurance of fully recharging the battery within 12 hours, avoiding a premature shutdown with its own attendant risk.

If the condition is due to one or more cells in a low voltage condition but still greater than 2.07 V and float voltage is found to be satisfactory, this is not indication of a substantially discharged battery and 12 hours is a reasonable time prior to declaring the battery inoperable.

Since Required Action B.1 only specifies "perform," a failure of SR 3.8.4.1 acceptance criteria does not result in the Required Action not met. However, if SR 3.8.4.1 is failed, the appropriate Condition(s), depending on the cause of the failure, is entered.

(continued)

BASES

ACTIONS

C.1, C.2, and C.3

With one or more cells in one or more batteries in one DG DC subsystem < 2.07 V, the battery cell is degraded. Within 2 hours verification of the required battery charger OPERABILITY is made by monitoring the battery terminal voltage (SR 3.8.4.2) and of the overall battery state of charge by monitoring the battery float charge current (SR 3.8.6.2). This assures that there is still sufficient battery capacity to perform the intended function.

Therefore, the affected battery is not required to be considered inoperable solely as a result of one or more cells in one or more batteries < 2.07 V, and continued operation is permitted for a limited period up to 24 hours.

Since the Required Actions only specify "perform," a failure of SR 3.8.4.2 or SR 3.8.6.2 acceptance criteria does not result in this Required Action not met. However, if one of the SRs is failed the appropriate Condition(s), depending on the cause of the failures, is entered. If SR 3.8.6.2 is failed then there is not assurance that there is still sufficient battery capacity to perform the intended function and the battery must be declared inoperable immediately.

D.1 and D.2

One or more batteries in one DG DC subsystem with float current > 1 amps indicates that a partial discharge of the battery capacity has occurred. This may be due to a temporary loss of a battery charger or possibly due to one or more battery cells in a low voltage condition reflecting some loss of capacity. Within 2 hours verification of the required battery charger OPERABILITY is made by monitoring the battery terminal voltage. If the terminal voltage is found to be less than the minimum established float voltage there are two possibilities, the battery charger is inoperable or is operating in the current limit mode. Condition B addresses charger inoperability. If the charger is operating in the current limit mode after 2 hours that is an indication that the battery has been substantially discharged and likely cannot perform its required design functions. The time to return the battery to its fully charged condition in this case is a function of the battery charger capacity, the amount of loads on the associated DC system, the amount of the previous discharge, and the recharge characteristic of the battery. The charge time can be extensive, and there is not adequate assurance that it can be recharged within 12 hours (Required Action D.2). The battery must therefore be declared inoperable.

If the float voltage is found to be satisfactory but there are one or more battery cells with float voltage less than 2.07 V, the associated "OR" statement in Condition H is applicable and the battery must be declared inoperable immediately. If float voltage is satisfactory and there are no

(continued)

BASES

ACTIONS

D.1 and D.2 (continued)

cells less than 2.07 V there is good assurance that, within 12 hours, the battery will be restored to its fully charged condition (Required Action D.2) from any discharge that might have occurred due to a temporary loss of the battery charger.

A discharged battery with float voltage (the charger setpoint) across its terminals indicates that the battery is on the exponential charging current portion (the second part) of its recharge cycle. The time to return a battery to its fully charged state under this condition is simply a function of the amount of the previous discharge and the recharge characteristic of the battery. Thus there is good assurance of fully recharging the battery within 12 hours, avoiding a premature shutdown with its own attendant risk.

If the condition is due to one or more cells in a low voltage condition but still greater than 2.07 V and float voltage is found to be satisfactory, this is not indication of a substantially discharged battery and 12 hours is a reasonable time prior to declaring the battery inoperable.

Since Required Action D.1 only specifies "perform," a failure of SR 3.8.4.2 acceptance criteria does not result in the Required Action not met. However, if SR 3.8.4.2 is failed, the appropriate Condition(s), depending on the cause of the failure, is entered.

E.1, E.2, and E.3

With one or more required batteries in one vital DC subsystem or one DG battery with one or more cells electrolyte level above the top of the plates, but below the minimum established design limits, the battery still retains sufficient capacity to perform the intended function. Therefore, the affected battery is not required to be considered inoperable solely as a result of electrolyte level not met. Within 31 days the minimum established design limits for electrolyte level must be re-established.

With electrolyte level below the top of the plates there is a potential for dryout and plate degradation. Required Actions E.1 and E.2 address this potential (as well as provisions in Specification 5.7.2.22, Battery Monitoring and Maintenance Program). They are modified by a Note that indicates they are only applicable if electrolyte level is below the top of the plates. Within 8 hours level is required to be restored to above the top of the plates. The Required Action E.2 requirement to verify that there is no leakage by visual inspection and the Specification 5.7.2.22.b item to initiate action to equalize and test in accordance with manufacturer's recommendation. They are performed following the restoration of the electrolyte level to above the top of the plates. Based on the results of the manufacturer's recommended testing the battery(ies) may have to be declared inoperable and the affected cell(s) replaced.

(continued)

BASES

ACTIONS (continued)

F.1

With one or more batteries in one vital DC subsystem or one DG battery with pilot cell temperature less than the minimum established design limits, 12 hours is allowed to restore the temperature to within limits. A low electrolyte temperature limits the current and power available. Since the battery is sized with margin, while battery capacity is degraded, sufficient capacity exists to perform the intended function and the affected battery is not required to be considered inoperable solely as a result of the pilot cell temperature not met.

G.1

With one or more batteries in redundant vital DC subsystems with battery parameters not within limits there is not sufficient assurance that battery capacity has not been affected to the degree that the batteries can still perform their required function, given that redundant batteries are involved. With redundant batteries involved this potential could result in a total loss of function on multiple systems that rely upon the batteries. With more than one DG battery with battery parameters not within limits there is not sufficient assurance that battery capacity has not been affected to the degree that the batteries can still perform their required function.

The longer Completion Times specified for battery parameters on non-redundant batteries not within limits are therefore not appropriate, and the parameters must be restored to within limits on at least one subsystem within 2 hours.

H.1

With one or more batteries with any battery parameter outside the allowances of the Required Actions for Condition A, B, C, D, E, F, or G, sufficient capacity to supply the maximum expected load requirement is not assured and the corresponding battery must be declared inoperable. Additionally, discovering one or more vital DC batteries in one subsystem with one or more battery cells float voltage less than 2.07 V and float current greater than 2 amps, or one DG battery cells float voltage greater than or equal to 2.07 V and float current greater than 1 amp, indicates that the battery capacity may not be sufficient to perform the intended functions. The battery must therefore be declared inoperable immediately.

(continued)

SURVEILLANCE REQUIREMENTS

SR 3.8.6.1 and SR 3.8.6.2

Verifying battery float current while on float charge is used to determine the state of charge of the battery. Float charge is the condition in which the charger is supplying the continuous charge required to overcome the internal losses of a battery and maintain the battery in a charged state. The equipment used to monitor float current must have the necessary accuracy and capability to measure electrical currents in the expected range. The float current requirements are based on the float current indicative of a charged battery. The 7 day Frequency is consistent with IEEE-450 (Ref. 2).

SR 3.8.6.1 is modified by a Note that states the float current requirement is not required to be met when battery terminal voltage is less than the minimum established float voltage of SR 3.8.4.1. When this float voltage is not maintained the Required Actions of LCO 3.8.4 ACTION A are being taken, which provide the necessary and appropriate verifications of the battery condition. Furthermore, the float current limit of 2 amps is established based on the nominal float voltage value and is not directly applicable when this voltage is not maintained.

SR 3.8.6.2 is modified by a Note that states the float current requirement is not required to be met when battery terminal voltage is less than the minimum established float voltage of SR 3.8.4.2. When this float voltage is not maintained the Required Actions of LCO 3.8.4 ACTION D are being taken, which provide the necessary and appropriate verifications of the battery condition. Furthermore, the float current limit of 1 amp is established based on the nominal float voltage value and is not directly applicable when this voltage is not maintained.

SR 3.8.6.3 and SR 3.8.6.6

Optimal long term battery performance is obtained by maintaining a float voltage greater than or equal to the minimum established design limits provided by the battery manufacturer, which corresponds to 132 V at the battery terminals, or 2.20 Vpc. This provides adequate overpotential, which limits the formation of lead sulfate and self discharge, which could eventually render the battery inoperable. Float voltages in this range or less, but greater than 2.07 Vpc, are addressed in Specification 5.7.2.22. SRs 3.8.6.3 and 3.8.6.6 require verification that the cell float voltages are equal to or greater than the short term absolute minimum voltage of 2.07 V. The Frequency for cell voltage verification every 31 days for pilot cell and 92 days for each connected cell is consistent with IEEE-450 (Ref. 2).

(continued)

SURVEILLANCE REQUIREMENTS (continued)

SR 3.8.6.4

The limit specified for electrolyte level ensures that the plates suffer no physical damage and maintains adequate electron transfer capability. The minimum design electrolyte level is the minimum level indication mark on the battery cell jar. The Frequency is consistent with IEEE-450 (Ref. 2).

SR 3.8.6.5

This Surveillance verifies that the pilot cell temperature is greater than or equal to the minimum established design limit (i.e., 60°F for vital batteries and 50°F for DG batteries). Pilot cell electrolyte temperature is maintained above this temperature to assure the battery can provide the required current and voltage to meet the design requirements. Temperatures lower than assumed in battery sizing calculations act to inhibit or reduce battery capacity. The Frequency is consistent with IEEE-450 (Ref. 2).

SR 3.8.6.7

A battery performance discharge test is a test of constant current capacity of a battery, normally done in the as found condition, after having been in service, to detect any change in the capacity determined by the acceptance test. The test is intended to determine overall battery degradation due to age and usage.

Either the battery performance discharge test or the modified performance discharge test is acceptable for satisfying SR 3.8.6.7; however, only the modified performance discharge test may be used to satisfy the battery service test requirements of SR 3.8.4.7.

A modified discharge test is a test of the battery capacity and its ability to provide a high rate, short duration load (usually the highest rate of the duty cycle). This will often confirm the battery's ability to meet the critical period of the load duty cycle, in addition to determining its percentage of rated capacity. Initial conditions for the modified performance discharge test should be identical to those specified for a service test.

It may consist of just two rates; for instance the one minute rate for the battery or the largest current load of the duty cycle, followed by the test rate employed for the performance test, both of which envelope the duty cycle of the service test. Since the ampere-hours removed by a one minute discharge represents a very small portion of the battery capacity, the test rate can be changed to that for the performance test without compromising the results of the performance discharge test. The battery terminal voltage for the modified performance discharge test must remain above the minimum battery terminal voltage specified in the battery service test for the duration of time equal to that of the service test.

(continued)

SURVEILLANCE REQUIREMENTS

SR 3.8.6.7 (continued)

The acceptance criteria for this Surveillance are consistent with IEEE-450 (Ref. 2) and IEEE-485 (Ref. 4). These references recommend that the battery be replaced if its capacity is below 80% of the manufacturer's rating. A capacity of 80% shows that the battery rate of deterioration is increasing, even if there is ample capacity to meet the load requirements. Furthermore, the battery is sized to meet the assumed duty cycle loads when the battery design capacity reaches this 80% limit.

The Surveillance Frequency for this test is normally 60 months. If the battery shows degradation, or if the battery has reached 85% of its expected life and capacity is < 100% of the manufacturer's rating, the Surveillance Frequency is reduced to 12 months. However, if the battery shows no degradation but has reached 85% of its expected life, the Surveillance Frequency is only reduced to 24 months for batteries that retain capacity ≥ 100% of the manufacturer's ratings. Degradation is indicated, according to IEEE-450 (Ref. 2), when the battery capacity drops by more than 10% relative to its capacity on the previous performance test or when it is ≥ 10% below the manufacturer's rating. These Frequencies are consistent with the recommendations in IEEE-450 (Ref. 2).

This SR is modified by a Note. The reason for the Note is that performing the Surveillance would perturb the electrical distribution system and challenge safety systems. Credit may be taken for unplanned events that satisfy this SR.

REFERENCES

1. Watts Bar FSAR, Section 15, “Accident Analysis,” and Section 6, “Engineered Safety Features.”

2. IEEE-450-2002, "IEEE Recommended Practice for Maintenance, Testing, and Replacement of Vented Lead-Acid Batteries for Stationary Applications."

3. Watts Bar FSAR, Section 8, “Electric Power.”

4. IEEE-485-1983, "IEEE Recommended Practice for Sizing Large Lead Storage Batteries for Generating Stations and Substations."

Enclosure 4

Regulatory Commitments

Commitment	Due Date/Event
TVA commits to include in the FSAR a requirement to maintain a 2 percent design margin for the vital batteries which corresponds to a 2 amp float current value being used as an indication that the battery is at least 98 percent charged.	Prior to implementation of the approved TSTF-500 license amendment
TVA commits to include in the FSAR a requirement to maintain a 2 percent design margin for the DG batteries which corresponds to a 1 amp float current value being used as an indication that the battery is at least 98 percent charged.	Prior to implementation of the approved TSTF-500 license amendment
TVA commits that the licensee-controlled program, required and described in TS Section 5.7, “Programs, Programs, and Manuals,” and titled, “Battery Monitoring and Maintenance Program,” will require verification of the selection of the pilot cell or cells when performing SR 3.8.6.5.	Prior to implementation of the approved TSTF-500 license amendment
TVA commits to a licensee-controlled program that will require the availability of a means to charge the batteries that is capable of being supplied power from a power source that is independent of the offsite power supply.	Prior to implementation of the approved TSTF-500 license amendment
TVA commits to verify that the equipment that will be used to monitor float current under SR 3.8.6.1 and SR 3.8.6.2 will have the necessary accuracy and capability to measure electrical currents in the expected range. Additionally, TVA commits to verify that the minimum required procedural time to measure battery float current will be 30 seconds or as recommended by the float current measurement instrument manufacturer.	Prior to implementation of the approved TSTF-500 license amendment
TVA commits to relocating the monitoring of battery parameters (i.e., specific gravity, electrolyte level, cell temperature, float voltage, connection resistance, and physical condition) to the licensee-controlled program, required and described in TS Section 5.7, “Programs, Programs, and Manuals,” and titled the “Battery Monitoring and Maintenance Program.”	Prior to implementation of the approved TSTF-500 license amendment

Enclosure 4

Regulatory Commitments

Commitment	Due Date/Event
TVA commits to revising the FSAR to include the following: • How a 2 percent design margin for the vital batteries corresponds to a 2 amp float current value indicating that the battery is at least 98 percent charged. • How a 2 percent design margin for the DG batteries corresponds to a 1 amp float current value indicating that the battery is at least 98 percent charged. • How long term battery performance is obtained by maintaining a float voltage greater than or equal to the minimum established design limits provided by the battery manufacturer. • How the batteries are sized with correction margins that include temperature and aging and how these margins are maintained. • The minimum established design limit for battery terminal float voltage. • The minimum established design limit for electrolyte level. • The minimum established design limit for electrolyte temperature. • How each battery is designed with additional capacity above that required by the design duty cycles to allow for temperature variations and other factors. • Normal DC system operation i.e., powered from the battery chargers with the batteries floating on the system, and with a loss of normal power to the battery charger. • The minimum requirements for the alternate means (i.e., spare battery charger) that are used to obtain an extended battery charger CT.	Prior to implementation of the approved TSTF-500 license amendment

Enclosure 5

Letters from Battery Manufacturers Verifying the Acceptability of Using Float Current Monitoring

C&D TECHNOLOGIES, INC.
Power Solutions

1400 Union Meeting Road
Blue Bell, PA 19422
Phone: (215) 775-1306
Fax: (215) 619-7887

Sent via Email to: rnballard@tva.gov

February 23, 2018

Ms. Regina Ballard
Tennessee Valley Authority

Subject: Watts Bar Nuclear Plant – Using Float Current for State of Charge

Dear Regina:

In regards to the C&D battery models KCR and LCUN in safety related (Class 1-E) applications at Watts Bar, it is acceptable to use float current monitoring instead of specific gravity monitoring as a reliable and accurate indication of the state of charge of the battery. This relationship remains valid for the life of these batteries.

For technical basis, please reference IEEE 450-2010, Annex A.2, which indicates in part:

A.2 Stabilized charging current used to determine a fully charged condition

The pattern of charging current delivered by a conventional voltage-regulated charger after a discharge is the most accurate method for determining the state of charge. As the cells approach full charge, the battery voltage rises to approach the charger output voltage, and the charging current decreases. When the charging current has stabilized at the charging voltage for three consecutive hourly measurements, the battery is near full charge. The expected charging current range applicable to each model may be verified by test or in consultation with the manufacturer.

I hope that this information meets your needs. If you require any additional information, please contact me.

Regards,

Kristen Jamison
Nuclear Applications Engineer
C&D Technologies, Inc.

C&D TECHNOLOGIES, INC.
Power Solutions

1400 Union Meeting Road
Blue Bell, PA 19422
Phone: (215) 775-1314
Fax: (215) 619-7887

Sent via Email to: tcwalker@tva.gov

May 30, 2013

Mr. Tim Walker
Watts Bar Nuclear Plant
Tennessee Valley Authority

Subject: Use of Float Current to Determine Operability
Revision of Letter dated February 22, 2013

Dear Tim:

The following statements are based on a battery temperature of 77F.

For the LCUN-33 batteries, when the float current drops to less than or equal to 2 amps, the battery would have been at least 98% recharged.

For the KCR-7 batteries, when the float current drops to less than or equal to 1 amp, the battery would have been at least 98% recharged.

This relationship will not change as the batteries age.

These values of float current are also valid if the float voltage has been adjusted to compensate for battery temperatures that are above or below 77F. See C&D's Installation and Operating Manual (RS-1476) at the following link for recommended temperature compensation factors.

http://cdtechno.com/pdf/ref/rs_1476_0610.pdf

I hope that this information meets your needs. If you require any additional information, please contact me.

Regards,

Larry A. Carson

Larry A. Carson
Nuclear Product Manager
C&D Technologies, Inc.

Enclosure 6

Evaluation of an Extended Completion Time for Technical Specification 3.8.4, Required Action A.3

The Vital 125 volt (V) DC Control Power System is a Class 1E DC electrical power system that provides control power to the emergency alternating current (AC) power system. The 125 V DC vital control power system is composed of four channels (Channels I, II, III, and IV) in two trains (Channels I and III in Train A and Channels II and IV in Train B), which are shared by both WBN Units 1 and 2. Each channel consists of a battery charger that supplies normal DC power, a battery for emergency DC power, and a battery board that facilitates load grouping and provides circuit protection.

Vital Battery Boards I, II, III, and IV have manual access to two spare (backup) chargers for use upon loss of the normal charger. Each pair of spare chargers is mechanically interlocked such that only one charger in each pair can be utilized at a time. Additionally, Vital Battery Boards I, II, III, and IV have manual access to a fifth 125V DC Vital Battery System, and is intended to serve as a replacement for any one of the four 125V DC vital batteries during testing, maintenance, and outages with no loss of system reliability under any mode of operation.

During normal operation the DC load is powered from the battery chargers with the batteries "floating" on the system. In case of loss of normal power to the battery charger, the DC load is automatically powered from the station batteries.

Each battery is separately housed in a ventilated room apart from its charger and distribution centers. Each subsystem is located in an area separated physically and electrically from the other subsystem to ensure that a single failure in one subsystem does not cause a failure in a redundant subsystem. There is no sharing of dedicated components between redundant Class 1E subsystems, such as batteries, battery chargers, or distribution panels.

With the batteries in the fully charged condition, the system has the capacity to supply the required loads for a minimum of four hours with a loss of all AC power. Each battery is designed with additional capacity above that required by the design duty cycles to allow for temperature variations and other factors.

Each DC electrical power subsystem battery charger has ample power output capacity for the steady state operation of connected loads required during normal operation, while at the same time maintaining its battery bank fully charged. Each battery charger also has sufficient excess capacity to restore the battery from the design minimum charge to its fully charged state while supplying normal steady state loads.

Each battery charger is normally in the float-charge mode. Float-charge is the condition in which the charger is supplying the connected loads and the battery cells are receiving adequate current to optimally charge the battery. The purpose of the float-charge is to overcome the internal losses of the battery such that the battery is maintained in a fully charged state.

The normal supply of DC current to the vital battery boards is from the battery charger in each channel. Each charger maintains a float voltage of approximately 135 volts on the associated battery board with the battery connected to the board and is capable of maintaining 140 volts during an equalizing charge period (all loads can tolerate the 140 volt equalizing voltage). The charger supplies normal steady state DC load demand on the battery board and maintains the battery in a charged state. Normal recharging of the battery from the design discharged condition can be accomplished in approximately 12 hours (with accident loads being supplied) following a 30 minute AC power outage and in approximately 36 hours (with normal loads being

supplied) following a 4-hour AC power outage. The battery chargers, including the spare chargers if in service, are automatically loaded on the diesel generators for a loss of offsite power event. Two pairs of spare chargers are available for the four channels (two each for two channels). Each spare charger can be connected to either of its two assigned channels.

AC power for each charger is derived from the station auxiliary power system via two 480V AC 3-phase circuits which are physically and electrically independent. Each circuit has access to a preferred (offsite) and a standby (onsite) source. If the normal circuit supplying a charger is unavailable, the alternate circuit is selected by a manual transfer. The transfer switches are mechanically interlocked to prevent closing switches in a manner to parallel both feeds. The alternate 480V feeder breakers are verified open in accordance with the TSs. Each charger is equipped with a DC voltmeter, DC ammeter, and charger abnormal alarm. Malfunction of a charger is annunciated in the Main Control Room. Upon loss of normal power to a charger, each may be energized from the standby power system.

Chargers I, II, III, IV, and V are solid-state type devices that convert a 3-phase 480V AC input to a nominal 125V DC output having a rated capacity of 200 amperes. Over this output current range, the DC output voltage will vary no more than ±1.0% for a supply voltage amplitude variation of ± 7.5% and frequency variation of ± 2.0%.

The operational features of the chargers include:

(1) float and equalize modes of operation,
(2) output voltage adjustable over the range of 125 to 140 volts,
(3) a current limit feature which limits continuous overload operation to 125% of rated output,
(4) protective devices which prevent a failed charger from discharging its associated battery and protect the charger from external overloads,
(5) metering and alarm circuits to monitor the charger output,
(6) parallel operation capability, and
(7) high voltage cutout function that will trip the output breaker in the event there is an over-voltage condition.

The chargers normally operate in the float mode at 135V for Batteries I-IV and 139.5V for Battery V. The maximum equalizing voltage for batteries I-IV is 140V when connected to the distribution system. The system configuration, using substitution of Battery V, permits off-line equalization at higher than normal values.

Onsite Standby Diesel Generator System

The Standby Diesel Generator (SDG) system serves as the plant emergency standby alternating current (AC) power source. It is designed, installed and tested to requirements necessary to assure its availability. Its sole purpose is for emergency power in case of a loss of offsite power.

The WBN SDG system consists of four self-contained, water-cooled, automatic starting, diesel engine driven, stationary electric generators. Two diesel generators (DGs) powering the same load group (i.e., both 1A and 2A, or both 1B and 2B) are required to mitigate a design basis event (DBE). Redundancy for single failure is provided by maintaining four DGs in ready condition for automatic start.

Enclosure 6

Evaluation of an Extended Completion Time for Technical Specification 3.8.4, Required Action A.3

Each DG consists of two 16-cylinder engines directly connected to a common 6.9 kV generator with exciter. Each DG is capable of starting and accelerating to rated speed within 10 seconds to provide power to the needed engineered safety features and shutdown loads. Each DG has a "continuous" and "short time" rating of 4400kW-5500 kVA and 4840kW-6050 kVA, respectively.