NEI

NUCLEAR ENERGY INSTITUTE

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September 18, 2000

Dr. William D. Beckner, Branch Chief
Technical Specifications Branch
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

SUBJECT: Forwarding Response to Battery TSTF Proposal

REFERENCE: NRC letter dated August 11, 2000, "Proposed Modifications to TSTF 360, Requirements for DC Sources"

PROJECT NUMBER: 689

Dear Dr. Beckner:

Enclosed is the NEI Technical Specification Task Force (TSTF) response to the comments provided in Enclosure 2 of the Reference. This response provides concurrence and recommended changes as appropriate. It addresses the proposed corresponding Bases changes and includes the recommended changes as markups of affected TS and Bases pages provided by the Reference. A formal revision to the entire TSTF-360 package will follow, pending discussions of the acceptability of the enclosed recommendations.

The industry is appreciative of the efforts made and progress achieved that are reflected in the Reference. The recommended changes to the *Improved Standard Technical Specifications* 3.8.4, 3.8.5 and 3.8.6 reflect a significant improvement in and positive steps toward providing appropriate Technical Specifications for the DC Electrical System.

Please contact me at (202) 739-8105 or Vince Gilbert at (202) 739-8138 if you have any questions or need to meet with industry experts on these recommended changes.

Sincerely,

James W. Davis

Enclosures

NRC Comment #1: With this NRC change, battery terminal voltage will only be allowed to be less than minimum-float-voltage for 2 hours. This limitation is being applied even if the battery is not discharging, including conditions where the battery is known to be charged sufficiently to be considered operable or is being returned to a fully charged state at the maximum rate allowed by the charger design. See detailed discussion below (paraphrased from input provided by Kyle Floyd). This discussion inter-relates this Comment and NRC Comment #2:

> *For those plants with appreciable house loads and an adequate charger they may still have problems getting back to minimum established float voltage within 2 hours. Assume a charger rated at 150 A at current limit and a house load of 80 A. If the charger fails and the battery discharges for 2 hours before the charger is restored, the charge removed from the battery is 160 A-h (80 X 2). Ignoring recharge efficiency, the time required for the voltage to recover to the minimum established float voltage could be 2.5 hours (160/(150-80)). Since the battery terminal voltage may be less than the minimum established float voltage during current limit mode, this would violate the NRC proposed limits under 3.8.4, Action A.1. Any battery terminal voltage greater than open circuit voltage at 2-hours should be acceptable for demonstrating that adequate actions towards complete restoration are being made.*
>
> *The Industry proposal determined that the battery was not discharging within 2 hours (Required Action A.1). This in effect establishes that there is a charger connected to the battery and that it is at least carrying the house load. However, it doesn't require the battery terminal voltage to be at the float voltage level, which may be very difficult to achieve and is a needless requirement at the time, as noted above. Required Action A.2 is the assessment of the battery terminal voltage, float charging current, and other factors to determine the battery state of charge. However, it doesn't require the unnecessary restriction on float charging current at or below [2] amps within 12 hours. Any battery having an exponential current time constant $\geq$ 2.4 hours may not be below it's float current limit in 12 hours (12/5 time constants = 2.4) (there is at least one plant with a known 3 hour time constant).*
>
> *After reviewing this proposal as a whole, one of two approaches should be chosen for Required Action A.2 (see further discussion following the summary of approaches):*
> *(1) The 12-hour completion time for restoring the charge to the battery should be a plant-specific, bracketed value, as long as we are using the [2] amp float current as the acceptance limit; or*
> *(2) Retain the true operability limit of [10] amps with the 12 hour Completion Time.*
>
> *By restricting the exponential portion of the recharge to 12 hours, we have effectively added a new design constraint that must be met. Since the system characteristics (battery & charger size, voltage limitations, etc) are already established, the remaining choices are to reduce the house load during this contingency or to supplement the charging system with an additional temporary charger. A better approach is to establish the recharge limit based on specific battery system characteristics. For example, for a system with a 3 hour time constant, the proper time limit is 15 hours. Or better yet, we could recognize that the amount of charge returned between 2 and 5 time constants is less than 10 % of the total under the curve and much less than 10% of the total recharge. The exponential current characteristic response has been around for a long time. (Woodbridge wrote of it in his paper, "Storage Battery Charging" in 1935.) Using [10] amp limit which occurs at 2 time constants, we would have a better intermediate benchmark occurring much earlier on the exponential. With this change, a completion time of 12 hours or less could be supported.*

TSTF POSITION:

(a) Required Action A.2 Completion Time of 12 hours should be considered for extension based on plant-specific design issues. As such it is requested that "12" hours be bracketed.

NRC Comment #2: (also related to Comment #7) Within 12 hours of battery charger inop (and getting the battery charger > minimum-float-voltage within 2 hours – Required Action A.1) the change requires that the battery must be fully charged (<[2] amps) in 12 hours. The original TSTF proposal was to require adequate determination that the battery was capable of performing its intended function within 12 hrs (and 24 hrs to get < [2] amps per 3.8.6 Action B <see Cmt #7>).

TSTF POSITION:

(a) Required Action A.2 Completion Time of 12 hours should be considered for extension based on plant-specific design issues. As such it is requested that "12" hours be bracketed.

NRC Comment #3: The NRC corrected an editorial oversight in SR 3.8.4.2 of the original submittal when it did not state "greater than or equal to".

TSTF POSITION:

(a) The TSTF accepts this change.

NOTE: The marked change of "[4]" to "[8]" in SR 3.8.4.1 was actually a correction penciled-in the TSTF at the time of our submittal. If reflected a "typo" in that we had not justified any change from the "[8]" in TSTF-360. As such the NRC did not comment on this markup (it was not their change). It is intended to leave the "[8]" and pursue any future changes to this value independently of TSTF-360.

NRC Comment #4: NRC proposes a new 5.5.x Program which requires monitoring and maintenance of the batteries based on IEEE-450. The TSTF change was drafted to relocate several IEEE-450 activities to "a licensee controlled program" (intent being the TRM). It is not exceedingly clear whether the NRC intended all these relocations to be within the 5.5.x Program, or just the critical [2.13] V actions.

TSTF POSITION:

(a) Assuming we limit the new Administrative Program to specific issues (cell voltage < [2.13] v) and not all of IEEE-450 monitoring and maintenance, the TSTF is willing to accept the NRC proposal as an interim position pending further discussions. Refer to the proposed re-wording to clarify the extent of the 5.5.x Program (refer to Comment #8 related to proposed Program Item 5.5.x.b). The remainder of a plant's battery maintenance and monitoring program is or had been agreed to be adequately controlled without placing it within the confines of a Technical Specification Program. Also, note the elimination of the specific reference to the version of IEEE-450, which allows future programmatic upgrades to approved standards without necessitating a License amendment. The committed to version of IEEE-450 does appear within the Bases.

5.5.x Battery Monitoring and Maintenance Program

This Program provides for restoration and maintenance , based on [the recommendations of IEEE Standard 450, "IEEE Recommended Practice for Maintenance, Testing , and Replacement of Vented Lead-Acid Batteries For Stationary Applications," or of the battery manufacturer] of the following:

a. Actions to restore battery cells with float voltage < [2.13] V, and

b. Actions to equalize and test battery cells that had been discovered with electrolyte level below the minimum established design limit.

NRC Comment #5: The NRC change limits battery parameter degradations to only one train/division at one time. NRC does give new Action E to allowing 2 hours if both trains/divisions are affected (avoiding LCO 3.0.3).

TSTF POSITION:

(a) Since the degradations in any train/division are not intended to reflect inoperability, it is reasonable to allow activities for concurrent restoration on both train/divisions; however, given the likelihood of both trains/divisions being concurrently affected is somewhat remote, the TSTF is willing to accept these changes.

NRC Comment #6: The NRC adds a formal verification that no charger problem exists as Required Action B.1 to 3.8.6.

TSTF POSITION:

(a) The TSTF is willing to accept this change.

NRC Comment #7: The NRC proposes to revise the actions in 3.8.6 for battery float current above [2] amps: ANY float current above [2] amps is OK for 12 hours (not limited to [10] amps); but ONLY for 12 hours; not the 24 hours originally proposed.

TSTF POSITION:

(a) The TSTF is willing to accept this change. However, consistent with the reply related to Comment #2, the Completion Time of 12 hours should be considered for extension based on plant-specific design issues. As such it is requested that "12" hours be bracketed.

NRC Comment #8: The NRC proposes changes for recovery of electrolyte level. The NRC deleted the verification of cell voltage, replaced it with leakage inspection and "Initiate action to equalize and test...".

TSTF POSITION:

With these comments, the TSTF accepts these changes:

(a) Required Action C.3, "Initiate action to equalize and test..." is proposed to be relocation to the new 5.5.x Program (see INSERT proposed in Comment #4). This Action is similar in nature to the other item (follow-on activities for fully restoring a cell whose voltage is < [2.13] V) the NRC is proposing for the Program; that is it is a follow-on activity for full restoration that can be adequately guided by the Administrative Control Program.

(b) For editorial ITS presentation consistency, eliminate the "by visual inspection" from Required Action C.2. The "how-to" of any action or surveillance is not conventionally included within the Specifications, and is considered Bases material.

NRC Comment #9: NRC proposes a limitation in a new portion of Condition F. The change results in no allowance for concurrent single cell < 2.07 V & battery float current >[2] amps. rs)?

TSTF POSITION:

With these editorial comments, the TSTF accepts these changes:

(a) Add "battery" to "float current" in the added portion of Condition F.

(b) "one battery cells" in the hand-marked added portion of Condition F should be "one or more battery cells" to match the re-typed version.

(b) For 3.8.6 Action E it is proposed to change "cell" to "battery" in the Condition and the Required Action. This will match the Specification title.

Responses to Selected Bases Changes

NOTE: *Italicized* discussions below are paraphrased from input provided by various Industry battery experts.

INSERT: Battery Capacity

(1) *It's not clear why all the wording was added to replace the simple word "bounding." There may be more than one design basis event, but there is only one bounding with respect to determining battery capacity. The existing wording should remain.*

(2) *The addition of station blackout considerations in the battery capacity Bases is confusing because there is no specific context in terms of surveillance testing. It should be noted that the [18] month service test cannot be modified to envelope both the LOOP/LOCA loads and the SBO loads. The issue of SBO being in the Bases is of serious concern. Sizing criteria is based upon the design duty cycle -- it is not based upon SBO.*

TSTF POSITION:

(a) The addition of the bracketed SBO discussions should be deleted from the Insert.

INSERT: SR 3.8.4.2 Bases

(1) *3rd. par. - The inserted wording should read "largest coincident demand..." to make it clear that if some of the loads have a definite sequence established such that they are non-coincident, they need not be combined.*

TSTF POSITION:

(a) Incorporate recommended change.

NEW INSERT: 3.8.4 ACTION Bases, A.1, A.2, A.3

(1) *Suggest rewording of para. 1, 6th sentence to read: "A discharged battery having a terminal voltage of at least the minimum established float voltage indicates..."*

Also, the 12 hours in the last sentence should be changed to match the final resolution of the TS completion times discussed in comment 7 above.

(2) *Suggest rewording of para. 2, 1st sentence to read: "If the battery terminal voltage cannot be restored to greater than or equal to the minimum established float voltage within 2 hours, and the charger is not operating in the current-limit mode, a faulty charger is indicated."*

(3) *Suggest rewording of para. 3, 1st sentence to read: "If the charger...after 2 hours, that is an indication that the battery is partially discharged and its capacity margins will be reduced."*

More information would be needed to make a determination that the battery cannot perform its design function. However, the reworded sentence is correct for all situations.

Note: Similar changes should be made to the 3.8.5 and 3.8.6 ACTION Bases as well.

TSTF POSITION:

(a) Incorporate recommended changes.

3.8 ELECTRICAL POWER SYSTEMS

3.8.4 DC Sources – Operating

LCO 3.8.4 The {Train A and Train B} DC electrical power subsystems shall be OPERABLE.

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

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One [or two] battery charger[s on one {train}] inoperable.	A.1 Restore battery terminal voltage to greater than or equal to the minimum established float voltage.	2 hours
	AND	
	A.2 Verify battery float current ≤ [2] amps.	Once per [12] hours
	AND	
	A.3 Restore battery charger[s] to OPERABLE status.	7 days

3.8 ELECTRICAL POWER SYSTEMS

3.8.5 DC Sources – Shutdown

LCO 3.8.5 DC electrical power subsystem shall be OPERABLE to support the DC electrical power distribution subsystem(s) required by LCO 3.8.10, "Distribution Systems - Shutdown."

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

ACTIONS

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

CONDITION	REQUIRED ACTION	COMPLETION TIME
B. One [or two] batter[y][ies on one train] with float current > [2] amps.	B.1 Perform SR 3.8.4.1. AND B.2 Restore battery float current to ≤ [2] amps.	2 hours [12] hours

CONDITION	REQUIRED ACTION	COMPLETION TIME
----------NOTE---------- Required Actions C.2 and C.3 shall be completed if electrolyte level was below the top of plates. ----------	----------NOTE---------- Required Actions C.1 and C.2. and C.3 are only applicable if electrolyte level was below the top of plates. ----------	
C. One [or two] batter[y][ies on one train] with one or more cells electrolyte level less than minimum established design limits.	C.1 Restore electrolyte level to above top of plates.	8 hours
	AND	
	C.2 Verify no evidence of leakage by visual inspection.	12 hours
	AND	
	C.3 Initiate action to equalize and test in accordance with manufacturer's recommendation.	12 hours
	AND	
	C.3 Restore electrolyte level to greater than or equal to minimum established design limits.	31 days

CONDITION	REQUIRED ACTION	COMPLETION TIME
D. One [or two] batter[y][ies on one train] 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 redundant trains with cell parameters not within limits.	E.1 Restore cell parameters for batteries in one train to within limits. battery	2 hours
F. Required Actions and associated Completion Time of Condition A, B, C, D, or E not met. OR One [or two] battery[y][ies on one train] with one or more battery cells float voltage < [2.07] V and float current > [2] amps.	F.1 Declare associated battery inoperable. ADD TO MARKUP VERSION	Immediately

SURVEILLANCE REQUIREMENTS

Insert for Section 5.5

5.5.X Battery Monitoring and Maintenance Program

This program provides for battery monitoring and maintenance 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." The program shall include, but not be limited to, the following:

Provisions for taking the battery manufacturer's prescribed actions when one or more battery cells' float voltage is found < [2.13] V.

5.5.x Battery Monitoring and Maintenance Program

This Program provides for restoration and maintenance , based on [the recommendations of IEEE Standard 450, "IEEE Recommended Practice for Maintenance, Testing , and Replacement of Vented Lead-Acid Batteries For Stationary Applications," or of the battery manufacturer] of the following:

a. Actions to restore battery cells with float voltage < [2.13] V, and

b. Actions to equalize and test battery cells that had been discovered with electrolyte level below the minimum established design limit.

~~[Each battery also has adequate charge capacity to meet the assumed duty cycle for the station blackout event.]~~

INSERT: Battery Capacity

STET

... meet the assumed duty cycle for the ~~bounding~~ design basis event. Additional margin is designed and supports the ability of the battery to carry the DC loads continuously for ~~approximately~~ [2] hours as discussed in the FSAR, Chapter [8] (Ref. 4).

at least

in the design basis event scenario

~~[and for at least [4] hours in the station blackout scenario]~~

INSERT: Vpc Bases

... The minimum design voltage limit is 105/210 V.

The battery cells are of flooded lead acid construction with a nominal specific gravity of [1.215]. This specific gravity corresponds to an open circuit battery voltage of approximately 120 V for a [58] cell battery (i.e., cell voltage of [2.065] volts per cell (Vpc)). The open circuit voltage is the voltage maintained when there is no charging or discharging. Once fully charged with its open circuit voltage ≥ [2.065] Vpc, the battery cell will maintain its capacity for [30] days without further charging per manufacturer's instructions. Optimal long term performance however, is obtained by maintaining a float voltage [2.22 to 2.28] Vpc. This provides adequate over-potential which limits the formation of lead sulfate and self discharge. The nominal float voltage of [2.25] Vpc corresponds to a total float voltage output of [130.5] V for a [58] cell battery as discussed in the FSAR, Chapter [8] (Ref. 4).

INSERT: Charger

~~This charging capacity exceeds the minimum requirements for the charger to support the required DC loads in analyzed accidents. This excess capability supports minimizing the operational limitations imposed on battery testing and associated recharging.~~

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

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

INSERT: 3.8.4 ACTION Bases (continued)

B.1

REVIEWERS NOTE

Delete ACTION B if Required Action B.1 Completion Time is the same as Required Action C.1 Completion Time. A [12] hour Completion Time may be considered for Required Action B.1 (as outlined in the optional Bases provided at the end of the Required Action B.1 Bases below) based on compensatory factors acceptable to the NRC Staff.

Replace with New Insert: 3.8.4 ACTION Bases

Condition B represents one {PWR: train}{BWR: division} with one [or two] batter[y][ies] inoperable. With one [or two] batter[y][ies] 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 to that {train}. Therefore, it is imperative that the operator's attention focus on stabilizing the unit, thereby minimizing the potential for complete loss of DC power to the affected {train}. The [2] hour limit allows sufficient time to effect restoration of an inoperable battery while minimizing the risk of a loss of AC power to the associated battery charger as a result of imposing a required unit shutdown. During this time, additional single failures are not required to be assumed. Therefore, even in the event of a loss of offsite power (alone or in conjunction with a DBA), the battery charger will be expected to restore power to the DC subsystem after the associated diesel generator is connected. [As such, 12 hours is an acceptable extension to the period allowed for: 1) loss of both the battery and the charger (LCO 3.8.4, Condition C), or 2) for the complete deenergization of the DC bus (LCO 3.8.9, ACTIONS).]

INSERT: SR 3.8.4.1 Bases

..., while supplying the continuous steady state loads of the associated DC subsystem. On float charge, battery cells will receive adequate current to optimally charge the battery. The voltage requirements are based on the nominal design voltage of the battery and are consistent with the minimum float voltage established by the battery manufacturer ([2.25] Vpc or [130.5] V at the battery terminals). This voltage maintains the battery plates in a condition that supports maintaining the grid life (expected to be approximately 20 years).

INSERT: SR 3.8.4.2 Bases

Coincident

This charging capacity exceeds the minimum requirements for the charger to support the required DC loads in analyzed accidents. This excess capability supports minimizing the operational limitations imposed on battery testing and associated recharging.

[8]

expect combined demands of the various continuous steady state loads (irrespective of the status of the plant during which these demands occur). The level of loading may not normally be is available following the battery service test and will need to supplemented with additional loads.

This SR provides two options. One option requires that each battery charger be capable of supplying [400] amps at the minimum established float voltage for [4] hours. The ampere requirements are based on the output rating of the chargers. The voltage requirements are based on the charger voltage level after a response to a loss of AC power. The 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 ~~expected normal operating loads~~. The duration for this test may be longer than the charger sizing criteria since the battery recharge is affected by float voltage, temperature, and the exponential decay in charging current. The battery is recharged when the measured charging current is ≤ [2] amps.

B.1

----------REVIEWERS NOTE----------

The 2 hour Completion Times of Required Actions B.1 and C.1 are in brackets. Any 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 Regulatory Guide (RG) 1.177, "An Approach for Plant-Specific, Risk-Informed Decision Making: Technical Specifications."

Condition B represents one {PWR: train}{BWR: division} with one [or two] batter[y][ies] inoperable. With one [or two] batter[y][ies] 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 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.) likely rely upon the batter[y][ies]. 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 batter[y][ies] will not be able to be brought online. 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 3.8.4, 3.8.5, and 3.8.6 together with additional specific completion times.

NEW INSERT: 3.8.5 ACTION Bases

.....

Condition A represents one {PWR: train}{BWR: division} with one [or two] battery chargers inoperable (e.g., the voltage limit of SR 3.8.4.1 is not maintained). The ACTIONS provide a tiered response that focuses on returning the battery to the fully charged state and restoring a fully qualified charger to OPERABLE status in a reasonable time period. Required Action A.1 requires that the battery terminal voltage be restored to greater than or equal to the minimum established float voltage within 2 hours. This time provides for returning the inoperable charger to OPERABLE status or providing an alternate means of restoring battery terminal voltage to greater than or equal to the minimum established float voltage. Restoring the battery terminal voltage to greater than or equal to the minimum established float voltage provides good assurance that, within [12] hours, the battery will be restored to its fully charged condition (Required Action A.2) from any discharge that might have occurred due to the charger inoperability. A discharged battery ~~with float voltage (the charger setpoint) across its terminals~~ indicates that the battery is on the exponential charging current portion (the second part) of its recharge cycle. The time to return a battery to its fully charged state under this condition is simply a function of the amount of the previous discharge and the recharge characteristic of the battery. Thus there is good assurance of fully recharging the battery within [12] hours, avoiding a premature shutdown with its own attendant risk.

having terminal voltage of at least the minimum established float voltage

If established battery terminal float voltage cannot be restored to ~~the battery terminals within 2 hours, that is an indication that the battery charger (primary or alternate) across the battery is faulty or is operating in the current limit mode~~. 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.

greater than or equal to the minimum established float voltage within 2 hours, and the charger is not operating in the current-limiting mode, a faulty charger is indicated.

NEW INSERT: 3.8.4 ACTION Bases

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

Condition A represents one {PWR: train}{BWR: division} with one [or two] battery chargers inoperable (e.g., the voltage limit of SR 3.8.4.1 is not maintained). The ACTIONS provide a tiered response that focuses on returning the battery to the fully charged state and restoring a fully qualified charger to OPERABLE status in a reasonable time period. Required Action A.1 requires that the battery terminal voltage be restored to greater than or equal to the minimum established float voltage within 2 hours. This time provides for returning the inoperable charger to OPERABLE status or providing an alternate means of restoring battery terminal voltage to greater than or equal to the minimum established float voltage. Restoring the battery terminal voltage to greater than or equal to the minimum established float voltage provides good assurance that, within [12] hours, the battery will be restored to its fully charged condition (Required Action A.2) from any discharge that might have occurred due to the charger inoperability. A discharged battery ~~with float voltage (the charger setpoint) across its terminals~~ indicates that the battery is on the exponential charging current portion (the second part) of its recharge cycle. The time to return a battery to its fully charged state under this condition is simply a function of the amount of the previous discharge and the recharge characteristic of the battery. Thus there is good assurance of fully recharging the battery within [12] hours, avoiding a premature shutdown with its own attendant risk.

having terminal voltage of at least the minimum established float voltage

If established battery terminal float voltage cannot be restored ~~to the battery terminals within 2 hours, that is an indication that the battery charger (primary or alternate) across the battery is faulty or is operating in the current limit mode~~. 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.

to greater than or equal to the minimum established float voltage within 2 hours, and the charger is not operating in the current-limiting mode, a faulty charger is indicated.

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

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

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

is partially

its capacity margins will be reduced.

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

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

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

NEW INSERT: 3.8.6 ACTION Bases

B.1 and B.2

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

If the float voltage is found to be satisfactory but there are one or more battery cells with float voltage less than [2.07] V, the associated "OR" statement in Condition 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 [12] hours, the battery will be restored to its fully charged condition (Required Action B.2) from any discharge that might have occurred due to a temporary loss of the battery charger. A discharged battery with float voltage (the charger setpoint) across its terminals indicates that the battery is on the exponential charging current portion (the second part) of its recharge cycle. The time to return a battery to its fully charged state under this condition is simply a function of the amount of the previous discharge and the recharge characteristic of the battery. Thus there is good assurance of fully recharging the battery within [12] hours, avoiding a premature shutdown with its own attendant risk.

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

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

C.1, C.2, C.3, and C.4

.....

With electrolyte level below the top of the plates there is a potential for dryout and plate degradation. Required Actions C.1, C.2, and ~~C.3~~ address this potential. They are modified by a note that indicates they are only applicable if electrolyte level is below the top of the plates. Within 8 hours level is required to be restored to above the top of the plates. The requirement to verify that there is no leakage by visual inspection and 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 batter[y][ies] may have to be declared inoperable and the affected cell[s] replaced.

(as well as provisions in 5.5.[x], Battery Monitoring and Maintenance Program)

Required Action C.2

the 5.5.x.b item

E.1

With one of more batteries in redundant trains with cell 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 there 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 cell parameters on non-redundant batteries not within limits are therefore not appropriate, and the parameters must be restored to within limits on at least one train within 2 hours.

battery

battery

F.1

... discovering one or more batteries in one train 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.