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

Title: Changes related to Section 3.8.7, Battery Parameters

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-500, Rev. 2, DC Electrical Rewrite - Update to TSTF-360

STS NUREGs Affected:

TSTF-500, Rev. 2 NUREG-1430, -1431, -1432, -1433, and -1434

NRC Approval Date:

TSTF-500, Rev. 2: 09-Sept-2011

TSTF Classification:

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 A113:

TS 3.8.7, "Battery Parameters" is revised to add the word "float" in "cell voltage", i.e., replace "cell voltage" with "cell float voltage."

VEGP LAR DOC L21:

TS 3.8.7, "Battery Parameters," is revised to delete the SR 3.8.7.6 Note.

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

This section discusses changes: (1) that were applicable to previous designs, but are not to the current design; (2) that are already incorporated in the GTS; and (3) that are superseded by another change.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. Section VI of this GTST presents a summary discussion of the changes in TSTF-500, Rev.2, along with detailed discussions of the specific changes that are applicable for inclusion in Subsection 3.8.7 of the AP1000 STS.

The change defined in VEGP LAR DOC L21 is addressed in the discussion of TSTF-500 because the change is also included in TSTF-500, Rev. 2.

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)

1. GTS 3.8.7 Condition A, is revised to state, “One or more batteries in one division with one or more battery cells **with** float voltage < [2.07] V.” A similar change is made to the second condition statement of Condition F, so that is says, “One or more batteries in one division with one or more battery cells **with** float voltage < [2.07] V and float current > [2] amps.” The first sentence in Bases for ACTIONS B.1 and B.2 is revised to state "...with float **current** > [2] amps indicate**s** that ..."

2. Editorial correction: In the ACTIONS Section of the Bases (2nd paragraph under A.1, A.2, and A.3), the phrase "there is not assurance" is replaced with "there is no assurance."

3. BASES discussion of ACTIONS C.1, C.2, and C.3, second paragraph was revised to include the following sentence, " A note for Condition C also assures that the Required Action C.2, verify no evidence of leakage, is completed whenever the electrolyte level is detected to be below the top of the plates."

V. Applicability

Affected Generic Technical Specifications and Bases:

Section 3.8.7 Battery Parameters

Changes to the Generic Technical Specifications and Bases:

1. Revise the LCO statement to add "DC electrical power subsystem" before "batteries shall be within limits." (TSTF-500, Rev. 2)

2. Place brackets around the value for battery cells float voltage (e.g., [2.07] V) whenever the cell float voltage is stated in the Specification, Bases, or both. The battery cell float voltage is specified in Conditions, Required Actions, Surveillance Requirements, and in the Bases. (TSTF-500, Rev .2)

3. Place brackets around the value for battery float current (e.g., [2]) amps whenever the battery float current is stated in the Specification, Bases, or both. The battery float current is specified in Conditions, Required Actions, Surveillance Requirements, and in the Bases. (TSTF-500, Rev. 2)

4. Revise TS 3.8.7 SR 3.8.7.2 and SR 3.8.7.5 to add the word "float." (TSTF-500, Rev. 2; VEGP LAR DOC A113)

5. Delete Note in SR 3.8.7.6. (VEGP LAR DOC L21)

6. Clarify in the Bases for SR 3.8.7.6 that the surveillance can be performed any time with the spare battery and the charger providing power to the bus. (VEGP LAR DOC L21)

7. Remove reference to IEEE-450 1995. Replace with IEEE-450. (TSTF-500, Rev. 2)

8. GTS 3.8.7 Condition A, is revised by inserting “with” as indicated in bold font, to state, “One or more batteries in one division with one or more battery cells **with** float voltage < [2.07] V.” A similar change is made to the second condition statement of Condition F, so that is says, “One or more batteries in one division with one or more battery cells **with** float voltage < [2.07] V and float current > [2] amps.” The first sentence in Bases for ACTIONS B.1 and B.2 is revised to state "...with float **current** > [2] amps indicate**s** that ..."(proposed change).

9. Add a sentence in Bases for ACTIONS C.1, C.2, and C.3 to discuss the note under Condition C. (proposed change)

VI. Traveler Information

Description of TSTF changes:

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,
B. Description of changes to Subsection Title and LCO statement in AP1000 GTS 3.8.7, "Battery Parameters" Title and LCO,
C. Description of changes to AP1000 GTS 3.8.7, "Battery Parameters" Actions
D. Description of changes to AP1000 GTS 3.8.7, "Battery Parameters" Surveillances
E. Description of changes to AP1000 GTS 3.8.7, "Battery Parameters" Bases.

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

TSTF-360, "DC Electrical Rewrite," was approved by the NRC in December 2000 and incorporated in Revision 2 of the 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; the following summary describes these changes.

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.

2. TS 3.8.4, Required Action A.3, and TS 3.8.5, Required Action A.3, specify a 72 hour Completion Time vice the 7 day Completion Time in TSTF-360-A. Licensees wishing to adopt a Completion Time for Required Action A.3 longer than 72 hours will need to demonstrate that the Completion Time is appropriate for the plant in accordance with the

guidance in Regulatory Guide (RG) 1.177, "An Approach for Plant-Specific, Risk-Informed Decisionmaking: Technical Specifications," and RG 1.174, "An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis." 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.

3. TSTF-360-A applied a Reviewer's Note to TS 3.8.6 stating that licensees must adopt a Battery Monitoring and Maintenance Program based on IEEE-450-1995. That Reviewer's Note is deleted in TSTF-500 because it is no longer necessary. Reliance on IEEE-450-2002 is incorporated in the Battery Monitoring and Maintenance Program.

4. 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 more 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.

TSTF-360-A contained two documents: "Battery Primer for Nuclear Power Plants," and "Assessment of Lead-Acid Battery State of Charge by Monitoring Float Current," which are also included in TSTF-500 as Enclosures 1 and 2. These documents provided justification for using float current instead of specific gravity as a method of monitoring the state-of-charge for the batteries and establishing a return to service limit. In order to use float current, licensees are required to provide letters from the manufacturers of the batteries in use at their station supporting the use of float current monitoring instead of specific gravity monitoring and to provide plant/battery specific bases for the [2] amp return to service limit. One method of selecting the return to service limit that has been accepted by the NRC is reserving [5%] of the available design margin above that required to perform the intended design function. TSTF-500 contains a "Verifications and Regulatory Commitments" section that defines the requirements licensee must satisfy to justify using float current as a method of monitoring a battery's state-of-charge.

Specific changes for AP1000 Section 3.8.7 are discussed below.

B. Description of changes to Subsection Title and LCO statement in AP1000 GTS 3.8.7, "Battery Parameters" Title and LCO,

TSTF-500, Rev.2 discusses four changes: (a) changes to the Subsection Title, (b) removal of a Reviewer’s Note, (c) changes to the LCO statement, and (d) deletion of the table defining battery cell parameter requirements (e.g., NUREG-1431, Rev. 1, Table 3.8.6.1).

Item (a), (b), and (d) were already incorporated in the GTS. Item (c) revises GTS LCO 3.8.7 to say “Battery Parameters for Division A, B, C, and D DC electrical power subsystem batteries” instead of just “Battery Parameters for Division A, B, C, and D batteries.”

C. Description of changes to AP1000 GTS LCO 3.8.7, "Battery Parameters" Actions

TSTF-500, Rev. 2 redefines the Conditions and associated Required Actions and Completion Times by replacing them with Conditions A, B, C, D, E, and F and their associated Required Actions and Completion Times.

The Actions table of GTS 3.8.7 already includes these new Conditions, Required Actions, and Completion Times, and therefore, is consistent with TSTF-500, Rev. 2. However, in some cases, it is considered appropriate to place battery parameters within brackets to account for plant/battery specific variations:

1. Place brackets around the value for battery cell float voltage (e.g., [2.07] V) whenever the cell float voltage is stated in the Specifications or Bases, or both.

2. Place brackets around the value for battery float current (e.g., [2] amps) whenever the battery float current is stated in the Specifications or Bases, or both.

3. GTS 3.8.7 Condition A, is revised for clarification by adding the word “with”; it states, “One or more batteries in one division with one or more battery cells **with** float voltage < [2.07] V.” A similar change is made to the second condition statement of Condition F, so that is says, “One or more batteries in one division with one or more battery cells **with** float voltage < [2.07] V and float current > [2] amps.”

D. Description of changes to AP1000 GTS LCO 3.8.7, "Battery Parameters” Surveillances

TSTF-500, Rev. 2 defines the Surveillance Requirements consistent with the Conditions specified in the Actions table. GTS 3.8.7 already includes the new Surveillance Requirements, and therefore, is consistent with TSTF-500, Rev. 2. Minor changes are proposed; they include adding brackets to parameter values and clarifying the cases where the intent of “cell voltage” is “cell float voltage,” as follows:

1. Place brackets for battery cell float voltage (e.g., [2.07] V) whenever the cell float voltage is stated in the Specifications or Bases, or both.

2. Place brackets for battery float current (e.g., [2] amps) whenever the battery float current is stated in the Specifications or Bases, or both.

3. Revise GTS SR 3.8.7.2 and SR 3.8.7.5 to replace “cell voltage” with “cell float voltage.”

E. Description of changes to AP1000 GTS LCO 3.8.7, "Battery Parameters" Bases.

The Bases for the Specification 3.8.7 are revised to reflect the changes addressed above. Changes proposed include adding brackets to parameter values and clarifying the cases where the intent of “cell voltage” is “cell float voltage,” and revising a reference, as follows:

1. Place brackets for battery cell float voltage (e.g., [2.07] V) whenever the cell float voltage is stated in the Specifications or Bases, or both.

2. Place brackets for battery float current (e.g., [2] amps) whenever the battery float current is stated in the Specifications or Bases, or both.

3. References to IEEE-450-1995, are removed and as needed, replaced with IEEE-450. The REFERENCES Section is appropriately modified with reference to IEEE-450-1995

replaced with IEEE-450, because reference to IEEE-450-2002 is included in the revised Battery Monitoring and Maintenance Program in TS Section 5.5.

Rationale for TSTF changes:

TSTF-500

Revision of LCO statement

The revision to the LCO to refer to “Division A, B, C, and D DC electrical power subsystem batteries” instead of “Division A, B, C, and D batteries” improves consistency with LCO statements in other dc electrical power system specifications (e.g., LCO 3.8.4 and LCO 3.8.5 in NUREG-1431; these LCOs describe separate and independent DC electrical power subsystems and use the term "subsystem" in the Conditions, as well as in the LCO statement).

Monitoring for battery cell float voltage and battery float current

Licensees are required to establish a Battery Monitoring and Maintenance Program that 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 recommendation. The program must contain action requirements to equalize and test battery cells when the electrolyte level in one or more cells drops below the top of plates instead of when the electrolyte level in one or more cells drops below the minimum established design limit, and to verify that the voltages of the remaining cells are > [2.07] V when the voltage in one or more cells has been found to be < [2.13] V.

In order to use float current, licensees are required to provide letters from the manufacturers of the batteries in use at their station supporting the use of float current monitoring instead of specific gravity monitoring and to provide plant/battery specific bases for the [2] amp return to service limit. One method of selecting the return to service limit that has been accepted by the NRC is reserving [5%] of the available design margin above that required to perform the intended design function.

Replacing "cell voltage" with "cell float voltage" in SR 3.8.6.2 and 3.8.6.5 in NUREG-1431

The addition of the word "float" in SR 3.8.6.2 and SR 3.8.6.5 makes the SR descriptions consistent with the corresponding Condition A. Condition A states, "One [or two] batter[y][ies in one subsystem] with one or more battery cells float voltage < [2.07] V."

Removing reference to IEEE-450-1995

NRC has not reviewed or endorsed IEEE-450-1995. NRC has endorsed IEEE-450-2002 in Regulatory Guide 1.129, Revision 2. TSTF-500, Rev. 2 changes are based on IEEE-450-2002. Accordingly, it is appropriate to reference Regulatory Guide 1.129 and IEEE-450, but not IEEE-450-1995.

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

VEGP LAR A113:

TS 3.8.7, "Battery Parameters" is revised to add the word "float" in "cell voltage", i.e., replace "cell voltage" with "cell float voltage."

VEGP LAR L21:

TS 3.8.7, "Battery Parameters," is revised to delete the SR 3.8.7.6 Note.

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

VEGP LAR A113

The word “float” is added to SR 3.8.7.2 and SR 3.8.7.5 for consistency with TS 3.8.7 Condition A, which states, “One or more batteries in one division with one or more battery cells float voltage < 2.07 V.” The addition of the word “float” to SR 3.8.7.2 and SR 3.8.7.5 is consistent with the Bases. The SR 3.8.7.2 and SR 3.8.7.5 Bases state, “SRs 3.8.7.2 and 3.8.7.5 require verification that the cell float voltages are equal to or greater than the short term absolute minimum voltage of 2.07 V.” The revised presentation of SR 3.8.7.2 and SR 3.8.7.5 is consistent with NUREG-1431 SR 3.8.6.2 and SR 3.8.6.5.

The proposed changes are for consistency within TS 3.8.7. These changes are designated as administrative changes and are acceptable because they do not result in technical changes to the TS.

VEGP LAR L21

The SR 3.8.7.6 Note states, “This Surveillance shall not be performed in MODE 1, 2, 3, or 4. However, credit may be taken for unplanned events that satisfy this SR.” Per the SR 3.8.7.6 Bases, the “reason for the Note is that performing the Surveillance would perturb the electrical distribution system and challenge safety systems.”

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 provides 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 and SR 3.8.7.6 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) 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 on a battery when the TS require that the battery and the associated battery charger to be operable. 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. For consistency, TS Bases for SR 3.8.7.6 are being revised to reflect similar information regarding utilizing the spare battery. During performance of this SR, the spare battery would replace the battery being tested. Therefore, performance of SR 3.8.7.6 would not perturb the electrical distribution system and challenge safety systems. As such, the scope and intent of the SR 3.8.7.6 Note is also 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, thereby resulting in no increase to plant risk due to maintenance and testing activities. This change is designated as less restrictive because a limitation on SR testing is deleted.

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

GTS 3.8.7 Condition A, is revised to state, “One or more batteries in one division with one or more battery cells **with** float voltage < **[**2.07**]** V.” A similar change is made to the second condition statement of Condition F, so that is says, “One or more batteries in one division with one or more battery cells **with** float voltage < **[**2.07**]** V and float current > **[**2**]** amps.” The first sentence in Bases for ACTIONS B.1 and B.2 is revised to state "...with float **current** > [2] amps indicate**s** that ..."

A sentence is added in the ACTIONS section of Bases under C.1, C.2, and C.3. The sentence is as follows, " A note for Condition C also assures that the Required Action C.2, verify no evidence of leakage, is completed whenever the electrolyte level is detected to be below the top of the plates."

An editorial correction in the ACTIONS Section of the Bases (2nd paragraph under A.1, A.2, and A.3) to replace "there is not assurance" with "there is no assurance."

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

The LCO statement of Specification 3.8.7 is revised for consistency with other Section 3.8 LCOs.

The addition of a sentence in the Bases section for ACTIONS C.1, C.2, and C.3 clarifies the intent of the note under Condition C.

The other corrections are editorial for clarification of intent and are acceptable.

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 than the STS on which TSTF-500, Rev. 2 is based. Subsection 3.8.7, “Battery Parameters” in AP1000 corresponds to the Subsection 3.8.6, “Battery Parameters” in the Westinghouse STS, NUREG-1431, being referred to in TSTF-500, Rev. 2. These differences, relating to the numbering of TS Sections, are administrative and do not affect the applicability of changes in TSTF-500, Rev. 2, for incorporation into the AP1000 STS.

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

The AP1000 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. 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. The voltage limit is 2.13 V per cell, which corresponds to a total minimum voltage output of 256 V per battery.

The DC electrical power system in the standard plant analyzed in TSTF-500, Ref.2 is assumed to consist of two independent and redundant safety Class 1E DC electrical power subsystems. Each subsystem consists of the batteries, the associated battery charger(s) for each battery, and all the associated control equipment and interconnected cabling. The battery cells are of flooded lead acid construction and have an open circuit voltage of approximately 120V for a 58 cell battery (i.e., a cell voltage of 2.065 volts per cell).

As evident from the above discussion, the configuration of the batteries in AP1000 and in the standard plant in TSTF-500, Rev.2 are different. However, criteria for sizing the large lead storage batteries in both cases are based on IEEE-485. The battery parameters are similar, i.e., the voltage per cell for batteries is comparable. Accordingly, the Conditions defined for the standard plant in TSTF-500, Rev. 2 apply to the AP1000 DC electrical power system. To account for the plant-specific variations, the cell voltage is paced within brackets.

Revision of LCO statement

The revision to the LCO statement is to refer to the “Battery Parameters for Division A, B, C, and D DC electrical power subsystem batteries” instead of “Battery Parameters for Division A, B, C, and D batteries.” This is justified because the revised LCO statement is consistent with LCO 3.8.1 and 3.8.2.

LCO 3.8.1 states “The Division A, B, C, and D Class 1E DC electrical power subsystems shall be OPERABLE” and LCO 3.8.2 states ‘DC electrical power subsystems shall be OPERABLE to support the DC electrical power distribution subsystem(s) required by LCO 3.8.6, “Distribution Systems - Shutdown.”’ These LCOs describe separate and independent electrical power subsystems and use the term “subsystem” which appears in the Conditions, in the LCO.

Accordingly, the addition of the phrase “DC electrical power subsystem” in the statement of LCO 3.8.7 will make all of the Section 3.8 LCO statements consistent. The change is, therefore, acceptable.

Brackets for battery cells voltage and battery float current

An administrative program, the Battery Monitoring and Maintenance Program, is included in Section 5.5, "Program and manuals" of the AP1000 STS. The monitoring of the current battery parameters (i.e., specific gravity, electrolyte level, cell temperature, float voltage, connection resistance, and physical condition) is located in this program. The program, with TSTF-500 changes incorporated, includes the following provisions:

1. Actions to restore battery calls with float voltage < [2.13] V;

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

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

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

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

A change is also implemented in the way pilot cells are selected. In the past, pilot cells were selected to represent average cells in the battery. The change to [2.07] V now requires pilot cells to be selected to represent the lowest voltage cells in the battery. This ensures that other cells are above the pilot cell voltage which must remain above the TS limit.

Also, TS operability requirements now allow verifying battery float current to be ≤ [2] amps while on float charge as a means of determining that the battery is fully charged (See SR 3.8.7.1). In order to use float current, licensees are required to provide letters from the manufacturers of the batteries in use at their station supporting the use of float current monitoring instead of specific gravity monitoring and to provide plant/battery specific bases for the [2] amp return to service limit. One method of selecting the return to service limit that has been accepted by the NRC is reserving [5%] of the available design margin above that required to perform the intended design function.

Considering the need for the licensees to develop the Battery Monitoring and Maintenance Program, it is appropriate to place the battery cells voltage and battery float current within bracket to provide flexibility to the licensee in developing the program, as recommended in TSTF-500, Rev. 2.

Replacing "cell voltage" with "cell float voltage" in SR 3.8.7.2 and 3.8.7.5

The addition of the word "float" in SR 3.8.7.2 and SR 3.8.7.5 makes the SR statements consistent with the corresponding Conditions A and F. As revised, Condition A states, "One or more batteries in one division with one or more battery cells with float voltage < 2.07 V." The Bases for SR 3.8.7.2 and SR 3.8.7.5 are also written in terms of cell float voltage. Accordingly, changing the SRs to replace "cell voltage" with "cell float voltage" is appropriate and acceptable.

Removing reference to IEEE-450-1995

NRC has not reviewed or endorsed IEEE-450-1995. NRC has endorsed IEEE-450-2002 in Regulatory Guide 1.129, Revision 2. TSTF-500, Rev. 2 changes are based on IEEE-450-2002. Accordingly, it is appropriate to reference Regulatory Guide 1.129 and IEEE-450, but not IEEE-450-1995. Reference to IEEE-450 implies reference to the latest version of the IEEE Std.

Remaining 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.

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. In some cases, brackets and Reviewer's Note are included where it is considered plant-specific evaluation may result in a different value or a changed requirement. In other cases, based on the AP1000 GTS and NRC approval, it was considered that the requirement will not require change(s) for a specific AP1000 plant.

3. Following the guidance in TSTF-450, reference to IEEE-450-1995 is removed and in some cases, replaced with IEEE-450. This reference to IEEE-450 is not clear. A complete reference to IEEE-450-2002 should be considered.

Pranab K. Samanta
Brookhaven National Laboratory
631-344-4948
samanta@bnl.gov

Review Information:

Availability for public review and comment on Revision 0 of this traveler approved by NRC staff on Thursday, May 22, 2014.

NRC Final Approval Date:

NRC Contact:

T. Robert Tjader
United States Nuclear Regulatory Commission
301-415-1187
Theodore.Tjader@nrc.gov

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)

6. TSTF-GG-05-01, "Writer's Guide for Plant-Specific Improved Technical Specifications," June 2005.

XI. MARKUP of the Applicable GTS Section 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

3.8.7 Battery Parameters

LCO 3.8.7 Battery Parameters for Division A, B, C, and D **DC electrical power subsystem** batteries shall be within limits.

APPLICABILITY: When associated DC electrical power sources are required to be OPERABLE.

ACTIONS

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

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One or more batteries in one division with one or more battery cells float voltage < **[**2.07**]** V.	A.1 Perform SR 3.8.1.1. AND A.2 Perform SR 3.8.7.1. AND A.3 Restore affected cell voltage ≥ **[**2.07**]** V.	2 hours 2 hours 24 hours
B. One or more batteries in one division with float current > **[**2**]** amps.	B.1 Perform SR 3.8.1.1. AND B.2 Restore battery float current to ≤ **[**2**]** amps.	2 hours 24 hours

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
----------NOTE---------- Required Action C.2 shall be completed if electrolyte level was below the top of plates ---------- C. One or more batteries in one division with one or more cells electrolyte level less than minimum established design limits.	----------NOTE---------- Required Actions C.1 and C.2 are only applicable if electrolyte level was below the top of plates ---------- C.1 Restore electrolyte level to above top of plates. AND C.2 Verify no evidence of leakage. AND C.3 Restore electrolyte level to greater than or equal to minimum established design limits.	8 hours 12 hours 31 days
D. One or more batteries in one division with pilot cell electrolyte temperature less than minimum established design limits.	D.1 Restore battery pilot cell temperature to greater than or equal to minimum established design limits.	12 hours
E. One or more batteries in two or more divisions with battery parameters not within limits.	E.1 Restore battery parameters for batteries in three divisions to within limits.	2 hours

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
F. Required Action and associated Completion Time not met. OR One or more batteries in one division with one or more battery cells float voltage < [2.07] V and float current > [2] amps.	F.1 Declare associated battery inoperable.	Immediately

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
3.8.7.1	----------NOTE---------- Not required to be met when battery terminal voltage is less than the minimum established float voltage of SR 3.8.1.1. ---------- Verify each battery float current is ≤ [2] amps.	7 days
3.8.7.2	Verify each battery pilot cell **float** voltage is ≥ [2.07] V.	31 days
3.8.7.3	Verify each battery connected cell electrolyte level is greater than or equal to minimum established design limits.	31 days
3.8.7.4	Verify each battery pilot cell temperature is greater than or equal to minimum established design limits.	31 days

SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE		FREQUENCY
3.8.7.5	Verify each battery connected cell **float** voltage is ≥ **[**2.07**]** V.	92 days
3.8.7.6	~~NOTE~~ ~~This Surveillance shall not be performed in MODE 1, 2, 3, or 4. However, credit may be taken for unplanned events that satisfy this SR.~~ Verify battery capacity is ≥ 80% of the manufacturer's rating when subjected to a performance discharge test or a modified performance discharge test.	60 months AND 12 months when battery shows degradation, or has reached 85% of the expected life with capacity < 100% of manufacturer's rating AND 24 months when battery has reached 85% of the expected life with capacity ≥ 100% of manufacturer's rating

B 3.8 ELECTRICAL POWER SYSTEMS

B 3.8.7 Battery Parameters

BASES

BACKGROUND

LCO 3.8.7, Battery Parameters, delineates the limits on electrolyte temperature, level, float voltage and specific gravity for the DC power source batteries. A discussion of these batteries and their OPERABILITY requirements is provided in the Bases for LCO 3.8.1, "DC Sources - Operating," and LCO 3.8.2, "DC Sources - Shutdown." In addition to the limitations of this Specification, the licensee controlled program also implements a program specified in Specification 5.5.11 for monitoring various battery parameters ~~that is based on the recommendations of IEEE Standard 450-1995, "IEEE Recommended Practice For Maintenance, Testing, And Replacement Of Vented Lead-Acid Batteries For Stationary Applications" (Ref. 3)~~.

APPLICABLE SAFETY ANALYSES

The initial conditions of Design Basis Accident (DBA) and transient analyses in Chapter 6 (Ref. 1), and Chapter 15 (Ref. 2), assume engineered safety features are OPERABLE. The DC electrical power system provides normal and emergency DC electrical 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 DC subsystems is consistent with the initial assumptions of the accident analyses and is based upon meeting the design basis of the unit. 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.

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

BASES

LCO

Battery parameters must remain within acceptable limits to ensure availability of the required DC power to shut down the reactor and maintain it in a safe condition after an anticipated operational occurrence or a postulated DBA. Battery parameter limits are conservatively established, allowing continued DC electrical system function even with limits not met. Additional preventative maintenance, testing, and monitoring performed in accordance with the licensee controlled program is conducted as specified in Specification 5.5.11.

APPLICABILITY

The battery parameters are required solely for the support of the associated DC electrical power subsystems. Therefore, battery parameter limits are only required when the DC power source is required to be OPERABLE. Refer to the Applicability discussion in Bases for LCO 3.8.1, and LCO 3.8.2.

ACTIONS

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

With one or more cells in one or more batteries in one Division < **[**2.07**]** V, the battery cell is degraded. Within 2 hours verification of the required battery charger, OPERABILITY is made by monitoring the battery terminal voltage (SR 3.8.1.1) and of the overall battery state of charge by monitoring the battery float charge current (SR 3.8.7.1). This assures that there is still sufficient battery capacity to perform the intended function. Therefore, the affected battery is not required to be considered inoperable solely as a result of one or more cells in one or more batteries < **[**2.07**]** V, and continued operation is permitted for a limited period up to 24 hours.

Since the Required Actions only specify “perform,” a failure of SR 3.8.1.1 or SR 3.8.7.1 acceptance criteria does not result in this Required Action not met. However, if one of the SRs is failed the appropriate Condition(s), depending on the cause of the failures, is entered. If SR 3.8.7.1 is failed then there is no~~t~~ assurance that there is still sufficient battery capacity to perform the intended function and the battery must be declared inoperable immediately.

BASES

ACTIONS (continued)

B.1 and B.2

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

If the float voltage is found to be satisfactory but there are one or more battery cells with float voltage less than **[**2.07**]** V, the associated "OR" statement in Condition F is applicable and the battery must be declared inoperable immediately. If float voltage is satisfactory and there are no cells less than **[**2.07**]** V there is good assurance that, within 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 a temporary loss of the battery charger.

A discharged battery with float voltage (the charger setpoint) across its terminals indicates that the battery is on the exponential charging current portion (the second part) of its recharge cycle. The time to return a battery to its fully charged state under this condition is simply a function of the amount of the previous discharge and the recharge characteristic of the battery. Thus there is good assurance of fully recharging the battery within 24 hours, avoiding a premature shutdown with its own attendant risk.

BASES

ACTIONS (continued)

If the condition is due to one or more cells in a low voltage condition but still greater than **[**2.07**]** V and float voltage is found to be satisfactory, this is not indication of a substantially discharged battery and 24 hours is a reasonable time prior to declaring the battery inoperable.

Since Required Action B.1 only specifies "perform," a failure of SR 3.8.1.1 acceptance criteria does not result in the Required Action not met. However, if SR 3.8.1.1 is failed, the appropriate Condition(s), depending on the cause of the failure, is entered.

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

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

With electrolyte level below the top of the plates there is a potential for dryout and plate degradation. Required Actions C.1 and C.2 address this potential (as well as provisions in Specification 5.5.11, Battery Monitoring and Maintenance Program). They are modified by a note that indicates they are only applicable if electrolyte level is below the top of the plates. **A note for Condition C also assures that the Required Action C.2, verify no evidence of leakage, is completed whenever the electrolyte level is detected to be below the top of the plates.** Within 8 hours level is required to be restored to above the top of the plates. The Required Action C.2 requirement to verify that there is no leakage by visual inspection and the Specification 5.5.11.b item to initiate action to equalize and test in accordance with manufacturer's recommendation are taken from ~~Annex D of~~ IEEE Standard 450~~-1995~~. They are performed following the restoration of the electrolyte level to above the top of the plates. Based on the results of the manufacturer's recommended testing the batteries may have to be declared inoperable and the affected cells replaced.

BASES

ACTIONS (continued)

D.1

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

E.1

With one or more batteries in two or more Divisions with battery parameters not within limits there is not sufficient assurance that battery capacity has not been affected to the degree that the batteries can still perform their required function, given that redundant batteries are involved. With redundant batteries involved this potential could result in a total loss of function on multiple systems that rely upon the batteries. The longer Completion Times specified for battery parameters on non-redundant batteries not within limits are therefore not appropriate, and the parameters must be restored to within limits in three Divisions within 2 hours.

F.1

With one or more batteries with any battery parameter outside the allowances of the Required Actions for Condition A, B, C, D, or E, sufficient capacity to supply the maximum expected load requirement is not assured and the corresponding battery must be declared inoperable. Additionally, discovering one or more batteries in one Division with one or more battery cells float voltage less than **[**2.07**]** V and float current greater than **[**2**]** amps indicates that the battery capacity may not be sufficient to perform the intended functions. The battery must therefore be declared inoperable immediately.

BASES

SURVEILLANCE REQUIREMENTS

SR 3.8.7.1

Verifying battery float current while on float charge is used to determine the state of charge of the battery. Float charge is the condition in which the charger is supplying the continuous charge required to overcome the internal losses of a battery and maintain the battery in a charged state. The float current requirements are based on the float current indicative of a charged battery. Use of float current to determine the state of charge of the battery is consistent with IEEE-450 (Ref. 3). The 7 day Frequency is consistent with IEEE-450 (Ref. 3).

This SR is modified by a Note that states the float current requirement is not required to be met when battery terminal voltage is less than the minimum established float voltage of SR 3.8.1.1. When this float voltage is not maintained the Required Actions of LCO 3.8.1 ACTION A are being taken, which provide the necessary and appropriate verifications of the battery condition. Furthermore, the float current limit of **[**2**]** amps is established based on the nominal float voltage value and is not directly applicable when this voltage is not maintained.

SR 3.8.7.2 and SR 3.8.7.5

Optimal long term battery performance is obtained by maintaining a float voltage greater than or equal to the minimum established design limits provided by the battery manufacturer, which corresponds to 264.0 V at the battery terminals, or 2.20 Volts per cell. This provides adequate over-potential, which limits the formation of lead sulfate and self discharge, which could eventually render the battery inoperable. Float voltages in this range or less, but greater than **[**2.07**]** Volts per cell, are addressed in Specification 5.5.11. SRs 3.8.7.2 and 3.8.7.5 require verification that the cell float voltages are equal to or greater than the short term absolute minimum voltage of **[**2.07**]** V. The Frequency for cell voltage verification every 31 days for pilot cell and 92 days for each connected cell is consistent with IEEE-450 (Ref. 3).

SR 3.8.7.3

The limit specified for electrolyte level ensures that the plates suffer no physical damage and maintains adequate electron transfer capability. The Frequency is consistent with IEEE-450 (Ref. 3).

BASES

SURVEILLANCE REQUIREMENTS (continued)

SR 3.8.7.4

This Surveillance verifies that the pilot cell temperature is greater than or equal to the minimum established design limit (i.e., 60°F). Pilot cell electrolyte temperature is maintained above this temperature to assure the battery can provided the required current and voltage to meet the design requirements. Temperatures lower than assumed in battery sizing calculations act to inhibit or reduce battery capacity. The Frequency is consistent with IEEE-450 (Ref. 3).

SR 3.8.7.6

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

Either the battery performance discharge test or the modified performance discharge test is acceptable for satisfying SR 3.8.7.6; however, only the modified performance discharge test may be used to satisfy the battery service test requirements of SR 3.8.1.3. **This Surveillance may be performed during any plant condition with the spare battery and charger providing power to the bus.**

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

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

BASES

SURVEILLANCE REQUIREMENTS (continued)

The acceptance criteria for this Surveillance are consistent with IEEE-450 (Ref. 3) and IEEE-485 (Ref. 4). These references recommend that the battery be replaced if its capacity is below 80% of the manufacturer's rating. A capacity of 80% shows that the battery rate of deterioration is increasing, even if there is ample capacity to meet the load requirements. Furthermore, the battery is sized to meet the assumed duty cycle loads when the battery design capacity reaches this 80% limit.
The Surveillance Frequency for this test is normally 60 months. If the battery shows degradation, or if the battery has reached 85% of its expected life and capacity is < 100% of the manufacturer's rating, the Surveillance Frequency is reduced to 12 months. However, if the battery shows no degradation but has reached 85% of its expected life, the Surveillance Frequency is only reduced to 24 months for batteries that retain capacity ≥ 100% of the manufacturer's ratings. Degradation is indicated, according to IEEE-450 (Ref. 3), when the battery capacity drops by more than 10% relative to its capacity on the previous performance test or when it is ≥ 10% below the manufacturer's rating. These Frequencies are consistent with the recommendations in IEEE-450 (Ref. 3).

~~This SR is modified by a Note. The reason for the Note is that performing the Surveillance would perturb the electrical distribution system and challenge safety systems. 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.~~

BASES

REFERENCES

1. Chapter 6, “Engineered Safety Features.”

2. Chapter 15, “Accident Analyses.”

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

4. IEEE-485-1983, June 1983.

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

3.8.7 Battery Parameters

LCO 3.8.7 Battery Parameters for Division A, B, C, and D DC electrical power subsystem batteries shall be within limits.

APPLICABILITY: When associated DC electrical power sources are required to be OPERABLE.

ACTIONS

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

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One or more batteries in one division with one or more battery cells float voltage < [2.07] V.	A.1 Perform SR 3.8.1.1. AND A.2 Perform SR 3.8.7.1. AND A.3 Restore affected cell voltage ≥ [2.07] V.	2 hours 2 hours 24 hours
B. One or more batteries in one division with float current > [2] amps.	B.1 Perform SR 3.8.1.1. AND B.2 Restore battery float current to ≤ [2] amps.	2 hours 24 hours

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
----------NOTE---------- Required Action C.2 shall be completed if electrolyte level was below the top of plates ----------	----------NOTE---------- Required Actions C.1 and C.2 are only applicable if electrolyte level was below the top of plates ----------	
C. One or more batteries in one division with one or more cells electrolyte level less than minimum established design limits.	C.1 Restore electrolyte level to above top of plates. AND C.2 Verify no evidence of leakage. AND C.3 Restore electrolyte level to greater than or equal to minimum established design limits.	8 hours 12 hours 31 days
D. One or more batteries in one division with pilot cell electrolyte temperature less than minimum established design limits.	D.1 Restore battery pilot cell temperature to greater than or equal to minimum established design limits.	12 hours
E. One or more batteries in two or more divisions with battery parameters not within limits.	E.1 Restore battery parameters for batteries in three divisions to within limits.	2 hours

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
F. Required Action and associated Completion Time not met. OR One or more batteries in one division with one or more battery cells float voltage < [2.07] V and float current > [2] amps.	F.1 Declare associated battery inoperable.	Immediately

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
3.8.7.1	----------NOTE---------- Not required to be met when battery terminal voltage is less than the minimum established float voltage of SR 3.8.1.1. ---------- Verify each battery float current is ≤ [2] amps.	7 days
3.8.7.2	Verify each battery pilot cell float voltage is ≥ [2.07] V.	31 days
3.8.7.3	Verify each battery connected cell electrolyte level is greater than or equal to minimum established design limits.	31 days
3.8.7.4	Verify each battery pilot cell temperature is greater than or equal to minimum established design limits.	31 days

SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE		FREQUENCY
3.8.7.5	Verify each battery connected cell float voltage is ≥ [2.07] V.	92 days
3.8.7.6	Verify battery capacity is ≥ 80% of the manufacturer's rating when subjected to a performance discharge test or a modified performance discharge test.	60 months AND 12 months when battery shows degradation, or has reached 85% of the expected life with capacity < 100% of manufacturer's rating AND 24 months when battery has reached 85% of the expected life with capacity ≥ 100% of manufacturer's rating

B 3.8 ELECTRICAL POWER SYSTEMS

B 3.8.7 Battery Parameters

BASES

BACKGROUND

LCO 3.8.7, Battery Parameters, delineates the limits on electrolyte temperature, level, float voltage and specific gravity for the DC power source batteries. A discussion of these batteries and their OPERABILITY requirements is provided in the Bases for LCO 3.8.1, “DC Sources - Operating,” and LCO 3.8.2, “DC Sources - Shutdown.” In addition to the limitations of this Specification, the licensee controlled program also implements a program specified in Specification 5.5.11 for monitoring various battery parameters.

APPLICABLE SAFETY ANALYSES

The initial conditions of Design Basis Accident (DBA) and transient analyses in Chapter 6 (Ref. 1), and Chapter 15 (Ref. 2), assume engineered safety features are OPERABLE. The DC electrical power system provides normal and emergency DC electrical 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 DC subsystems is consistent with the initial assumptions of the accident analyses and is based upon meeting the design basis of the unit. 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.

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

BASES

LCO

Battery parameters must remain within acceptable limits to ensure availability of the required DC power to shut down the reactor and maintain it in a safe condition after an anticipated operational occurrence or a postulated DBA. Battery parameter limits are conservatively established, allowing continued DC electrical system function even with limits not met. Additional preventative maintenance, testing, and monitoring performed in accordance with the licensee controlled program is conducted as specified in Specification 5.5.11.

APPLICABILITY

The battery parameters are required solely for the support of the associated DC electrical power subsystems. Therefore, battery parameter limits are only required when the DC power source is required to be OPERABLE. Refer to the Applicability discussion in Bases for LCO 3.8.1, and LCO 3.8.2.

ACTIONS

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

With one or more cells in one or more batteries in one Division < [2.07] V, the battery cell is degraded. Within 2 hours verification of the required battery charger, OPERABILITY is made by monitoring the battery terminal voltage (SR 3.8.1.1) and of the overall battery state of charge by monitoring the battery float charge current (SR 3.8.7.1). This assures that there is still sufficient battery capacity to perform the intended function. Therefore, the affected battery is not required to be considered inoperable solely as a result of one or more cells in one or more batteries < [2.07] V, and continued operation is permitted for a limited period up to 24 hours.

Since the Required Actions only specify “perform,” a failure of SR 3.8.1.1 or SR 3.8.7.1 acceptance criteria does not result in this Required Action not met. However, if one of the SRs is failed the appropriate Condition(s), depending on the cause of the failures, is entered. If SR 3.8.7.1 is failed then there is no assurance that there is still sufficient battery capacity to perform the intended function and the battery must be declared inoperable immediately.

BASES

ACTIONS (continued)

B.1 and B.2

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

If the float voltage is found to be satisfactory but there are one or more battery cells with float voltage less than [2.07] V, the associated "OR" statement in Condition F is applicable and the battery must be declared inoperable immediately. If float voltage is satisfactory and there are no cells less than [2.07] V there is good assurance that, within 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 a temporary loss of the battery charger.

A discharged battery with float voltage (the charger setpoint) across its terminals indicates that the battery is on the exponential charging current portion (the second part) of its recharge cycle. The time to return a battery to its fully charged state under this condition is simply a function of the amount of the previous discharge and the recharge characteristic of the battery. Thus there is good assurance of fully recharging the battery within 24 hours, avoiding a premature shutdown with its own attendant risk.

BASES

ACTIONS (continued)

If the condition is due to one or more cells in a low voltage condition but still greater than [2.07] V and float voltage is found to be satisfactory, this is not indication of a substantially discharged battery and 24 hours is a reasonable time prior to declaring the battery inoperable.

Since Required Action B.1 only specifies “perform,” a failure of SR 3.8.1.1 acceptance criteria does not result in the Required Action not met. However, if SR 3.8.1.1 is failed, the appropriate Condition(s), depending on the cause of the failure, is entered.

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

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

With electrolyte level below the top of the plates there is a potential for dryout and plate degradation. Required Actions C.1 and C.2 address this potential (as well as provisions in Specification 5.5.11, Battery Monitoring and Maintenance Program). They are modified by a note that indicates they are only applicable if electrolyte level is below the top of the plates. A note for Condition C also assures that the Required Action C.2, verify no evidence of leakage, is completed whenever the electrolyte level is detected to be below the top of the plates. Within 8 hours level is required to be restored to above the top of the plates. The Required Action C.2 requirement to verify that there is no leakage by visual inspection and the Specification 5.5.11.b item to initiate action to equalize and test in accordance with manufacturer’s recommendation are taken from IEEE Standard 450. They are performed following the restoration of the electrolyte level to above the top of the plates. Based on the results of the manufacturer’s recommended testing the batteries may have to be declared inoperable and the affected cells replaced.

BASES

ACTIONS (continued)

D.1

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

E.1

With one or more batteries in two or more Divisions with battery parameters not within limits there is not sufficient assurance that battery capacity has not been affected to the degree that the batteries can still perform their required function, given that redundant batteries are involved. With redundant batteries involved this potential could result in a total loss of function on multiple systems that rely upon the batteries. The longer Completion Times specified for battery parameters on non-redundant batteries not within limits are therefore not appropriate, and the parameters must be restored to within limits in three Divisions within 2 hours.

F.1

With one or more batteries with any battery parameter outside the allowances of the Required Actions for Condition A, B, C, D, or E, sufficient capacity to supply the maximum expected load requirement is not assured and the corresponding battery must be declared inoperable. Additionally, discovering one or more batteries in one Division with one or more battery cells float voltage less than [2.07] V and float current greater than [2] amps indicates that the battery capacity may not be sufficient to perform the intended functions. The battery must therefore be declared inoperable immediately.

BASES

SURVEILLANCE REQUIREMENTS

SR 3.8.7.1

Verifying battery float current while on float charge is used to determine the state of charge of the battery. Float charge is the condition in which the charger is supplying the continuous charge required to overcome the internal losses of a battery and maintain the battery in a charged state. The float current requirements are based on the float current indicative of a charged battery. Use of float current to determine the state of charge of the battery is consistent with IEEE-450 (Ref. 3). The 7 day Frequency is consistent with IEEE-450 (Ref. 3).

This SR is modified by a Note that states the float current requirement is not required to be met when battery terminal voltage is less than the minimum established float voltage of SR 3.8.1.1. When this float voltage is not maintained the Required Actions of LCO 3.8.1 ACTION A are being taken, which provide the necessary and appropriate verifications of the battery condition. Furthermore, the float current limit of [2] amps is established based on the nominal float voltage value and is not directly applicable when this voltage is not maintained.

SR 3.8.7.2 and SR 3.8.7.5

Optimal long term battery performance is obtained by maintaining a float voltage greater than or equal to the minimum established design limits provided by the battery manufacturer, which corresponds to 264.0 V at the battery terminals, or 2.20 Volts per cell. This provides adequate over-potential, which limits the formation of lead sulfate and self discharge, which could eventually render the battery inoperable. Float voltages in this range or less, but greater than [2.07] Volts per cell, are addressed in Specification 5.5.11. SRs 3.8.7.2 and 3.8.7.5 require verification that the cell float voltages are equal to or greater than the short term absolute minimum voltage of [2.07] V. The Frequency for cell voltage verification every 31 days for pilot cell and 92 days for each connected cell is consistent with IEEE-450 (Ref. 3).

SR 3.8.7.3

The limit specified for electrolyte level ensures that the plates suffer no physical damage and maintains adequate electron transfer capability. The Frequency is consistent with IEEE-450 (Ref. 3).

BASES

SURVEILLANCE REQUIREMENTS (continued)

SR 3.8.7.4

This Surveillance verifies that the pilot cell temperature is greater than or equal to the minimum established design limit (i.e., 60°F). Pilot cell electrolyte temperature is maintained above this temperature to assure the battery can provided the required current and voltage to meet the design requirements. Temperatures lower than assumed in battery sizing calculations act to inhibit or reduce battery capacity. The Frequency is consistent with IEEE-450 (Ref. 3).

SR 3.8.7.6

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

Either the battery performance discharge test or the modified performance discharge test is acceptable for satisfying SR 3.8.7.6; however, only the modified performance discharge test may be used to satisfy the battery service test requirements of SR 3.8.1.3. This Surveillance may be performed during any plant condition with the spare battery and charger providing power to the bus.

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

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

BASES

SURVEILLANCE REQUIREMENTS (continued)

The acceptance criteria for this Surveillance are consistent with IEEE-450 (Ref. 3) and IEEE-485 (Ref. 4). These references recommend that the battery be replaced if its capacity is below 80% of the manufacturer's rating. A capacity of 80% shows that the battery rate of deterioration is increasing, even if there is ample capacity to meet the load requirements. Furthermore, the battery is sized to meet the assumed duty cycle loads when the battery design capacity reaches this 80% limit.
The Surveillance Frequency for this test is normally 60 months. If the battery shows degradation, or if the battery has reached 85% of its expected life and capacity is < 100% of the manufacturer's rating, the Surveillance Frequency is reduced to 12 months. However, if the battery shows no degradation but has reached 85% of its expected life, the Surveillance Frequency is only reduced to 24 months for batteries that retain capacity ≥ 100% of the manufacturer's ratings. Degradation is indicated, according to IEEE-450 (Ref. 3), when the battery capacity drops by more than 10% relative to its capacity on the previous performance test or when it is ≥ 10% below the manufacturer's rating. These Frequencies are consistent with the recommendations in IEEE-450 (Ref. 3).

REFERENCES

1. Chapter 6, "Engineered Safety Features."
2. Chapter 15, "Accident Analyses."
3. IEEE-450.
4. IEEE-485-1983, June 1983.