Advanced Passive 1000 (AP1000)
Generic Technical Specification Traveler (GTST)

Title: Changes related to Section 3.8.1, DC Sources - Operating

I. Technical Specifications Task Force (TSTF) Travelers, Approved Since Revision 2 of STS NUREG-1431, and Used to Develop this GTST

TSTF Number and Title:

TSTF-425, Rev. 3, Relocate Surveillance Frequencies to Licensee Control - RITSTF Initiative 5b
TSTF-451-T, Rev. 0, Correct the Battery Monitoring and Maintenance Program and the Bases for SR 3.8.4.2
TSTF-500, Rev. 2, DC Electrical Rewrite - Update to TSTF-360

STS NUREGs Affected:

TSTF-425, Rev. 3, NUREG-1430, -1431, -1432, -1433, and -1434
TSTF-451-T, Rev. 0: NUREG-1430, -1431, -1432, -1433, and -1434
TSTF-500, Rev. 2: NUREG-1430, -1431, 1432, 1433, and 1434

NRC Approval Date:

TSTF-425, Rev. 3: 18-Mar-2009
TSTF-451-T, Rev. 0: 21-Jul-03 (Approved for Use)
TSTF-500, Rev. 2: 09-Sept-11

TSTF Classification:

TSTF-425, Rev.3, Technical Change
TSTF-451-T, Rev. 0: Technical Change
TSTF-500, Rev. 2: Technical Change

II. Reference Combined License (RCOL) Standard Departures (Std. Dep.), RCOL COL Items, and RCOL Plant-Specific Technical Specifications (PTS) Changes Used to Develop this GTST

RCOL Std. Dep. Number and Title:

None

RCOL COL Item Number and Title:

None

RCOL PTS Change Number and Title:

VEGP LAR DOC L21:	Current TS 3.8.1, “DC Sources - Operating” is revised to delete SR 3.8.1.3 Note 2.

III. Comments on Relations Among TSTFs, RCOL Std. Dep., RCOL COL Items, and RCOL PTS Changes

This section discusses the considered changes that are: (1) applicable to operating reactor designs, but not to the AP1000 design; (2) already incorporated in the GTS; or (3) superseded by another change.

TSTF-500, Rev.2 is an update of TSTF-360-A and portions of TSTF-500, Rev. 2 are the same as TSTF-360-A which was implemented in Rev. 2 of NUREG-1431 and in the AP1000 GTS. Additional changes in TSTF-500, Rev. 2 were reviewed and changes applicable to AP1000 were included. Changes related to Completion Time values were not incorporated; Completion Time values for AP1000 were finalized in AP1000 DCD Rev. 19. In this section, reference to IEEE 450-1995 was removed. In addition, since the values for battery parameters and Completion Times were finalized in AP1000 DCD Rev.19 or approved in VEGP Units 3 and 4 plant-specific TS in Amendment 13, brackets and reviewer's notes are not used for AP1000 STS.

TSTF-432 is not considered in this GTST. TSTF-432 is a topical report and is not considered applicable for AP1000, without further analyses.

The change proposed in TSTF-451-T, Rev. 0 is the same change that was incorporated in VEGP TS in response to RAI Letter No. 1, Question 16-14. In response to the RAI, SR 3.8.1.2 and the associated Bases discussion were made consistent by replacing the term "coincident demands" with "combined demands" in the Bases for SR 3.8.1.2. No separate change was necessary for addressing the response to RAI Letter No. 1, Question 16 -14.

TSTF-425 is deferred for future consideration.

IV. Additional Changes Proposed as Part of this GTST (modifications proposed by NRC staff and/or clear editorial changes or deviations identified by preparer of GTST)

A typographical correction was made in the third paragraph of the Bases discussion of SR 3.8.1.2 (pg. B 3.8.1-12). In addition, minor editorial changes are made in the Bases discussions.

References in the “References” section in the Bases is renumbered by their first appearance in the body of the Bases.

<u>APOG Recommended Changes to Improve the Bases</u>

Throughout the Bases, references to Sections and Chapters of the FSAR do not include the “FSAR” clarifier. Since these Section and Chapter references are to an external document, it is appropriate to include the “FSAR” modifier. (DOC A003)

Revise TS 3.8.1 Bases Background to insert “equipment” after “monitoring” in first statement for editorial clarification.

Revise TS 3.8.1 Bases Background first paragraph to add “up to” for editorial clarification.

Revise TS 3.8.1 Bases Background presentation of battery bank configuration to be more consistent with AP1000 DCD 8.3.2.1.1.1.

Revise TS 3.8.1 Bases Background replacing “engineered safeguard features” with “engineered safety features.”

Revise TS 3.8.1 Bases Background to add “(also referred to as the battery)” after “battery bank.”

V. Applicability

Affected Generic Technical Specifications and Bases:

Section 3.8.1, DC Sources - Operating

Changes to the Generic Technical Specifications and Bases:

1. SR 3.8.1.3, Note 2 is deleted along with the discussion of Note 2 in the Bases (LAR DOC L21).

2. In the Background section of the Bases, presentation of battery bank configuration was revised to be more consistent with AP1000 DCD 8.3.2.1.1.1. (APOG Comment)

3. The Bases for SR 3.8.1.2 (first sentence, 3rd paragraph) is revised to be consistent with the Surveillance by replacing the word “coincident” with “combined” (TSTF-451-T, Rev. 0). This change was incorporated in VEGP TS in response to request for additional information (RAI).

4. Reference to IEEE-450 in SR 3.8.1.1 is deleted (TSTF-500, Rev. 2) and the “Reference” section in the Bases is revised so that they are numbered by the first appearance in the body of the Bases.

5. The following editorial changes are made in the “Background” section of the Bases based on APOG comment:

   Insert “equipment” after “monitoring” in the first statement.

   Add “up to” in the first paragraph.

   Replace “engineered safeguard features” with “engineered safety features.”

   Add “(also referred to as battery)” after “battery bank.”

6. The acronym “FSAR” is added to modify “Section” and “Chapter” in references to the FSAR throughout the Bases. (DOC A003)

7. The remaining changes are editorial, grammatical, or administrative in nature.

VI. Traveler Information

Description of TSTF changes:

TSTF-451

TSTF-451 makes the Specification SR 3.8.1.2 and the Bases consistent by using the phrase "combined" in the Bases instead of "coincident."

TSTF-500

TSTF-500 updates and replaces TSTF-360-A, Revision 1, "DC Electrical Rewrite." The update reflects the current NRC position on the proposed changes and approval of recent plant-specific amendments to adopt TSTF-360-A.

TSTF-500 proposed new action requirements for an inoperable battery charger and new alternate test criteria for the battery chargers in STS 3.8.4, "DC Sources - Operating," and STS 3.8.5, "DC Sources - Shutdown." This traveler also proposed the relocation of safety related battery preventive maintenance-related Surveillance Requirements (SRs) from STS 3.8.4 to a licensee controlled program. TSTF-500 also proposed changes to STS 3.8.6, "Battery Parameters," by relocating Table 3.8.6-1, "Battery Cell Parameter Requirements," to a licensee-controlled program; adding action requirements specific to out-of-limits conditions for battery cell voltage, electrolyte level, and electrolyte temperature; and specific SRs for verification that these parameters are within limits. (The LCO numbers in this paragraph relate to NUREG-1431 and not AP1000 STS).

For clarification and description of the changes based on TSTF-500, the following information is presented below:

A. Summary of applicable changes to AP1000 GTS based on TSTF-500, and
B. Discussion of applicable changes to AP1000 GTS 3.8.1, "DC Sources - Operating" Surveillance,

A. Summary of Applicable Changes for AP1000 STS based on TSTF-500

TSTF-360, "DC Electrical Rewrite," was approved by the NRC in December 2000 and incorporated in Revision 2 of STS NUREGs - 1430 to 1434. TSTF-500 proposed additional changes to be applied to Revision 3.1 of the STS NUREGs. The differences between TSTF-360-A and TSTF-500 constitute the additional changes.

Since the AP1000 GTS are based on Revision 2 version of the STS NUREG-1431, the NRC staff concludes that the changes in TSTF-500 are applicable to the AP1000 GTS. Based on the review of the changes, the approved AP1000 DCD Rev. 19, and the approved VEGP Units 3 and 4 plant-specific TS in Amendment 13, the following summary describes the changes applicable to AP1000 STS.

1. TSTF-360-A was based on IEEE-450-1995, "IEEE Recommended Practice for Maintenance, Testing, and Replacement of Vented Lead-Acid Batteries for Stationary Applications." The NRC has not reviewed or endorsed IEEE-450-1995. Therefore, the changes proposed in TSTF-500 are based on IEEE-450-2002. The NRC has endorsed IEEE-450-2002 in Regulatory Guide 1.129, Revision 2. Reference to IEEE-450-1995 is not appropriate.

2. The Battery Monitoring and Maintenance Program is revised to reference IEEE-450-2002 and Regulatory Guide 1.129, Revision 2 (with exceptions), to require actions to equalize and test battery cells when the electrolyte level drops below the top of plates instead of when the electrolyte level drops below the minimum established design limit, to require actions to verify the voltages of remaining cells are > [2.07] V when one or cells have been found with voltages < [2.13] V. The Battery Monitoring and Maintenance Program is also revised to state the license controlled program will contain limits on average electrolyte temperature, battery connection resistance, and battery terminal voltage; and a requirement to obtain specific gravity readings of all cells at each discharge test, consistent with manufacturer recommendations.

AP1000 GTS do not use brackets and Reviewer's Notes in Subsection 3.8.1. The values used for parameters and Completion Times were finalized in AP1000 DCD Rev. 19 or were approved in VEGP Units 3 and 4 plant-specific TS in Amendment 13. Accordingly, all brackets and Reviewer's notes are omitted from AP1000 STS 3.8.1.

B. <u>Discussion of Applicable Changes to GTS 3.8.1 “DC sources - Operating” Surveillances</u>

AP1000 GTS 3.8.1 Surveillance Requirements have already incorporated the changes proposed in TSTF-500, Rev. 2. No additional changes were applicable. The changes from TSTF-500 included in AP-1000 GTS are the following:

1. Surveillance on battery corrosion, connection resistance, visual inspection, terminal connection, and discharge tests are relocated to an administrative program or to other specifications.

2. Remaining Surveillances are written in a manner where specific values are relocated to the Bases making the requirements less susceptible to future amendments; the values can be controlled in the TS Bases by the Technical Specifications Bases Control Program.

3. An alternative criterion is added for SR 3.8.1.2 to verify the design capacity of each battery charger, consistent with the alternative criteria discussed as part of TSTF-500, Rev. 2.

<u>Summary Description of Changes to GTS Bases based on TSTF-500</u>

The changes to the AP1000 Section 3.8.1 Bases are as follows:

1. Discussions for SR 3.8.1.2 are revised replacing the word “coincident” with “combined.”

2. Reference to IEEE-450 in in the Bases for SR 3.8.1.1 and the “References” section is deleted.

3. The remaining the changes are editorial, grammatical or administrative in nature.

Rationale for TSTF changes:

TSTF-451

In the Bases for SR 3.8.4.2 in NUREG-1431, the sentence, “The other option requires that each 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),” is revised to state, “The other option requires that each battery charger be capable of recharging the battery after a service test coincident with supplying the largest *combined* demands of the various continuous steady state loads (irrespective of the status of the plant during which these demands occur)” (italics added).

This wording has caused confusion for two reasons. First, the Surveillance uses the phrase “largest combined demands” and the Bases uses the phrase, “largest coincident demands”. Second, the first paragraph of the SR 3.8.4.2 Bases states: “This SR verifies the design capacity of the battery chargers.” According to Regulatory Guide 1.32 (Ref. 9), 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 unit during these demand occurrences” (italics added).

Regulatory Guide 1.32, “Criteria for Safety-Related Electric Power Systems for Nuclear Power Plants,“ Revision 2, Regulatory Position 1.b states, “Battery Charger Supply. The provisions of Section 5.3.4 of IEEE Std. 308-1974 should be construed to mean that the capacity of the battery charger supply should 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 which these demands occur.”

The proposed change makes the Bases consistent with the Specifications, the other statements in the Bases, and with Regulatory Guide 1.32.

TSTF-500

This section presents the rationale provided in TSTF-500 for changes that are retained in DC Sources - Operating TS. Brackets and Completion Times, as they appear in TSTF-500, are retained here.

Condition, Required Action, and Completion Time for Inoperable Battery Charger

In NUREG-1431, TS 3.8.4 contained a Condition for one DC electrical train inoperable. The proposed change in TSTF-500, Rev. 2 adds two additional Conditions, which are exceptions to the existing Condition. The proposed change to the TS 3.8.4 Actions addresses the condition in which one or two required battery chargers on one train are inoperable and effectively increase the Completion Time for an inoperable battery charger from an existing 2 hours to [72] hours, provided the battery terminal is restored to greater than or equal to the minimum established float voltage within 2 hours, and battery float current is verified to be less than or equal to [2] amps once per [12] hours.

The first Condition (Condition A) applies when one [or more] battery charger[s] on one subsystem are inoperable (e.g., the voltage limit of SR 3.8.4.1 is not maintained). There are three Required Actions. The Required 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. The first Required Action states that the battery terminal voltage must be restored to greater than or equal to the minimum established float voltage within 2 hours. The second Required Action states that the battery float current must be verified to be ≤ [2] amps once per [12] hours. As stated in a Reviewer's Note in the Bases, a plant that cannot meet the 12 hour Completion Time due to an inherent battery charging characteristic can propose an alternate time equal to 2 hours plus the time experienced to accomplish the exponential charging current portion of the battery charge profile following the service test (SR 3.8.4.3). The third Required Action states that the battery charger[s] must be restored to Operable status. The third Completion Time is [72] hours.

New Required Action A.1 would provide assurance that a battery discharge is terminated by requiring that the battery terminal voltage be restored to greater than or equal to the minimum established float voltage within 2 hours. The battery charger, in addition to maintaining battery operability, provides DC control power to AC circuit breakers and thus supports the recovery of AC power following events such as loss of offsite power or station blackout (SBO). The 2 hour Completion Time provides an allowance for returning an inoperable charger to Operable status or for reestablishing an alternate means of restoring battery terminal voltage to greater than or equal to the minimum established float voltage. This provides assurance that the battery will be restored to its fully charged condition from any discharge that might have occurred due to the battery charger being inoperable. At the end of the 2 hours, a terminal voltage of at least the minimum established float voltage provides indication that the battery is on the exponential charging current portion of its recharging cycle.

New Required Action A.2 would require that once per [12] hours, the battery float current be verified to be less than or equal to [2] amps. This provides an indication that, if the battery has been discharged as the result of an inoperable battery charger, it has now been fully charged. If at the expiration of the [12] hour period, the battery float current is not less than or equal to [2] amps, there may be additional problems and the battery is considered inoperable. This verification provides assurance that the battery has sufficient capacity to perform its safety function.

New Required Action A.3 requires restoring inoperable battery charger to Operable status. Given that the DC bus remains energized, the battery discharge is terminated based on restoration of the battery terminal voltage (new Required Action A.1), and the battery is fully recharged based upon battery float current (new Required Action A.2), there is reasonable basis for extending the restoration time for an inoperable battery charger beyond the existing [2] hour Completion Time to [72] hours (new Required Action A.3). The primary justification for the extended Completion Time is the availability of a spare battery charger that is appropriately sized to perform the design function of the charger being replaced. As stated in a Reviewer's Note in the Bases, a licensee wishing to adopt a Completion Time longer than 72 hours will need to demonstrate that the Completion Time is appropriate for the plant in accordance with the guidance in RG 1.177 and RG 1.174. Alternatively, the 7 day Completion Time can be justified by an acceptable method, such as a regulatory commitment that an alternate means to charge the batteries will be available that is capable of being supplied power from a power source that is independent of the offsite power supply. Otherwise, the 72 hour Completion Time must be adopted.

Condition, Required Action, and Completion Time for Inoperable Batteries

The second Condition (Condition B) in NUREG-1431 applies when one [or two] batteries on one train are inoperable. The Required Action states that the battery or batteries must be restored to Operable status within [2] hours. As stated in a Reviewer's Note in the Bases, a licensee wishing to request a longer Completion Time will need to demonstrate that the longer Completion Time is appropriate for the plant in accordance with the guidance in RG 1.177 and RG 1.174 or provide a regulatory commitment that an alternate means of charging the batteries is available. With the batteries on one train inoperable, the DC bus is being supplied by the Operable battery charger(s). Any event that results in a loss of the AC bus supporting the battery charger(s) will also result in loss of DC power to that train. Recovery of the AC bus, especially if it is due to a loss of offsite power, will be hampered by the fact that many of the components necessary for the recovery (e.g., diesel generator control and field flash, AC load shed and diesel generator output circuit breakers, etc.) may rely on the batteries. In addition, the energization transients of any DC loads that are beyond the capability of the battery charger(s) and normally require the assistance of the batteries will not be able to be restored. The [2] hour limit allows sufficient time to effect restoration of an inoperable battery given that the majority of the conditions that lead to battery inoperability (e.g., loss of battery charger, inadequate battery cell voltage, etc.) are identified in Specifications 3.8.4, 3.8.5, and 3.8.6 and provide additional Required Actions and associated Completion Times.

Existing Condition A is renumbered Condition C and the exception “for reasons other than Condition A [or B]” is added. Existing Conditions B and C are renumbered Conditions D and E with no other changes.

Reviewer's Note Relating to Conditions B and C in NUREG-1431

TSTF-500, Rev. 2 added a Reviewer’s Note that relates to Conditions B and C in NUREG-1431. The Reviewer’s Note states that Condition B should be included if Required Action B.1 (One or [or two] batter[y][ies in one subsystem] inoperable) and Required Action C.1 (One DC electrical power system inoperable for reasons other than Condition A or [B]) would have different Completion Times. If the plant design supports different Completion Times when a battery is inoperable but charger is OPERABLE, then Condition B is used. If not, Condition B is deleted and only Condition C is used.

Description of changes in RCOL Std. Dep., RCOL COL Item(s), and RCOL PTS Changes:

VEGP TS LAR DOC L21 revises SR 3.8.1.3 by deleting Note 2. Discussions relating to GTS SR 3.8.1.3, Note 2 are also deleted.

In SR 3.8.1.2, the term “coincident demand” is replaced with “combined demand” in response to a request for additional information (RAI).

Rationale for changes in RCOL Std. Dep., RCOL COL Item(s), and RCOL PTS Changes:

SR 3.8.1.3 Note 2 states, “This Surveillance shall not normally be performed in MODE 1, 2, 3, or 4 unless the spare battery is connected to replace the battery being tested. However, portions of the Surveillance may be performed to reestablish OPERABILITY provided an assessment determines the safety of the plant is maintained or enhanced.” As stated in the SR 3.8.1.3 Bases, the “reason for Note 2 is that performing the Surveillance would perturb the electrical distribution system and challenge safety systems if the spare battery is not connected.”

The DC electrical power design includes four Class 1E DC electrical power subsystems each with battery banks and chargers. In addition, there is one installed spare battery and one installed spare battery charger, which provide backup service in the event that one of the battery banks and/or one of the preferred battery chargers is out of service. The spare battery bank and charger are Class 1E and have the same rating as the primary components. If the spare battery bank with the charger is substituted for one of the preferred battery banks or chargers, then the requirements of independence and redundancy between subsystems are maintained and the division is OPERABLE.

A spare battery bank and charger enables testing, maintenance, and equalization of battery banks offline. This configuration provides the capability for each battery bank or battery charger to be separately tested and maintained (including battery discharge tests, battery cell replacement, battery charger replacement) without limiting continuous plant operation at 100-percent power. The service test required by SR 3.8.1.3 would be performed on batteries only after they have been replaced with the spare. In this condition, the battery being tested is not connected to the electrical distribution system.

Final Safety Analysis Report (FSAR) Section 17.6 incorporates by reference NEI 07-02A, "Generic FSAR Template Guidance for Maintenance Rule Program Description for Plants Licensed Under 10 CFR Part 52," which requires procedures for maintenance risk assessment and management in accordance with 10 CFR 50.65(a)(4). The risk from maintenance activities is both assessed (i.e., using a risk-informed process to evaluate the overall contribution to risk of the planned maintenance activities) and managed (i.e., providing plant personnel with proper awareness of the risk, and taking actions as appropriate to control the risk). Therefore, battery service testing would not be performed when the TS require its operability. TS Bases for SR 3.8.1.3 currently include the acknowledgement that the service test may be performed during any plant condition with the spare battery and charger providing power to the bus. During performance of this SR, the spare battery would replace the battery being tested. Therefore, performance of this SR would not perturb the electrical distribution system and challenge safety systems.

As such, the scope and intent of SR 3.8.1.3 Note 2 is not required. The proposed change is acceptable because the required testing is performed on a specific battery when it is not connected to the electrical distribution system; thus resulting in no increase to plant risk due to maintenance activities. This change is designated as less restrictive because a limitation for SR testing is deleted.

The replacement of "coincident" with "combined" in Bases for SR 3.8.1.2 is same as a change made as part of TSTF-451, and was incorporated as part of TSTF-451 change.

Description of additional changes proposed by NRC staff/preparer of GTST:

The changes addressed in different Bases sections, based on APOG comments and NRC staff proposed changes, are as follows:

In page B 3.8.1-12, second line, "an" is replaced with "and."

The acronym "FSAR" is added to modify "Section" and "Chapter" in references to the FSAR throughout the Bases. (DOC A003)

In the "Background" section in the Bases, the presentation of battery bank configuration is made more consistent with AP1000 DCD 8.3.2.1.1.1. The following two sentences are added in the second paragraph, and a paragraph break is introduced after these inserted sentences.

The first battery bank in each of the four divisions, designated as the “24 hour” battery bank, provides power to the loads required for the first 24 hours following an event. The second battery bank in Divisions B and C, designated as the “72 hour” battery bank, is used for those loads requiring power for 72 hours following an event.

The following editorial changes are made in the “Background” section of the Bases:

The Class 1E DC and UPS System (IDS) provides electrical power for safety related and vital control instrumentation loads, including monitoring **equipment** and main control room emergency lighting.

It also provides power for safe shutdown when all the onsite and offsite AC power sources are lost and cannot be recovered for **up to** 72 hours.

Loads which are a one time or limited duration load (engineered ~~safeguards~~ **safety** features (ESF) actuation cabinets and reactor trip function)**, and that are** required within the first 24 hours following an accident**,** are connected to the “24 hour” battery bank.

A battery bank **(also referred to as the battery)** consists of two battery strings connected in series. Each battery string consists of 60 cells connected in series.

Also, additional minor editorial changes are made.

In the “References” section in the Bases, the references are renumbered based on their first appearance in the body of Bases.

Rationale for additional changes proposed by NRC staff/preparer of GTST:

The typographical correction gives correct meaning to the sentence.

Changes to the second paragraph in the “Background” section of the Bases make the presentation of the “battery bank configuration” consistent with the presentation in the AP1000 DCD 8.3.2.1.1.1.

Since Bases references to FSAR Sections and Chapters are to an external document, it is appropriate to include the “FSAR” modifier.

The remaining changes are editorial and provide clarity and consistency.

VII. GTST Safety Evaluation

Technical Analysis:

Difference in numbering scheme between AP1000 and the Standard Plant in TSTF-500, Rev. 2

AP1000 GTS Section 3.8 uses different numbering for subsections than the Westinghouse STS, NUREG-1431, on which TSTF-500 is based. GTS Subsection 3.8.1, “DC Sources- Operating” corresponds to the Subsection 3.8.4, “DC Sources - Operating” in NUREG-1431. These differences, relating to the numbering of TS Section 3.8 subsections, are administrative and do not affect the applicability of changes in TSTF-500 for incorporation into the AP1000 STS.

Design differences between AP1000 and the Standard Plant in TSTF-500, Rev. 2

The AP1000 DC electrical power system design differs from the standard plant design described in the Bases for Subsection 3.8.4 of NUREG-1431and considered in TSTF-500, Rev. 2. The 250 VDC electrical power system in AP1000 consists of four independent safety related Class 1E DC electrical power subsystems (Division A, B, C, and D). The DC system on which TSTF-500 is based is a 125/250 VDC electrical power system consisting of two independent and redundant safety related Class 1E DC electrical power subsystems (Train A and Train B). Considering this difference in designs between AP1000 and the plant described in TSTF-500, it is expected that the Action Conditions affected by the TSTF changes will be different. For the AP1000 DC electrical power system with four subsystems, more Conditions are specified and the safety implications of the number of inoperable batteries and battery chargers are different. In defining the AP1000 GTS action requirements, these differences were taken into consideration. The TSTF safety evaluation, in general, remains applicable since it considers loss of capability by the DC electrical power system to perform its intended safety functions in stages (loss of redundancy, loss of function), which applies to DC electrical power systems with different design configurations.

There are also differences in the number and types of battery banks and battery chargers between the AP1000 design and the standard plant design considered in TSTF-500, Rev. 2. In AP1000, two divisions, Divisions A and D each consist of one 24 hour battery bank, one battery charger, and the associated control equipment and interconnecting cabling. The other two divisions, Divisions B and C each consist of two battery banks (one 24 hour and one 72 hour), two battery chargers, and the associated control equipment and interconnecting cabling. The loads on the battery banks (including those on the associated inverters) are grouped according to their role in response to a Design Basis Accident (DBA). Loads which are a one time or limited duration load (engineered safety features (ESF) actuation cabinets and reactor trip function) required within the first 24 hours following an accident are connected to the “24 hour” battery bank. Loads which are continuous or required beyond the first 24 hours following an accident (emergency lighting, post accident monitoring, and Qualified Data Processing System) are connected to the “72 hour” battery bank. There are a total of six battery banks. A battery bank consists of two battery strings connected in series. Each battery string consists of 60 cells connected in series. Divisions A and D each have one 2400 ampere hour battery bank and Divisions B and C each have two 2400 ampere hour battery banks. For the standard plant design considered in TSTF-500, the two-train [125/250] VDC electrical power system each of the two subsystems consists of [two] 125 VDC batteries [(each battery [50]% capacity)], the associated battery charger(s) for each battery, and all the associated control equipment and interconnecting cabling. The [Train A and Train B] DC electrical power subsystems provide the control power for its associated Class 1E AC power load group, [4.16] kV switchgear, and [480]-V load centers. The DC electrical power subsystems also provide DC electrical power to the inverters, which in turn power the AC vital buses. In both cases, each battery has adequate storage capacity to carry the required load for the required duration.

For the AP1000 design, there is one installed spare battery bank and one installed spare battery charger, which provide backup service in the event that one of the battery banks and/or one of the preferred battery chargers is out of service. The spare battery bank and charger are Class 1E and have the same rating as the primary components. If the spare battery bank with the charger is substituted for one of the preferred battery banks or chargers, then the requirements of independence and redundancy between subsystems are maintained and the division is OPERABLE. For the standard plant design considered in TSTF-500, there is [one] spare battery charger per subsystem (or train), which provides backup service in the event that the preferred battery charger is out of service (there is no backup battery). If the spare battery charger is substituted for one of the preferred battery chargers, then the requirements of independence and redundancy between subsystems are maintained.

<u>Consideration of AP1000 design differences in technical evaluation for the applicable changes based on TSTF-500, Rev. 2</u>

An evaluation of the DC electrical power system design differences shows that AP1000 is essentially designed with four-train redundancy whereas the standard plant design considered in TSTF-500 is designed with two-train redundancy. In addition, AP1000 includes better backup service by providing a spare battery in addition to a spare battery charger. Considering the four train (division) design of the AP1000 DC electrical power system, it is appropriate to consider inoperability in each of the four trains. AP1000 defines Conditions A through G considering battery charger and battery inoperability in one or two divisions, and for subsystem inoperability for other reasons. For the standard plant design considered in TSTF-500, four Conditions, Conditions A through D, are defined as applicable for a two subsystem design. Since the differences in the specified Conditions are due to the differences in the design, they are appropriate. Without defining the additional Conditions as done in AP1000 GTS, the applicable inoperability in different divisions would not have been adequately addressed for the AP1000.

Therefore, for the TSTF-500 changes implemented by this GTST, no additional verification or regulatory commitment was needed. Verifications and regulatory commitments identified in TSTF-500 are applicable for the changes that have already been included in the AP1000 GTS and have been addressed as part of the AP1000 DCD approval.

<u>Replacing the word “coincident” with “combined” in the Bases for SR 3.8.1.2 (TSTF-451-T)</u>

In the Bases for GTS SR 3.8.1.2, the sentence, “The other option requires that each 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),” is revised to state, “The other option requires that each battery charger be capable of recharging the battery after a service test coincident with supplying the largest ***combined*** demands of the various continuous steady state loads (irrespective of the status of the plant during which these demands occur)” (emphasis added).

Similar to STS NUREG-1431, the change in wording is appropriate for two reasons. First, the Surveillance uses the phrase “largest combined demands” and the Bases uses the phrase, “largest coincident demands”. The Bases discussion should be consistent with the specification and the use of different words implies different meaning and could lead to confusion. Second, the first paragraph of the SR 3.8.1.2 Bases states: “This SR verifies the design capacity of the battery chargers.” According to Regulatory Guide 1.32, 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 unit during these demand occurrences" (emphasis added).

Regulatory Guide 1.32, "Criteria for Safety-Related Electric Power Systems for Nuclear Power Plants," Revision 2, Regulatory Position 1.b states, "Battery Charger Supply. The provisions of Section 5.3.4 of IEEE Std. 308-1974 should be construed to mean that the capacity of the battery charger supply should 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 which these demands occur." Accordingly, the word "combined" is appropriate, and not the word "coincident."

This change makes the Bases consistent with the Specifications, the other statements in the Bases, and with Regulatory Guide 1.32.

<u>Removal of Note 2 from SR 3.8.1.3 (VEGP LAR DOC L21)</u>

SR 3.8.1.3 Note 2 states, "This Surveillance shall not normally be performed in MODE 1, 2, 3, or 4 unless the spare battery is connected to replace the battery being tested. However, portions of the Surveillance may be performed to reestablish OPERABILITY provided an assessment determines the safety of the plant is maintained or enhanced." As stated in the SR 3.8.1.3 Bases, the "reason for Note 2 is that performing the Surveillance would perturb the electrical distribution system and challenge safety systems if the spare battery is not connected."

The DC electrical power design includes four Class 1E DC electrical power subsystems (divisions) each with battery banks and chargers. In addition, there is one installed spare battery and one installed spare battery charger, which provide backup service in the event that one of the battery banks and/or one of the preferred battery chargers is out of service. The spare battery bank and charger are Class 1E and have the same rating as the primary components. If the spare battery bank with the charger is substituted for one of the preferred battery banks or chargers, then the requirements of independence and redundancy between subsystems are maintained and the division is OPERABLE.

A spare battery bank and charger enables testing, maintenance, and equalization of battery banks offline. This configuration provides the capability for each battery bank or battery charger to be separately tested and maintained (including battery discharge tests, battery cell replacement, battery charger replacement) without limiting continuous plant operation at 100-percent power. The service test required by SR 3.8.1.3 would be performed on batteries only after they have been replaced with the spare. In this condition, the battery being tested is not connected to the electrical distribution system.

In addition, Maintenance Rule 10 CFR 50.65 requires maintenance risk assessment and management. The risk from maintenance activities is both assessed (i.e., using a risk-informed process to evaluate the overall contribution to risk of the planned maintenance activities) and managed (i.e., providing plant personnel with proper awareness of the risk, and taking actions as appropriate to control the risk). TS Bases for SR 3.8.1.3 currently include the acknowledgement that the service test may be performed during any plant condition with the spare battery and charger providing power to the bus. During performance of this SR, the spare battery would replace the battery being tested. Therefore, performance of this SR would not perturb the electrical distribution system and impose unacceptable risk.

As such, the scope and intent of SR 3.8.1.3 Note 2 is not required. The proposed change is acceptable because the required testing is performed on a specific battery when it is not connected to the electrical distribution system; and increase in plant risk is considered minimal and appropriately managed under the Maintenance Rule.

Removal of reference to IEEE-450-1995

The NRC has not reviewed or endorsed IEEE-450-1995. The changes in TSTF-500, Rev. 2 are based on IEEE-450-2002. The NRC endorsed IEEE-450-2002 in Regulatory Guide 1.129, Revision 2, dated February 2007. Accordingly, removal of reference to IEEE-450-1995 is appropriate and acceptable.

The Battery Monitoring and Maintenance Program Specification, which is proposed in TSTF-500, references IEEE-450-2002 and Regulatory Guide 1.129, Revision 2. As described in the GTST for GTS Subsection 5.5.11, the existing Battery Monitoring and Maintenance Program Specification is replaced with the program approved in TSTF-500. However, TSTF-500 did not revise the Bases “References” section for WOG STS Subsection 3.8.4 to replace the reference “Regulatory Guide 1.129, December 1974” with “Regulatory Guide 1.129, Revision 2, February 2007.”

To maintain consistency with the “References” section of the Bases for GTS Subsection 3.8.1 and TSTF-500, this GTST does not revise the Bases “References” section for GTS Subsection 3.8.1 by replacing the existing reference to “Regulatory Guide 1.129 Revision 1, “Maintenance Testing and Replacement of Large Lead Storage Batteries for Nuclear Power Plants,” U.S. Nuclear Regulatory Commission, February 1978,” with “Regulatory Guide 1.129 Revision 2, “Maintenance, Testing, and Replacement of Vented Lead-Acid Storage Batteries for Nuclear Power Plants” U.S. Nuclear Regulatory Commission, February 2007.” Since the guidance in Revision 0, Revision 1, and Revision 2 of Regulatory Guide 1.129 is the same with respect to the Frequency of the battery service test, which is a Surveillance Requirement specified in WOG STS SR 3.8.4.3 and GTS SR 3.8.1.3, retaining the GTS Bases reference to RG 1.129 Revision 1 in the Bases for AP1000 STS Subsection 3.8.1 is acceptable.

The references in the “References” section is renumbered based on their first appearance in the body of Bases.

Clarification of battery bank configuration

In the “Background” section of the Bases, the discussion of battery banks for the divisions and the loads on the batteries was not clear. Additional clarifications are added and the presentation is now clear and consistent with the discussion in AP1000 DCD Chapter 8.

Editorial, Grammatical, and Administrative Changes

The remaining changes are editorial, clarifying, grammatical, or otherwise considered administrative. These changes do not affect the technical content, but improve the readability, implementation, and understanding of the requirements, and are therefore acceptable.

Having found that this GTST’s proposed changes to the GTS and Bases are acceptable, the NRC staff concludes that AP1000 STS Subsection 3.8.1 is an acceptable model Specification for the AP1000 standard reactor design.

References to Previous NRC Safety Evaluation Reports (SERs):

None

VIII. Review Information

Evaluator Comments:

In addressing the changes to AP1000 STS based on TSTF-500, Rev.2, a review was conducted of the changes that are already included, based on implementation of TSTF-360-A earlier and an analysis to determine the additional changes that apply to the AP1000 design. A summary discussion is provided in Section VI to present a clear understanding of the changes that are additionally applicable. In determining the additional changes that apply consideration was also given to the approved AP1000 GTS as part of the AP1000 DCD. The following comments may be useful to the reviewer.

1. TSTF-500, Rev. 2 uses the term “subsystem” instead of the term “division.” AP1000 GTS uses both “division” and “subsystem” in the Specifications and Bases. From the Bases discussion, it is understood that both “division” and “subsystem” refer to the same aspect of the system. No change is made. It may be appropriate to present the Specifications and Bases in terms of “division” removing use of “subsystem” throughout.

2. AP1000 GTS does not use brackets and Reviewer's Notes in this Section. The values used for battery parameters and Completion Times were finalized in AP1000 DCD Rev. 19 or were approved in VEGP Units 3 and 4 plant-specific TS in Amendment 13. All brackets and reviewer's notes are omitted from AP1000 STS 3.8.1.

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Review Information:

Availability for public review and comment on Revision 0 of this traveler approved by NRC staff on 5/20/2014.

APOG Comments (Ref. 7) and Resolutions

(Internal #3) Throughout the Bases, references to Sections and Chapters of the FSAR do not include the “FSAR” modifier. Since these Section and Chapter references are to an external document, it is appropriate to include the “FSAR” modifier. This is resolved by adding the “FSAR” modifier as appropriate.

(Internal #16) _TSTF-500, APOG recommendations regarding TSTF-500 were addressed. TSTF-500 related changes, not applicable to AP1000 STS, were removed. A discussion of the changes that were retained is presented in the GTST. Brackets for battery parameters and Completion Times were removed.

(Internal #445) 3.8.01, Pg. 43, In the first sentence of the first paragraph in the “Background” section in the Bases, the word “equipment” was inserted after “monitoring” for editorial clarification.

(Internal #446) 3.8.01, Pg. 43, In the second sentence of the first paragraph in the “Background” section of the Bases, “up to” was added for editorial clarification.

(Internal #447) 3.8.01, Pg. 43, Second paragraph in the “Background” section of the Bases was revised clarifying the arrangements and the loads on the battery banks.

(Internal #448) 3.8.01, Pg. 43, In the second paragraph of the “Background” section in the Bases, “engineered safeguard features” was replaced with “engineered safety features.”

(Internal #449) 3.8.01, Pg. 43, In the “Background” section of the Bases, the next to last sentence of second paragraph is clarified by inserting “(also referred to as the battery)” right after the phrase “A battery bank” to avoid potential confusion concerning the equivalence of the terms “battery” and “battery bank.”

NRC Final Approval Date: 12/10/2015

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IX. Evaluator Comments for Consideration in Finalizing Technical Specifications and Bases

None

X. References Used in GTST

1. AP1000 DCD, Revision 19, Section 16, "Technical Specifications," June 2011 (ML11171A500).

2. Southern Nuclear Operating Company, Vogtle Electric Generating Plant, Unit 3 and 4, Technical Specifications Upgrade License Amendment Request, February 24, 2011 (ML12065A057).

3. TSTF-GG-05-01, Technical Specification Task Force (TSTF) Writer's Guide for Plant-Specific Improved Technical Specifications, Revision 1.

4. RAI Letter No. 01 Related to License Amendment Request (LAR) 12-002 for the Vogtle Electric Generating Plant Units 3 and 4 Combined Licenses, September 7, 2012 (ML12251A355).

5. Southern Nuclear Operating Company, Vogtle Electric Generating Plant, Units 3 and 4, Response to Request for Additional Information Letter No. 01 Related to License Amendment Request LAR-12-002, ND-12-2015, October 04, 2012 (ML12286A363 and ML12286A360).

6. NRC Safety Evaluation (SE) for Amendment No. 13 to Combined License (COL) No. NPF-91 for Vogtle Electric Generating Plant (VEGP) Unit 3, and Amendment No. 13 to COL No. NPF-92 for VEGP Unit 4, September 9, 2013 (ADAMS Package Accession No. ML13238A337), which contains:

ML13238A355,	Cover Letter - Issuance of License Amendment No. 13 for Vogtle Units 3 and 4 (LAR 12-002).
ML13238A359,	Enclosure 1 - Amendment No. 13 to COL No. NPF-91
ML13239A256,	Enclosure 2 - Amendment No. 13 to COL No. NPF-92
ML13239A284,	Enclosure 3 - Revised plant-specific TS pages (Attachment to Amendment No. 13)
ML13239A287,	Enclosure 4 - Safety Evaluation (SE), and Attachment 1 - Acronyms
ML13239A288,	SE Attachment 2 - Table A - Administrative Changes
ML13239A319,	SE Attachment 3 - Table M - More Restrictive Changes
ML13239A333,	SE Attachment 4 - Table R - Relocated Specifications
ML13239A331,	SE Attachment 5 - Table D - Detail Removed Changes
ML13239A316,	SE Attachment 6 - Table L - Less Restrictive Changes

The following documents were subsequently issued to correct an administrative error in Enclosure 3:

ML13277A616,	Letter - Correction To The Attachment (Replacement Pages) - Vogtle Electric Generating Plant Units 3 and 4- Issuance of Amendment Re: Technical Specifications Upgrade (LAR 12-002) (TAC No. RP9402)
ML13277A637,	Enclosure 3 - Revised plant-specific TS pages (Attachment to Amendment No. 13) (corrected)

7. APOG-2014-008, APOG (AP1000 Utilities) Comments on AP1000 Standardized Technical Specifications (STS) Generic Technical Specification Travelers (GTSTs), Docket ID NRC-2014-0147, September 22, 2014 (ML 14265A493).

XI. MARKUP of the Applicable GTS Subsection for Preparation of the STS NUREG

The entire section of the Specifications and the Bases associated with this GTST is presented next.

Changes to the Specifications and Bases are denoted as follows: Deleted portions are marked in strikethrough red font, and inserted portions in bold blue font.

3.8 ELECTRICAL POWER SYSTEMS

3.8.1 DC Sources - Operating

LCO 3.8.1 The Division A, B, C, and D Class 1E DC power subsystems shall be OPERABLE.

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

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One or more battery chargers in one division inoperable.	A.1 Restore battery terminal voltage to greater than or equal to the minimum established float voltage.	6 hours
	AND	
	A.2 Verify battery float current $\leq$ 2 amps.	Once per 24 hours
	AND	
	A.3 Restore battery charger(s) to OPERABLE status.	7 days
B. One or more battery chargers in two divisions inoperable.	B.1 Restore battery terminal voltage to greater than or equal to the minimum established float voltage.	2 hours
	AND	
	B.2 Verify battery float current $\leq$ 2 amps.	Once per 24 hours
	AND	

ACTIONS (continued)

CONDITION	REQUIRED ACTION		COMPLETION TIME
B. (continued)	B.3	Restore battery charger(s) to OPERABLE status.	7 days
C. One or more batteries in one division inoperable.	C.1	Restore batteries to OPERABLE status.	6 hours
D. One or more batteries in two divisions inoperable.	D.1	Restore batteries to OPERABLE status.	2 hours
E. One DC electrical power subsystem inoperable for reasons other than Condition A or C.	E.1	Restore DC electrical power subsystem to OPERABLE status.	6 hours
F. Two DC electrical power subsystems inoperable for reasons other than B or D.	F.1	Restore DC electrical power subsystem to OPERABLE status.	2 hours
G. Required Action and associated Completion Time not met.	G.1	Be in MODE 3.	6 hours
	<u>AND</u>		
	G.2	Be in MODE 5.	36 hours

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.8.1.1	Verify battery terminal voltage is greater than or equal to the minimum established float voltage.	7 days

SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE		FREQUENCY
SR 3.8.1.2	Verify each battery charger supplies ≥ 200 amps at greater than or equal to the minimum established float voltage for ≥ 8 hours. OR Verify each 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.	24 months
SR 3.8.1.3	-------------------------------NOTE~~S-~~----------------------------- --- ~~1.~~ The modified performance discharge test in SR 3.8.7.6 may be performed in lieu of SR 3.8.1.3.~~2.~~ ~~This Surveillance shall not normally be performed in MODE 1, 2, 3, or 4 unless the spare battery is connected to replace the battery being tested. However, portions of the Surveillance may be performed to reestablish OPERABILITY provided an assessment determines the safety of the plant is maintained or enhanced.~~ --- Verify battery capacity is adequate to supply, and maintain in OPERABLE status, the required emergency loads for the design duty cycle when subjected to a battery service test.	24 months

B 3.8 ELECTRICAL POWER SYSTEMS

B 3.8.1 DC Sources - Operating

BASES

BACKGROUND

The Class 1E DC and UPS System (IDS) provides electrical power for safety related and vital control instrumentation loads, including monitoring **equipment** and main control room emergency lighting. It also provides power for safe shutdown when all the onsite and offsite AC power sources are lost and cannot be recovered for **up to** 72 hours. As required by 10 CFR 50, Appendix A, GDC 17 (Ref. 1), the Class 1E DC electrical power system is designed to have sufficient independence, redundancy, and testability to perform its safety functions, assuming a single failure. The Class 1E DC electrical power system also conforms to the requirements of Regulatory Guide 1.6 (Ref. 2) and IEEE-308 (Ref. 3).

The 250 VDC electrical power system consists of four independent safety related Class 1E DC electrical power subsystems (Division A, B, C, and D). Divisions A and D each consist of one ~~24 hour~~ battery bank, one battery charger, and the associated control equipment and interconnecting cable. Divisions B and C each consist of two battery banks ~~(one 24 hour and one 72 hour)~~, two battery chargers, and the associated control equipment and interconnecting cabling. **The first battery bank in each of the four divisions, designated as the "24 hour" battery bank, provides power to the loads required for the first 24 hours following an event. The second battery bank in Divisions B and C, designated as the "72 hour" battery bank, is used for those loads requiring power for 72 hours following an event.**

The loads on the battery banks (including those on the associated inverters) are grouped according to their role in response to a Design Basis Accident (DBA). Loads which are a one time or limited duration load (engineered safe**ty**~~guards~~ features (ESF) actuation cabinets and reactor trip function) **that are** required within the first 24 hours following an accident are connected to the "24 hour" battery bank. Loads which are continuous or required beyond the first 24 hours following an accident (emergency lighting, post accident monitoring, and Qualified Data Processing System) are connected to the "72 hour" battery bank. There are a total of six battery banks. A battery bank **(also referred to as the battery)** consists of two battery strings connected in series. Each battery string consists of 60 cells connected in series. Divisions A and D each have one 2400 ampere hour battery bank and Divisions B and C each have two 2400 ampere hour battery banks.

BASES

BACKGROUND (continued)

Additionally, there is one installed spare battery bank and one installed spare battery charger, which provide backup service in the event that one of the battery banks and/or one of the preferred battery chargers is out of service. The spare battery bank and charger are Class 1E and have the same rating as the primary components. If the spare battery bank with the charger is substituted for one of the preferred battery banks or chargers, then the requirements of independence and redundancy between subsystems are maintained and the division is OPERABLE.

During normal operation, the 250 VDC 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 bank provides power to an inverter, which in turn powers an AC instrumentation and control bus. The AC instrumentation and control bus loads are connected to inverters according to the battery bank type, 24 hour or 72 hour.

The Class 1E DC power distribution system is described in more detail in Bases for LCO 3.8.5, “Distribution System**s** - Operating,” and LCO 3.8.6, “Distribution System**s** - Shutdown.”

Each battery has adequate storage capacity to carry the required load for the required duration as discussed in Reference 4.

Each 250 VDC battery bank, including the spare battery bank, 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 subsystems to ensure that a single failure in one subsystem does not cause a failure in a separate subsystem. There is no sharing between separate Class 1E subsystems such as batteries, battery chargers, or distribution panels.

The batteries for each Class 1E electrical power subsystem are based on 125% of required capacity. The voltage limit is 2.13 V per cell, which corresponds to a total minimum voltage output of 256 V per battery discussed in Reference 4. The criteria for sizing large lead storage batteries are defined in IEEE-485 (Ref. 5).

BASES

BACKGROUND (continued)

Each electrical power subsystem 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 has sufficient capacity to restore the battery bank from the design minimum charge to its fully charged state within 24 hours while supplying normal steady state loads (Ref. 4).

APPLICABLE SAFETY ANALYSES

The initial conditions of DBA and transient analyses in the **FSAR** Chapter 6 (Ref. 6) and **FSAR** Chapter 15, (Ref. 7), assume that engineered safety features are OPERABLE. The Class 1E DC electrical power system provides 250 volts power for safety related and vital control instrumentation loads including monitoring and main control room emergency lighting during all MODES of operation. It also provides power for safe shutdown when all the onsite and offsite AC power sources are lost.

The OPERABILITY of the Class 1E DC sources is consistent with the initial assumptions of the accident analyses. This includes maintaining at least three of the four divisions of DC sources OPERABLE during accident conditions in the event of:

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

b. A worst case single failure.

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

LCO

Class 1E DC electrical power subsystems 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 (AOO) or a postulated DBA. Loss of Class 1E DC electrical power from one division does not prevent the minimum safety function from being performed (Ref. 4).

An OPERABLE Class 1E DC electrical power subsystem requires all required batteries and respective chargers to be operating and connected to the associated DC bus(es). The spare battery and/or charger may be used by one subsystem for OPERABILITY.

BASES

APPLICABILITY

The Class 1E DC electrical power sources are required to be OPERABLE in MODES 1, 2, 3, and 4 to ensure safe unit operation and to ensure that:

a. Acceptable fuel design limits and reactor coolant pressure boundary limits are not exceeded as a result of AOOs 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.

Class 1E DC electrical power requirements for MODES 5 and 6 are addressed in the Bases for LCO 3.8.2, “DC Sources - Shutdown.”

ACTIONS

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

Condition A represents one division with one or two battery chargers inoperable (e.g., the voltage limit of SR 3.8.1.1 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 6 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 24 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.

Because of the passive system design and the use of fail-safe components, the remaining Class 1E DC electrical power subsystems have the capacity to support a safe shutdown and to mitigate most DBAs following a subsequent worst case single failure. The 6 hour Completion Time is reasonable based on engineering judgement balancing the risks of operation without one DC subsystem against the risks of a forced shutdown. Additionally, the Completion Time reflects a reasonable time to assess plant status; attempt to repair or replace, thus avoiding an unnecessary shutdown; and, if necessary, prepare and effect an orderly and safe shutdown.

BASES

ACTIONS (continued)

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 24 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 6 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 6 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 24 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 24 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.

BASES

ACTIONS (continued)

B.1, B.2, and B.3

Condition B represents two divisions with one or more battery chargers inoperable (e.g., the voltage limit of SR 3.8.1.1 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 B.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 24 hours, the battery will be restored to its fully charged condition (Required Action B.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 24 hours, avoiding a premature shutdown with its own attendant risk.

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 24 hours (Required Action B.2).

Required Action B.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 fully recharged. If at the expiration of the initial 24 hour period the battery float current is not less than or equal to 2 amps this indicates there may

ACTIONS (continued)

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

Required Action B.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.

C.1

Condition C represents one division with one or more batteries inoperable. With one or more batteries inoperable, the DC bus is being supplied by the OPERABLE battery chargers. Any event that results in a loss of the AC bus supporting the battery chargers will also result in loss of DC to that train.

Because of the passive system design and the use of fail-safe components, the remaining Class 1E DC electrical power subsystems have the capacity to support a safe shutdown and to mitigate most DBAs following a subsequent worst case single failure. The 6 hour Completion Time is reasonable based on engineering judgement balancing the risks of operation without one DC subsystem against the risks of a forced shutdown. Additionally, the Completion Time reflects a reasonable time to assess plant status; attempt to repair or replace, thus avoiding an unnecessary shutdown; and, if necessary, prepare and effect an orderly and safe shutdown.

The installed spare battery bank and charger may be used to restore an inoperable Class 1E DC electrical power subsystem; however, all applicable Surveillances must be met by the spare equipment used, prior to declaring the subsystem OPERABLE.

BASES

ACTIONS (continued)

D.1

Condition D represents two divisions with one or more batteries inoperable. With one or more batteries inoperable, the DC bus is being supplied by the OPERABLE battery charger. Any event that results in a loss of the AC bus supporting the battery charger will also result in loss of DC to that train. The 2 hour limit allows sufficient time to effect restoration of an inoperable battery given that the majority of the conditions that lead to battery inoperability (e.g., loss of battery charger, battery cell voltage less than 2.07 V, etc.) are identified in Specifications 3.8.1, 3.8.2, and 3.8.7 together with additional specific completion times.

The installed spare battery bank and charger may be used to restore an inoperable Class 1E DC electrical power subsystem; however, all applicable Surveillances must be met by the spare equipment used, prior to declaring the subsystem OPERABLE.

E.1

If one of the Class 1E DC electrical power subsystems is inoperable, the remaining Class 1E DC electrical power subsystems have the capacity to support a safe shutdown and to mitigate all design basis accidents, based on conservative analysis.

Because of the passive system design and the use of fail-safe components, the remaining Class 1E DC electrical power subsystems have the capacity to support a safe shutdown and to mitigate most DBAs following a subsequent worst case single failure. The 6 hour Completion Time is reasonable based on engineering judgement balancing the risks of operation without one DC subsystem against the risks of a forced shutdown. Additionally, the Completion Time reflects a reasonable time to assess plant status; attempt to repair or replace, thus avoiding an unnecessary shutdown; and, if necessary, prepare and effect an orderly and safe shutdown.

The 6 hour Completion Time is also consistent with the time specified for restoration of one (of four) Protection and Safety Monitoring System (PMS) **actuation divisions** (LCO 3.3.~~2~~**15**, "**Engineered Safety Feature Actuation System (**ESFAS**) Actuation Logic - Operating"**~~Instrumentation~~). Depending on the nature of the DC electrical power subsystem inoperability, one supported division of instrumentation could be considered inoperable. Inoperability of a PMS

BASES

ACTIONS (continued)

Division is similar to loss of one DC electrical power subsystem. In both cases, actuation of the safety functions associated with one of the four subsystems/divisions may no longer be available.

F.1

Condition F represents two subsystems 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 unit, minimizing the potential for complete loss of DC power to the affected distribution subsystems. The 2 hour limit is consistent with the allowed time for two inoperable DC distribution subsystems.

If two of the required DC electrical power subsystems are inoperable (e.g., inoperable battery, inoperable battery charger(s), or inoperable battery charger and associated inoperable battery), the two remaining DC electrical power subsystems have the capacity to support a safe shutdown and to mitigate all but the very worst case events. Since a subsequent worst case single failure would, however, result in the loss of the third subsystem, leaving only one subsystem with limited capacity to mitigate events, continued power operation should not exceed 2 hours. The 2 hour Completion Time is based on Regulatory Guide 1.93 (Ref. **8**~~11~~) and reflects a reasonable time to assess unit status as a function of the inoperable DC electrical power subsystem and, if the DC electrical power subsystem is not restored to OPERABLE status, to prepare to effect an orderly and safe unit shutdown.

G.1 and G.2

If the inoperable DC electrical power subsystem cannot be restored to OPERABLE status within the required Completion Time, the unit 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 unit conditions from full power conditions in an orderly manner and without challenging plant systems.

SURVEILLANCE REQUIREMENTS

SR 3.8.1.1

Verifying battery terminal voltage while on float charge for the batteries helps to ensure the effectiveness of the battery chargers which support 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 initial voltages assumed in the battery sizing calculations. This voltage maintains the battery plates in a condition that supports maintaining the grid life (expected to be approximately 20 years). The 7 day Frequency is consistent with manufacturer recommendations~~ and IEEE-450 (Ref. 8)~~.

SR 3.8.1.2

This SR verifies the design capacity of the battery chargers. According to Regulatory Guide 1.32 (Ref. 9), 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 unit during these demand occurrences. 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 for 8 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 time period is sufficient for the charger temperature to have stabilized and to have been maintained for at least 2 hours.

The other option requires that each battery charger be capable of recharging the battery after a service test coincident with supplying the largest **combined**~~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

BASES

SURVEILLANCE REQUIREMENTS (continued)

voltage, temperature, an**d** 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 unit conditions required to perform the test and the other administrative controls existing to ensure adequate charger performance during these 24 month intervals. In addition, this Frequency is intended to be consistent with expected fuel cycle lengths.

SR 3.8.1.3

A battery service test is a special test of battery capability, as found, to satisfy the design requirements (battery duty cycle) of the Class 1E DC electrical power system. The discharge rate and test length corresponds to the design duty cycle requirements as specified in Reference 4.

The Surveillance Frequency of 24 months is consistent with the recommendations of Regulatory Guide 1.32 (Ref. **8**~~9~~) and Regulatory Guide 1.129 (Ref. 10), which state that the battery service test should be performed with intervals between tests not to exceed 24 months. This Surveillance may be performed during any plant condition with the spare battery and charger providing power to the bus.

This SR is modified by **a**~~two~~ Note~~s~~. **The** Note ~~1~~ allows the performance of a modified performance discharge test in lieu of a service test.

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.

BASES

SURVEILLANCE REQUIREMENTS (continued)

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 would perturb the electrical distribution system and challenge safety systems if the spare battery is not connected. This restriction from normally performing the Surveillance in MODE 1 or 2 is further amplified to allow portions of the Surveillance to be performed for the purpose of reestablishing OPERABILITY (e.g., post work testing following corrective maintenance, corrective modification, deficient or incomplete surveillance testing, and other unanticipated OPERABILITY concerns) provided an assessment determines plant safety is maintained or enhanced. This assessment shall, as a minimum, consider the potential outcomes and transients associated with a failed partial Surveillance, a successful partial Surveillance, and a perturbation of the offsite or onsite system when they are tied together or operated independently for the partial Surveillance; as well as the operator procedures available to cope with these outcomes. These shall be measured against the avoided risk of a plant shutdown and startup to determine that plant safety is maintained or enhanced when portions of the Surveillance are performed in MODE 1 or 2. Risk insights or deterministic methods may be used for the assessment.~~

REFERENCES

1. 10 CFR 50, Appendix A, GDC 17.

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 1991, "IEEE Standard Criteria for Class 1E Power Systems for Nuclear Power Generating Stations," Institute of Electrical and Electronic Engineers.

4. **FSAR** Section 8.3.2, "Class 1E DC Power Systems."

BASES

REFERENCES (continued)

5. IEEE-485 1997, “IEEE Recommended Practice for Sizing Lead-Acid Batteries for Stationary Applications,” Institute of Electrical and Electronic Engineers, June 1983.

6. **FSAR** Chapter 6, “Engineered Safety Features.”

7. **FSAR** Chapter 15, “Accident Analyses.”

~~8. IEEE-450 1995, “IEEE Recommended Practice for Maintenance, Testing, and Replacement of Vented Lead-Acid Batteries for Stationary Applications,” Institute of Electrical and Electronic Engineers, June 1986.~~

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

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

10. Regulatory Guide 1.129 Revision 1, “Maintenance Testing and Replacement of Large Lead Storage Batteries for Nuclear Power Plants,” U.S. Nuclear Regulatory Commission, February 1978.

~~1011. Regulatory Guide 1.93, “Availability of Electric Power Sources,” U.S. Nuclear Regulatory Commission, December 1974.~~

XII. Applicable STS Subsection After Incorporation of this GTST's Modifications

The entire subsection of the Specifications and the Bases associated with this GTST, following incorporation of the modifications, is presented next.

3.8 ELECTRICAL POWER SYSTEMS

3.8.1 DC Sources - Operating

LCO 3.8.1 The Division A, B, C, and D Class 1E DC power subsystems shall be OPERABLE.

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

ACTIONS

CONDITION	REQUIRED ACTION		COMPLETION TIME
A. One or more battery chargers in one division inoperable.	A.1	Restore battery terminal voltage to greater than or equal to the minimum established float voltage.	6 hours
	<u>AND</u>		
	A.2	Verify battery float current ≤ 2 amps.	Once per 24 hours
	<u>AND</u>		
	A.3	Restore battery charger(s) to OPERABLE status.	7 days
B. One or more battery chargers in two divisions inoperable.	B.1	Restore battery terminal voltage to greater than or equal to the minimum established float voltage.	2 hours
	<u>AND</u>		
	B.2	Verify battery float current ≤ 2 amps.	Once per 24 hours
	<u>AND</u>		

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
B. (continued)	B.3 Restore battery charger(s) to OPERABLE status.	7 days
C. One or more batteries in one division inoperable.	C.1 Restore batteries to OPERABLE status.	6 hours
D. One or more batteries in two divisions inoperable.	D.1 Restore batteries to OPERABLE status.	2 hours
E. One DC electrical power subsystem inoperable for reasons other than Condition A or C.	E.1 Restore DC electrical power subsystem to OPERABLE status.	6 hours
F. Two DC electrical power subsystems inoperable for reasons other than B or D.	F.1 Restore DC electrical power subsystem to OPERABLE status.	2 hours
G. Required Action and associated Completion Time not met.	G.1 Be in MODE 3. AND G.2 Be in MODE 5.	6 hours 36 hours

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.8.1.1	Verify battery terminal voltage is greater than or equal to the minimum established float voltage.	7 days

SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE		FREQUENCY
SR 3.8.1.2	Verify each battery charger supplies ≥ 200 amps at greater than or equal to the minimum established float voltage for ≥ 8 hours. OR Verify each 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.	24 months
SR 3.8.1.3	--------------------------------NOTE-------------------------------- The modified performance discharge test in SR 3.8.7.6 may be performed in lieu of SR 3.8.1.3. -- Verify battery capacity is adequate to supply, and maintain in OPERABLE status, the required emergency loads for the design duty cycle when subjected to a battery service test.	24 months

B 3.8 ELECTRICAL POWER SYSTEMS

B 3.8.1 DC Sources - Operating

BASES

BACKGROUND

The Class 1E DC and UPS System (IDS) provides electrical power for safety related and vital control instrumentation loads, including monitoring equipment and main control room emergency lighting. It also provides power for safe shutdown when all the onsite and offsite AC power sources are lost and cannot be recovered for up to 72 hours. As required by 10 CFR 50, Appendix A, GDC 17 (Ref. 1), the Class 1E DC electrical power system is designed to have sufficient independence, redundancy, and testability to perform its safety functions, assuming a single failure. The Class 1E DC electrical power system also conforms to the requirements of Regulatory Guide 1.6 (Ref. 2) and IEEE-308 (Ref. 3).

The 250 VDC electrical power system consists of four independent safety related Class 1E DC electrical power subsystems (Division A, B, C, and D). Divisions A and D each consist of one battery bank, one battery charger, and the associated control equipment and interconnecting cable. Divisions B and C each consist of two battery banks , two battery chargers, and the associated control equipment and interconnecting cabling. The first battery bank in each of the four divisions, designated as the “24 hour” battery bank, provides power to the loads required for the first 24 hours following an event. The second battery bank in Divisions B and C, designated as the “72 hour” battery bank, is used for those loads requiring power for 72 hours following an event.

The loads on the battery banks (including those on the associated inverters) are grouped according to their role in response to a Design Basis Accident (DBA). Loads which are a one time or limited duration load (engineered safety features (ESF) actuation cabinets and reactor trip function) that are required within the first 24 hours following an accident are connected to the “24 hour” battery bank. Loads which are continuous or required beyond the first 24 hours following an accident (emergency lighting, post accident monitoring, and Qualified Data Processing System) are connected to the “72 hour” battery bank. There are a total of six battery banks. A battery bank (also referred to as the battery) consists of two battery strings connected in series. Each battery string consists of 60 cells connected in series. Divisions A and D each have one 2400 ampere hour battery bank and Divisions B and C each have two 2400 ampere hour battery banks.

BASES

BACKGROUND (continued)

Additionally, there is one installed spare battery bank and one installed spare battery charger, which provide backup service in the event that one of the battery banks and/or one of the preferred battery chargers is out of service. The spare battery bank and charger are Class 1E and have the same rating as the primary components. If the spare battery bank with the charger is substituted for one of the preferred battery banks or chargers, then the requirements of independence and redundancy between subsystems are maintained and the division is OPERABLE.

During normal operation, the 250 VDC 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 bank provides power to an inverter, which in turn powers an AC instrumentation and control bus. The AC instrumentation and control bus loads are connected to inverters according to the battery bank type, 24 hour or 72 hour.

The Class 1E DC power distribution system is described in more detail in Bases for LCO 3.8.5, “Distribution Systems - Operating,” and LCO 3.8.6, “Distribution Systems - Shutdown.”

Each battery has adequate storage capacity to carry the required load for the required duration as discussed in Reference 4.

Each 250 VDC battery bank, including the spare battery bank, 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 subsystems to ensure that a single failure in one subsystem does not cause a failure in a separate subsystem. There is no sharing between separate Class 1E subsystems such as batteries, battery chargers, or distribution panels.

The batteries for each Class 1E electrical power subsystem are based on 125% of required capacity. The voltage limit is 2.13 V per cell, which corresponds to a total minimum voltage output of 256 V per battery discussed in Reference 4. The criteria for sizing large lead storage batteries are defined in IEEE-485 (Ref. 5).

BASES

BACKGROUND (continued)

Each electrical power subsystem 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 has sufficient capacity to restore the battery bank from the design minimum charge to its fully charged state within 24 hours while supplying normal steady state loads (Ref. 4).

APPLICABLE SAFETY ANALYSES

The initial conditions of DBA and transient analyses in the FSAR Chapter 6 (Ref. 6) and FSAR Chapter 15, (Ref. 7), assume that engineered safety features are OPERABLE. The Class 1E DC electrical power system provides 250 volts power for safety related and vital control instrumentation loads including monitoring and main control room emergency lighting during all MODES of operation. It also provides power for safe shutdown when all the onsite and offsite AC power sources are lost.

The OPERABILITY of the Class 1E DC sources is consistent with the initial assumptions of the accident analyses. This includes maintaining at least three of the four divisions of DC sources OPERABLE during accident conditions in the event of:

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

b. A worst case single failure.

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

LCO

Class 1E DC electrical power subsystems 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 (AOO) or a postulated DBA. Loss of Class 1E DC electrical power from one division does not prevent the minimum safety function from being performed (Ref. 4).

An OPERABLE Class 1E DC electrical power subsystem requires all required batteries and respective chargers to be operating and connected to the associated DC bus(es). The spare battery and/or charger may be used by one subsystem for OPERABILITY.

BASES

APPLICABILITY

The Class 1E DC electrical power sources are required to be OPERABLE in MODES 1, 2, 3, and 4 to ensure safe unit operation and to ensure that:

a. Acceptable fuel design limits and reactor coolant pressure boundary limits are not exceeded as a result of AOOs 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.

Class 1E DC electrical power requirements for MODES 5 and 6 are addressed in the Bases for LCO 3.8.2, “DC Sources - Shutdown.”

ACTIONS

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

Condition A represents one division with one or two battery chargers inoperable (e.g., the voltage limit of SR 3.8.1.1 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 6 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 24 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.

Because of the passive system design and the use of fail-safe components, the remaining Class 1E DC electrical power subsystems have the capacity to support a safe shutdown and to mitigate most DBAs following a subsequent worst case single failure. The 6 hour Completion Time is reasonable based on engineering judgement balancing the risks of operation without one DC subsystem against the risks of a forced shutdown. Additionally, the Completion Time reflects a reasonable time to assess plant status; attempt to repair or replace, thus avoiding an unnecessary shutdown; and, if necessary, prepare and effect an orderly and safe shutdown.

ACTIONS (continued)

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 24 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 6 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 6 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 24 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 24 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.

BASES

ACTIONS (continued)

B.1, B.2, and B.3

Condition B represents two divisions with one or more battery chargers inoperable (e.g., the voltage limit of SR 3.8.1.1 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 B.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 24 hours, the battery will be restored to its fully charged condition (Required Action B.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 24 hours, avoiding a premature shutdown with its own attendant risk.

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 24 hours (Required Action B.2).

Required Action B.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 fully recharged. If at the expiration of the initial 24 hour period the battery float current is not less than or equal to 2 amps this indicates there may

BASES

ACTIONS (continued)

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

Required Action B.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.

C.1

Condition C represents one division with one or more batteries inoperable. With one or more batteries inoperable, the DC bus is being supplied by the OPERABLE battery chargers. Any event that results in a loss of the AC bus supporting the battery chargers will also result in loss of DC to that train.

Because of the passive system design and the use of fail-safe components, the remaining Class 1E DC electrical power subsystems have the capacity to support a safe shutdown and to mitigate most DBAs following a subsequent worst case single failure. The 6 hour Completion Time is reasonable based on engineering judgement balancing the risks of operation without one DC subsystem against the risks of a forced shutdown. Additionally, the Completion Time reflects a reasonable time to assess plant status; attempt to repair or replace, thus avoiding an unnecessary shutdown; and, if necessary, prepare and effect an orderly and safe shutdown.

The installed spare battery bank and charger may be used to restore an inoperable Class 1E DC electrical power subsystem; however, all applicable Surveillances must be met by the spare equipment used, prior to declaring the subsystem OPERABLE.

ACTIONS (continued)

D.1

Condition D represents two divisions with one or more batteries inoperable. With one or more batteries inoperable, the DC bus is being supplied by the OPERABLE battery charger. Any event that results in a loss of the AC bus supporting the battery charger will also result in loss of DC to that train. The 2 hour limit allows sufficient time to effect restoration of an inoperable battery given that the majority of the conditions that lead to battery inoperability (e.g., loss of battery charger, battery cell voltage less than 2.07 V, etc.) are identified in Specifications 3.8.1, 3.8.2, and 3.8.7 together with additional specific completion times.

The installed spare battery bank and charger may be used to restore an inoperable Class 1E DC electrical power subsystem; however, all applicable Surveillances must be met by the spare equipment used, prior to declaring the subsystem OPERABLE.

E.1

If one of the Class 1E DC electrical power subsystems is inoperable, the remaining Class 1E DC electrical power subsystems have the capacity to support a safe shutdown and to mitigate all design basis accidents, based on conservative analysis.

Because of the passive system design and the use of fail-safe components, the remaining Class 1E DC electrical power subsystems have the capacity to support a safe shutdown and to mitigate most DBAs following a subsequent worst case single failure. The 6 hour Completion Time is reasonable based on engineering judgement balancing the risks of operation without one DC subsystem against the risks of a forced shutdown. Additionally, the Completion Time reflects a reasonable time to assess plant status; attempt to repair or replace, thus avoiding an unnecessary shutdown; and, if necessary, prepare and effect an orderly and safe shutdown.

The 6 hour Completion Time is also consistent with the time specified for restoration of one (of four) Protection and Safety Monitoring System (PMS) actuation divisions (LCO 3.3.15, “Engineered Safety Feature Actuation System (ESFAS) Actuation Logic - Operating”). Depending on the nature of the DC electrical power subsystem inoperability, one supported division of instrumentation could be considered inoperable. Inoperability of a PMS Division is similar to loss of one DC electrical

ACTIONS (continued)

power subsystem. In both cases, actuation of the safety functions associated with one of the four subsystems/divisions may no longer be available.

F.1

Condition F represents two subsystems 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 unit, minimizing the potential for complete loss of DC power to the affected distribution subsystems. The 2 hour limit is consistent with the allowed time for two inoperable DC distribution subsystems.

If two of the required DC electrical power subsystems are inoperable (e.g., inoperable battery, inoperable battery charger(s), or inoperable battery charger and associated inoperable battery), the two remaining DC electrical power subsystems have the capacity to support a safe shutdown and to mitigate all but the very worst case events. Since a subsequent worst case single failure would, however, result in the loss of the third subsystem, leaving only one subsystem with limited capacity to mitigate events, continued power operation should not exceed 2 hours. The 2 hour Completion Time is based on Regulatory Guide 1.93 (Ref. 8) and reflects a reasonable time to assess unit status as a function of the inoperable DC electrical power subsystem and, if the DC electrical power subsystem is not restored to OPERABLE status, to prepare to effect an orderly and safe unit shutdown.

G.1 and G.2

If the inoperable DC electrical power subsystem cannot be restored to OPERABLE status within the required Completion Time, the unit 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 unit conditions from full power conditions in an orderly manner and without challenging plant systems.

BASES

SURVEILLANCE REQUIREMENTS

SR 3.8.1.1

Verifying battery terminal voltage while on float charge for the batteries helps to ensure the effectiveness of the battery chargers which support 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 initial voltages assumed in the battery sizing calculations. This voltage maintains the battery plates in a condition that supports maintaining the grid life (expected to be approximately 20 years). The 7 day Frequency is consistent with manufacturer recommendations.

SR 3.8.1.2

This SR verifies the design capacity of the battery chargers. According to Regulatory Guide 1.32 (Ref. 9), 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 unit during these demand occurrences. The minimum required amperes and duration ensures 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 for 8 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 time period is sufficient for the charger temperature to have stabilized and to have been maintained for at least 2 hours.

The other option requires that each battery charger be capable of recharging the battery after a service test coincident with supplying the largest combined 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,

BASES

SURVEILLANCE REQUIREMENTS (continued)

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 unit conditions required to perform the test and the other administrative controls existing to ensure adequate charger performance during these 24 month intervals. In addition, this Frequency is intended to be consistent with expected fuel cycle lengths.

SR 3.8.1.3

A battery service test is a special test of battery capability, as found, to satisfy the design requirements (battery duty cycle) of the Class 1E DC electrical power system. The discharge rate and test length corresponds to the design duty cycle requirements as specified in Reference 4.

The Surveillance Frequency of 24 months is consistent with the recommendations of Regulatory Guide 1.32 (Ref. 8) and Regulatory Guide 1.129 (Ref. 10), which state that the battery service test should be performed with intervals between tests not to exceed 24 months. This Surveillance may be performed during any plant condition with the spare battery and charger providing power to the bus.

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

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.

BASES

SURVEILLANCE REQUIREMENTS (continued)

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.

REFERENCES

1. 10 CFR 50, Appendix A, GDC 17.
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 1991, "IEEE Standard Criteria for Class 1E Power Systems for Nuclear Power Generating Stations," Institute of Electrical and Electronic Engineers.
4. FSAR Section 8.3.2, "Class 1E DC Power Systems."
5. IEEE-485 1997, "IEEE Recommended Practice for Sizing Lead-Acid Batteries for Stationary Applications," Institute of Electrical and Electronic Engineers, June 1983.
6. FSAR Chapter 6, "Engineered Safety Features."
7. FSAR Chapter 15, "Accident Analyses."
8. Regulatory Guide 1.93, "Availability of Electric Power Sources," U.S. Nuclear Regulatory Commission, December 1974.
9. Regulatory Guide 1.32, "Criteria for Safety-Related Electric Power Systems for Nuclear Power Plants," U.S. Nuclear Regulatory Commission, February 1977.
10. Regulatory Guide 1.129 Revision 1, "Maintenance Testing and Replacement of Large Lead Storage Batteries for Nuclear Power Plants," U.S. Nuclear Regulatory Commission, February 1978.