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U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
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LaSalle County Station, Units 1 and 2
Facility Operating License Nos. NPF-11 and NPF-18
NRC Docket Nos. 50-373 and 50-374

Subject: Additional Information Supporting the License Amendment Request Associated With Direct Current Electrical Power

References:

1. Letter from K. R. Jury (Exelon Generation Corporation, LLC) to U.S. NRC, "Request for an Amendment to Technical Specifications Associated With Direct Current Electrical Power," dated December 9, 2004
2. U.S. NRC to C. M. Crane (Exelon Generation Company, LLC), "LaSalle County Power Station, Units 1 and 2 – Request for Additional Information Related to Request for Amendment to Technical Specifications Associated With Direct Current Electrical Power," dated June 2, 2006

In Reference 1, Exelon Generation Company, LLC, (EGC), requested an amendment to Appendix A, Technical Specifications (TS), of Facility Operating License Nos. NPF-11 and NPF-18 for LaSalle County Station (LSCS) Units 1 and 2 respectively. Specifically, the proposed changes were to modify TS Sections 3.8.4, "DC Sources - Operating," 3.8.5, "DC Sources - Shutdown," 3.8.6, "Battery Cell Parameters," and 5.5, "Programs and Manuals." The proposed changes also requested new actions for an inoperable battery charger and alternate battery charger testing criteria for Limiting Condition for Operation (LCO) 3.8.4 and 3.8.5.

The proposed changes also included the relocation of a number of Surveillance Requirements (SRs) in TS Section 3.8.4 that perform preventive maintenance on the safety related batteries to a licensee-controlled program. It was proposed that TS Table 3.8.6-1, "Battery Cell Parameter Requirements," be relocated to a licensee-controlled program, and specific actions with associated completion times for out-of-limits conditions for battery cell voltage, electrolyte level, and electrolyte temperature be added to TS Section 3.8.6. In addition, specific SRs were proposed for verification of these parameters.

A new program was also proposed for the maintenance and monitoring of station batteries based on the recommendations of Institute of Electrical and Electronics Engineers (IEEE) Standard 450-1995, "IEEE Recommended Practice for Maintenance, Testing, and Replacement of Vented Lead-Acid Batteries for Stationary Applications." The items relocated would be contained within this new program.

In Reference 2, the NRC requested additional information to complete the review of the license amendment. Attachment 1 of this letter provides the requested information.

EGC has reviewed the information supporting a finding of no significant hazards consideration that was previously provided to the NRC in Attachment 1 of Reference 1. The supplemental information provided in this submittal does not affect the bases for concluding that the proposed license amendment does not involve a significant hazards consideration.

There are no regulatory commitments contained in this letter. Should you have any questions concerning this letter, please contact Ms. Alison Mackellar at (630) 657-2817.

I declare under penalty of perjury that the foregoing is true and correct. Executed on the 16th day of August 2006.

Respectfully,

Darin M. Benyak
Manager, Licensing and Regulatory Affairs

Attachment 1: Response to Request for Additional Information
Attachment 2: Revised Technical Specification Bases Pages
Attachment 3: Draft Copy of TRM 3.8.d "Battery Monitoring and Maintenance"
Attachment 4: Simplified Schematic of the LSCS DC Distribution

**Question No. 1**

Proposed Limiting Condition for Operation (LCO) 3.8.4 indicates one inoperable required battery charger in any Division or the opposite unit Division 2 would require entry into the action statement. The LaSalle Updated Final Safety Analysis Report (UFSAR) indicates the 125 VDC design indicating that Unit 1, Divisions 1 and 2, DC systems have a single 100-percent capacity battery charger with Division 2 having an auxiliary battery charger rated at 75 A (37.5 percent.) The LaSalle UFSAR indicates the Unit 2, Divisions 1 and 2, DC systems have two redundant 100-percent capacity battery chargers. The proposed wording would indicate there is no incentive to correct a problem on the first Unit 2 battery charger to fail as long as the second battery charger remained operable. (Category 2.a)

a. Describe the purpose of the 75 A battery charger and confirm that this smaller battery charger would not be considered a 100-percent substitute for an inoperable Unit 1, Division 2 battery charger.

b. Describe what actions and completion time (CT) are proposed to return the first Unit 2, Division 1 or 2, inoperable battery charger to service.

c. Describe the independence of each unit to the opposite Division 2, 125 VDC system.

**Response**

a. LaSalle County Station (LSCS) has implemented a design change to replace the Unit 1 Division 2 75A battery charger with a fully qualified backup safety related (Class 1E) 100% capacity 200A battery charger (as documented in LSCS Engineering Change EC 333812, "Install Back-Up Unit 1 Division 2 125 Vdc Battery Charger"). LSCS has also implemented a design change and installed a fully qualified backup safety related (Class 1E) 100% capacity charger in the Unit 1 Division 1 DC system (as documented in LSCS EC 333810 "Install Back-Up Unit 1 Division 1 125 Vdc Battery Charger").

b. The backup battery charger associated with each DC system is a fully qualified charger powered from the safety related (Class 1E) distribution system, and as such is fully capable of supporting system design requirements. A single failed charger would be repaired in accordance with the LSCS work control process. Although there is no specific TS time requirement associated with the fully qualified backup charger, both chargers are safety related and maintenance rule components (i.e., the battery charger is a component required by 10 CFR 50.65, "Requirements for monitoring the effectiveness of maintenance at nuclear power plants,") and therefore repair and restoration would be given a high priority. Retaining both the in-service and back-up chargers available maintains a high degree of availability for the Unit 1 and Unit 2 Division 1 and Division 2 125 VDC systems.

c. LSCS Units 1 and 2 have certain common systems powered from Division 2 (e.g., each Division 2 bus contains one train of the Standby Gas Treatment (SBGT), Control Room Emergency Filtration and Air Conditioning Systems, and the Hydrogen Recombiners).

   The bus ties between Units 1 and 2 Division 2, 125 VDC system are provided with two normally open, manually operated circuit breakers. The unit cross-tie breakers are normally open during unit operation and administratively controlled by LSCS procedures LOS-DC-W1, "Weekly Surveillance for Safety Related 250 Vdc and 125 Vdc Batteries and DC Distribution," and LOP-DC-02, "DC System Unit Tie Operations." The batteries are not sized to support accident mitigation on one unit with concurrent safe shutdown of the other unit. No cross-tie current is assumed for battery loading, therefore both Unit 1 and Unit 2 Division 2 125 VDC systems are declared inoperable if the associated unit cross-tie breakers are closed. In addition, closure of any bus tie breaker will result in a main control room annunciator alarm.

## Question No. 2

Proposed Technical Specification (TS) 3.8.4 CT for Action A.1, restore battery terminal voltage to minimum established float voltage, is 2 hours. (Category 2.a)

a. Describe any onsite equipment planned to be used to restore the battery terminal voltage within 2 hours. Confirm that the AC power source for this replacement battery charger will come from a bus capable of being powered from the onsite power supply.

b. Define the "minimum established float voltage," and if it is less than 130 V (2.25 volts per cell), justify why a lower voltage is acceptable.

c. Describe what controls will be in place to terminate any discharge of a battery with a degraded or inoperable battery charger and specify how many ampere-hours (worst case) will be removed from the battery during the first 2 hours before the battery terminal voltage is returned to the minimum established float voltage.

## Response

a. As discussed in the response to Question 1, Units 1 and 2 Division 1 125 VDC and Division 2 125 VDC systems each have two fully qualified battery chargers. Each of these battery chargers is supplied by an onsite Engineered Safety Features (ESF) bus capable of being supplied by an onsite ESF diesel generator (DG). If the in-service battery charger is lost or becomes degraded, the second installed battery charger for that particular Division would be placed into service.

   For the Units 1 and 2 Division 1, 250 VDC battery chargers, there are no plans to utilize an alternate battery charger to restore the battery terminal voltage within 2 hours. Upon loss of these battery chargers, proposed TS LCO 3.8.4.A, "One required Division 1 250 VDC battery charger inoperable," would be entered with the Required Action to "Restore battery terminal voltage to greater than or equal to the minimum established float voltage," within 2 hours. In addition, in accordance with the proposed TS 3.8.4.D if the "Required Action and associated Completion Time of Condition A not met for the Division 1 250 VDC electrical power subsystem," in accordance with Required Action D.1 the "associated supported features" would be "Immediately" declared inoperable.

   For the Units 1 and 2 Division 3, 125 VDC battery chargers, there are no plans to utilize an alternate battery charger to restore the battery terminal voltage within 2 hours. Upon loss of these battery chargers, proposed TS LCO 3.8.4.A, "One required Division 1, 2, or 3 125 VDC battery charger on one division inoperable," would be entered with the Required Action to "Restore battery terminal voltage to greater than or equal to the minimum established float voltage," within 2 hours. In addition, in accordance with the proposed TS LCO 3.8.4.C, "Required Action and associated Completion Time of Condition A not met for the Division 3 DC electrical power subsystem," in accordance with Required Action C.1 the "High Pressure Core Spray System" would be "Immediately" declared inoperable.

b. The minimum float voltage establish at LSCS is based on the associated battery manufacturer's recommendations for allowable float voltage per cell. The float voltage of 2.23 volts per cell as opposed to 2.25 volts per cell is acceptable in accordance with battery manufacturer recommendations.

These values are documented in LSCS EC 350396, "Float voltage and Current for the 125 VDC and 250 VDC Batteries for both Unit 1 & 2," and are detailed below.

| **Battery** | **Division 1 250V** | **Division 1 125V** | **Division 2 125V** | **Division 3 125V** |
|---|---|---|---|---|
| Manufacturer and Model | GNB/NLI NCN-27 | GNB/NLI NCN-17 | GNB/NLI NCN-17 | C&D KCR-9 |
| Allowable Float Voltage Range | 2.17 - 2.25 | 2.17 - 2.25 | 2.17 - 2.25 | 2.20 - 2.25 |
| Recommended Float Voltage | 2.23 | 2.23 | 2.23 | 2.23 |
| Battery Terminal Voltage Range | 251.72 - 261.0 | 125.86 - 130.5 | 125.86 - 130.5 | 127.60 - 130.5 |
| Recommended Battery Terminal Voltage | 258.68 | 129.34 | 129.34 | 129.34 |

c. Each DC system contains instrumentation that provides alarms in the LSCS Main Control Room. The following monitoring features are provided for continuous supervision of each 125 VDC and 250 VDC systems:

- Power failure alarm relay, which indicates loss of AC power to the battery charger (except Division 3)
- Charger low DC voltage alarm relay (except Division 3)
- 125 VDC breaker trip alarms on the battery charger to bus breaker (except Division 3)
- DC bus under voltage alarm
- Battery high discharge alarm

The response to the DC system alarms is provided in LSCS Operating Abnormal Procedures LOA-DC-101/201, "Unit 1(2) DC Power System Failure." In accordance with LOA-DC-101/201, for a loss of a Division 1 or Division 2 battery charger, operator actions are to inspect the battery charger for damage. If no damage is observed the charger is placed back in service or, if necessary, the stand-by battery charger is placed into service. For the Division 1 250 VDC and Division 3 125 VDC battery chargers, operator actions are to inspect the battery charger for damage, if no damage is noted the chargers are placed back into service, if damage is observed the battery chargers are taken out-of-service and the appropriate TS LCO is entered.

The following tables provide the worst-case (under normal plant conditions) DC loading expected during a battery discharge of a 2-hour duration until the battery terminal voltage can be returned to the normal float voltage. Note that the worst-case DC loading is based on data from the LSCS battery sizing calculations.

| Battery | Worst-case DC Loading (amps) | 2-Hour Battery Discharge (A-hr) | Battery Rating Amp Hours (8-hour rating) |
|---|---|---|---|
| Unit 1, Division 1 250V | 28.4 | 56.8 | 1832 |
| Unit 1, Division 1 125V | 92.3 | 184.6 | 1128 |
| Unit 1, Division 2 125V | 66.3 | 132.6 | 1128 |
| Unit 1, Division 3 125V* | 5.0 | 10.0 | 308 |

| Battery | Worst-case DC Loading (amps) | 2-Hour Battery Discharge (A-hr) | Battery Rating Amp Hours (8-hour rating) |
|---|---|---|---|
| Unit 2, Division 1 250V | 28.4 | 56.8 | 1832 |
| Unit 2, Division 1 125V | 74.8 | 149.6 | 1128 |
| Unit 2, Division 2 125V | 62.0 | 124.0 | 1128 |
| Unit 2, Division 3 125V* | 5.0 | 10.0 | 308 |

* Division 3 batteries are sized to meet a notably smaller load than that of Divisions 1 and 2

## Question No. 3

The LaSalle UFSAR identifies different battery sizes for Division 1 and 2, 125 V batteries, Division 1, 250 V battery, and the Division 3 battery. Proposed TS 3.8.4 required action (RA) for Action A.2, and surveillance requirement (SR) required action A.2, verify battery float current ≤2 amperes. (Category 2.a)

a. Explain why the same proposed recharging current acceptance criteria is acceptable for the three size batteries at LaSalle.

## Response

LSCS EC 350396 documents that based on vendor design information a battery float current of ≤2 amperes for the Division 1 and 2 125 VDC and the 250 VDC batteries equals a 95% battery capacity. Based on battery sizing calculations, all of these batteries have a remaining margin of >5%. Battery sizing calculations are presented in the response to Question 17.

In Reference 3 the vendor stated that for the 125 VDC Division 3 batteries a 2A float current was estimated to corresponded to a 90% to 92% battery charge capacity. LSCS calculations conclude that the Unit 1 Division 3 battery has a remaining positive margin/capacity of 36.4% and that the Unit 2 Division 3 battery has a remaining positive margin/capacity of 35.9%. These values do not include the 1.15 (15%) design margin used for sizing the Division 3 batteries. In addition, LSCS will reserve a 10% design margin for the Division 3 batteries that will be reflected in the TS Bases. A revised mark-up of the TS

Bases page detailing this design margin is documented in Attachment 2. The TS Bases page is provided for information only and does not require NRC approval.

When the remaining battery margin is added to the 2A battery charge capacity the battery is fully capable of performing its design function. Therefore, a 2A float charge acceptance criteria is equally applicable to and acceptable for each of the Division 1, 2 and 3 125 VDC batteries and for the 250 VDC batteries.

**Question No. 4**

The technical analysis cited to support this change, contained in this LaSalle request, stated that verifying the charging current at 12-hour intervals provides assurance that the battery has sufficient capacity to perform its assumed safety function. If, at the expiration of the 12-hour period, the battery float current is not less than or equal to 2 amperes, industry experience indicates there may be additional battery problems. (Category 2.a)

a. Explain why it would take 12 hours to return a battery to a fully-charged state (i.e., less than 2 amperes charging current) that had experienced a limited 2-hour discharge.

b. Quantify the additional battery capacity that could be lost during this 12-hour period if the charging current does not return to less than 2 amperes, and explain why this additional loss of battery capacity meets safety requirements.

**Response**

a. The battery chargers at LSCS are sized in accordance with IEEE-946-1985, "IEEE Recommended Practice for the Design of Safety Related DC Auxiliary Power Systems for Nuclear Power Generating Stations," to recharge the battery to 95% capacity within 12 hours from a discharged state following an accident condition while supplying the continuous system loads. The recharge time is a function of the charger rating, continuous DC system loads, amp hours removed from the battery, and a constant that compensates for battery losses.

   A limited two-hour discharge on the battery would require less time to recharge the battery to < 2A charging current since the amp hours removed from the battery would be less than that removed to arrive at a discharged state following an accident condition.

b. Proposed TS LCO 3.8.4.A Required Action A.1 requires that battery terminal voltage be restored to greater than or equal to the minimum established float voltage within 2 hours to show battery discharge has stopped (i.e., if minimum float voltage is achieved, battery capacity is no longer being lost).

   If minimum float voltage is not achieved within 2 hours, the Required Action and associated Completion Time for the subject battery charger is not met and the appropriate TS LCO for the specific battery charger will be entered and the Required Actions taken in accordance with the appropriate proposed TS LCO (i.e., TS 3.8.4 C for Division 3, TS 3.8.4 D for Division 1 250 VDC, TS 3.8.4.E for the opposite unit Division 2 or TS 3.8.4 F for the Division 1 or 2 125 VDC).

Note that specific alarms that alert operators to low DC voltage and required operator actions to respond to system alarms are discussed in the response to Question 2.

**Question No. 5**

The proposed wording in SR 3.8.4.2 and SR 3.8.5 is not consistent with Section 8.3.2 of the LaSalle UFSAR, which indicates the following:

> The battery chargers are sized to recharge the batteries in a time commensurate with the recommendations of the battery manufacturer and the battery chargers will supply rated current for at least 8 hours.

The NRC staff has interpreted these statements to indicate that the battery chargers would recharge the batteries within 8 hours. (Category 2.a)

a. Explain why both SR 3.8.4.2 and SR 3.8.5, which require either (1) only a four-hour surveillance at rated current or (2) the capability of recharging the batteries within 24 hours, meet LaSalle's battery chargers UFSAR commitment.

**Response**

Current TS Surveillance Requirement (SR) 3.8.4.6 verifies that the battery chargers are able to supply rated current for a minimum of 4 hours was approved as part of the amendments issued on March 30, 2001 (Reference 4) that converted the previous TS for LSCS to Improved Technical Specifications (ITS).

The statements in UFSAR Section 8.3.2.1, "Unit Class 1E D-C Power System," that one; "each battery has its own charger with a capacity for restoring it to full charge under normal load in a time commensurate with the recommendations of the battery vendor;" and two; that the battery chargers will supply rated current for "at least 8 hours," are two independent statements that are not meant to imply that the battery chargers are sized to recharge the batteries within any specific time frame.

**Question No. 6**

LaSalle's current practice is to perform a modified performance discharge test in lieu of a service discharge test but has proposed striking the words "provided the modified performance test completely envelops the performance test." (SR 3.8.4.3, Note 1). According to industry standards, using the results of a modified performance discharge test in lieu of service discharge test data does not provide assurance that the battery will be capable of meeting the LaSalle duty-cycle requirements if the test does not completely envelop the service test required discharge profile. (Category 2.a)

a. Ensure that the modified performance test will completely envelope the service test discharge profile or provide justification why this modification is not required.

**Response**

In Reference 1, the revision to B.3.8.6, "Battery Parameters," SR 3.8.6.6 states that "a battery modified performance discharge test is a simulated duty cycle normally consisting of just two rates; the one minute rate published for the battery or the largest current load of the duty cycle, followed by a test rate employed for the performance discharge test, both of which envelope the duty cycle of the service test."

Battery testing and load profile determination for all batteries at LSCS are performed in accordance with IEEE 450-1995, "IEEE Recommended Practice for Maintenance, Testing and Replacement of Vented Lead-Acid Batteries for Stationary Applications," which states that it is permissible to perform a modified performance test if the test discharge rate envelops the duty cycle of the service test. IEEE 450-1995 is referenced in the revisions to TS Bases B 3.8.6 and B 3.8.4. The Class 1E battery load profiles for the service test and modified performance test have been reviewed and are documented in LSCS EC 359490, "Unit 1 and 2, Division 1, 2 and 3 125 Vdc Class 1E Battery Load Profiles for Service Test and Modified Performance Test." EC 359490 ensures that the modified performance test completely envelops the service test for the worst-case load profile (i.e., Loss of Offsite Power/Loss of Coolant Accident (LOOP/LOCA or SBO).

**Question No. 7**

Part 2 of proposed SR 3.8.6.6 states that the battery performance test is not required to be performed when the opposite unit is in Mode 4 or 5, or during movement of irradiated fuel in the secondary containment. (Category 2.a)

a. Clarify why activities in the opposite unit would justify not performing the battery performance test in the subject unit.

b. Clarify how the unit will return to service without performing the required battery performance test if the opposite unit is in Mode 4 or 5.

**Response**

To address this issue and to clarify and correct the information provided in Reference 1, NOTE 2 will be revised. The additional NOTE 2 of the proposed SR 3.8.6.6 was intended to be editorial and relocated from part of the current TS SR 3.8.4.9 (i.e., the NOTE in the current TS SR 3.8.4.9 refers to TS SR 3.8.4.8 that is proposed to be relocated to the new SR 3.8.6.6) and the current TS SR 3.8.5.1 (i.e., SR 3.8.4.8 was not required to be performed).

In a teleconference on August 14, 2006, Ms. Alison M. Mackellar of EGC notified Mr. Stephen P. Sands of the NRC regarding the issue. A corrected TS mark-up page and retyped TS page will be provided in a supplemental letter.

The proposed note(s) of SR 3.8.6.6 are required for completeness and there will be no changes in the proposed SR 3.8.6.6 from the current LSCS TS. The justification (i.e., item 6 on page 19 of Reference 1) will still be applicable with the exception of the reference to NOTE 2 will now be revised to NOTE(s) 2 and 3. In addition EGC has concluded that the corrected information will not affect the information regarding no significant hazards consideration provided in Reference 1.

**Question No. 8**

SR 3.8.6.6 does not include a requirement to increase the frequency to 12 months when the battery was identified as degraded in the previous performance test. Degraded is defined in

Institute of Electrical and Electronics Engineers (IEEE) Standard IEEE-450-1995, "Recommended Practice for Maintenance, Testing and Replacement of Vented Lead-Acid Batteries for Stationary Applications," as either less than 90-percent rated capacity or a loss of capacity of ≥ 10 percent from the previous performance test. (Category 2.a)

a. Explain why the frequency of performing the performance discharge test is not increased for a degraded battery.

**Response**

There are no changes in proposed SR 3.8.6.6 from the current LSCS TS. In Reference 1, for the proposed TS SR 3.8.6.6, the Surveillance Frequency for the battery performance discharge test is normally 60 months. In addition to this Surveillance Frequency, TS SR 3.8.6.6 further states that "when (the) battery shows signs of degradation or has reached 85% of its expected life with capacity < 100% of manufacturer's rating," the Surveillance Frequency is reduced to 12 months. However, if the battery shows no degradation, the Surveillance Frequency is "24 months when (the) battery has reached 85% of the expected life with capacity ≥ 100% of manufacturer's rating."

**Question No. 9**

Proposed SR 3.8.6 contains two inserts. Insert SR 3.8.6, ACTIONS and insert SR 3.8.6, Surveillance Requirements, contain the following limits: (Category 2.a)

| | |
|---|---|
| Cell Float Voltage | < 2.07 V |
| Float Current | > 2 A |
| Electrolyte Level | < minimum established design limits |
| Electrolyte Temperature | < minimum established design limits |

a. Explain why a cell float voltage below the manufacturer's recommended minimum float voltage is acceptable.

b. What ensures that the minimum established electrolyte level design limits are no less than the minimum level line on the cell jar?

c. What ensures that the minimum established electrolyte temperature design limits are no less than those minimum temperatures used in the sizing of the Division 1, 2 and 3 batteries?

d. Explain why it is acceptable to take 8 hours to restore electrolyte level to above the top of the plates and 31 days to restore the level to the minimum established design limits.

**Response**

a. The current LSCS TS 3.8.6 Condition A allows temporary reductions in battery cell voltage below 2.13 V for up to 31 days, and considers the battery inoperable when cell voltage drops below 2.07 V. The proposed TS 3.8.6 Condition A maintains the 2.07 volt requirement. A new section in the LSCS owner controlled program Technical Requirements Manual (TRM), TRM 3.8.d "Battery Monitoring and Maintenance," will maintain the 2.13 volt requirement.

Prolonged operation of cells below 2.13 V can reduce the life expectancy of individual cells. As such the 2.13 volt limit is a maintenance limit for taking corrective action. A cell voltage of 2.07 V or below under float conditions and not caused by elevated temperature of the cell indicates internal cell problems that may require cell replacement.

As noted in the response to Question 2, LSCS Engineering Change EC 350396 has recommended a float voltage of 2.23 volts/cell and an allowable float voltage range of 2.17 volts/cell to 2.25 volts/cell for the GNB/NLI battery systems and 2.20 volts/cell to 2.25 volts/cell for the C&D battery systems. This is based on the manufacturer's recommendations.

b. TRM 3.8.d will ensure that the minimum established electrolyte level design limits are no less than the minimum level line on the cell jar. Category A and Category B limits for electrolyte level will require the level to be greater than the minimum level indication mark.

   LSCS surveillance procedures LOS-DC-Q2, "Battery Readings for Safety-Related 250 Vdc and Div 1, 2, 3 125 Vdc Batteries," and LOS-DC-W1, provide acceptance criteria for electrolyte level. The acceptance criterion stated is greater than the minimum level indication mark on the battery cell and notes are provided in the surveillances to add water if the electrolyte level is 3/8 inches below the high level indication mark. This maintains the electrolyte level approximately 1/4 inch above the low-level indication mark and 3/4 inches above the top of the battery plates.

c. LSCS TRM 3.8.d Surveillance TSR 3.8.d.3 verifies the "average electrolyte temperature of representative cells is requires ≥ 60°F for the 125 V batteries, and ≥ 65°F for the 250 V battery." This will ensure the minimum established electrolyte temperature design limits are no less than those minimum temperatures used in the sizing of the Division 1, 2 and 3 batteries.

   LSCS surveillance procedures LOS-DC-Q2 and LOS-DC-W1 both provide acceptance criteria for electrolyte temperatures. The electrolyte temperature acceptance criteria are ≥ 60°F for the 125 V batteries and ≥ 65°F for the 250 V batteries. These temperatures are consistent with the battery sizing calculations.

d. The 8-hour period to restore the electrolyte level to above the top of the plates is required since electrolyte level below the top of the plates is an unexpected condition. Electrolyte levels are procedurally maintained above the minimum electrolyte level line, providing margin to prevent the top of the plates from being exposed. An electrolyte level that exposes the top of the plates would indicate a potential crack in the cell resulting in loss of electrolyte. In this condition, a detailed inspection of the battery cell would be required and justification for adding electrolyte or removing the battery cell from service would need to be provided. Once the plates have been covered, degradation to the battery cell from sulfation has been reduced.

   The 31-day period to restore the level to the minimum established design limits is required to allow for determination of the proper quantities of acid and water to be added, performance of an equalize charge, followed by a float charge. The quantity of acid and water to be added is critical to assure the specific gravity of the electrolyte meets the design specification of the battery cell.

Note that the proposed TS 3.8.6 Required Action C.1 directs a specific action plan to restore electrolyte level to above (the) top of (the) plates within 8 hours. In addition, proposed Required Action C.2 verifies (there is) no evidence of leakage within 12 hours, which is an enhancement to the existing LSCS TS.

The proposed 31-day Completion Time to restore the level to greater than or equal to the minimum established design limits in accordance with the proposed TS 3.8.6.C Required Action C.3; is the same 31-day Completion Time that is currently required in LSCS TS 3.8.6.A Required Action A.3.

**Question No. 10**

Proposed TS Section 5.5.14, "Battery Monitoring and Maintenance Program," has eliminated the recommendations of the battery manufacturer. (Category 2.a)

a. Explain why the battery manufacturer's recommendations will not be followed.

**Response**

The battery manufacturer's recommendations will be followed. LSCS TRM 3.8.d will contain parameter requirements that require the battery cell parameter to conform to the manufacturer recommendations for electrolyte level, specific gravity and float voltage.

**Question No. 11**

Proposed TS Section 5.5.14 has eliminated the recommendations of the battery manufacturer. TS 5.5.14 also requires actions to restore battery cells with float voltage < 2.13 V. The LaSalle UFSAR states that the normal average voltage per cell is 2.25 V. (Category 2.a)

a. Explain why the acceptance criteria for cell voltage is less than 2.25 V.

b. If the design average cell voltage is 2.25 V, justify why the battery terminal voltage of 130 V for the 58 cell batteries and 260 V for the 116 cell batteries is not part of the battery monitoring program.

**Response**

a. Refer to the response to Question 9(a).

b. Proposed SR 3.8.4.1 requires the battery terminal voltage to be maintained at greater than or equal to the minimum established float voltage. Since this is a TS Surveillance Requirement required to be performed on a 7-day Frequency it was not added to the Battery Monitoring Program.

   The response to Question 2 provides the minimum established float voltage.

**Question No. 12**

The existing SR 3.8.6, Condition B addresses average electrolyte temperature. The proposed SR 3.8.6, Condition D addresses only pilot cell electrolyte temperature limit criteria. Proposed TS 5.5.14 does not address electrolyte temperature. (Category 2.a)

a. Describe what controls will be placed on electrolyte temperature for the non-pilot cells.

**Response**

IEEE-450-1995 was used as the basis for developing the battery monitoring program (i.e., TRM 3.8.d) as noted on page 20 of Reference 1. Non-pilot cell electrolyte temperatures are addressed in TRM 3.8.d in accordance with IEEE-450-1995. A requirement to perform maintenance will also be included in TRM 3.8.d.

Switchgear room temperatures (note that the battery rooms are contained in the switchgear rooms) are monitored by operations as part of rounds each shift. The first indication of a problem with battery temperature would be the room temperature going out of tolerance low. Since batteries have very large thermal inertia, it is highly probably that the room temperature excursion would be corrected prior to the battery reaching minimum temperature. LSCS procedure LOA-VX-101/201, "Unit 1(2) Switchgear Heat Removal System Abnormal," would be entered on a decreasing Switchgear Room temperature of 65°F. The procedure provides direction to determine and correct the cause of the low switchgear room temperatures and establishes a special log to monitor battery electrolyte temperature and switchgear room temperatures. Monitoring would continue until the battery electrolyte and the room temperatures are restored. In addition, in accordance with LOS-AA-S101/S201, "Unit 1/2 Shiftly Surveillance," if Division 1, 2, or 3 Switchgear Room has temperature readings at or below 65°F, pilot cell temperatures are recorded in accordance with applicable portions of LOS-DC-W1.

For LSCS the worst-case scenario for battery temperature would consist of the following conditions/assumptions:

- Pilot cell is the warmest cell in the battery
- Pilot cell is at minimum temperature of 60°F (65°F for 250 VDC batteries)
- Battery is at IEEE-450-1975 limit of 5°F differential temperature
- Average cell temperature is 5°F less than pilot cell temperature

The resulting temperature correction factor used in the sizing calculations would be 1.110 (1.080 for the 250 VDC batteries) in accordance with recommendations of IEEE Standard 485-1997, "IEEE Recommended Practice for Sizing Lead-Acid Batteries for Stationary Applications." The required temperature correction factor for 55°F is 1.150; therefore the deviation in correction factor for the Division 1 and 2 125 VDC batteries is 0.040 (1.150 – 1.110), and 0.030 (1.110 –1.080) for the 250 VDC batteries. This results in an apparent capacity margin deficit of 3.5% (0.04/1.15) for the Division 1 and 2 125 VDC batteries and 2.7% (0.03/ 1.11) for the 250 VDC batteries.

Due to the sizing methodology in IEEE 485-1997, there is a cumulative effect due to the multiplication rather than addition of margins. For example, for the 250 VDC batteries the aging correction factor is 1.25, the remaining margin is greater than 1.05, and the temperature correction factor is 1.080. These values result in a combined sizing correction factor of 1.42 (1.25 x 1.08 x 1.05) or 142% capacity, and a required capacity or 138% (100 + 25 + 08 + 05). As the combined sizing correction factor is larger than the required capacity there is margin to absorb the 2.7% margin deficit.

For the Division 1 and 2 125 VDC batteries the correction factor is 1.25, the committed design margin is 1.05, and the temperature correction factor is 1.110. As such the combined sizing correction factor is 1.46 (1.25 x 1.11 x 1.05) or 146%, while the required capacity would be 141% (100 + 25 + 11 + 05). As the combined sizing correction factor is larger than the required capacity there is margin to absorb the 3.5% margin deficit.

The Division 3 batteries are also required to be maintained with a minimum electrolyte temperature of 60°F. However, the battery sizing calculations are based on 45°F, therefore if the average cell temperature were to fall to the worst-case temperature of 55°F, battery capacity margin would remain sufficient.

**Question No. 13**

The existing SRs 3.8.4.2 through 3.8.4.5 addressed physical damage to battery cells and racks, corrosion and terminal resistance. Proposed TS 5.5.14 does not address these physical characteristics. (Category 2.a)

a. Describe what controls will be placed on the physical characteristics of damage to battery cells and racks, corrosion and terminal resistance.

**Response**

TRM 3.8.d will contain Surveillance Requirements that will address physical characteristics of damage to battery cells, racks, corrosion and terminal resistance as detailed below.

- TSR 3.8.d.4 – Verify no visible corrosion at battery terminals and connectors or verify battery connection resistance is ≤ 1.5E-4 ohm for intercell connections and ≤ 1.5E-4 ohm for terminal connections. Frequency is 92 days.
- TSR 3.8.d.5 – Verify battery cells, cell plates, and racks show no visual indication of physical damage or abnormal deterioration that could degrade battery performance. Frequency is 24 months.
- TSR 3.8.d.6 – Remove visible corrosion and verify battery cell-to-cell and terminal connections are coated with anti-corrosion material. Frequency is 24 months.
- TSR 3.8.d.7 – Verify battery connection resistance is ≤ 1.5E-4 ohm for intercell connections and ≤ 1.5E-4 ohm for terminal connections. Frequency is 24 months.

**Question No. 14**

The existing SR 3.8.6, Table 3.8.6-1 addresses cell specific gravity following 7 days after a battery recharge. Proposed TS 5.5.14 does not address cell-specific gravity. Industry standards indicate that specific gravity is a better measure of battery charge in the steady state (away from the period immediately following recharge). (Category 2.a)

a. Explain why specific gravity is not used as the measure of battery capacity in the steady state.

b. Describe what actions will be taken to determine the electrolyte temperature of the remaining battery cells if the pilot cell temperature is found below the minimum established design limits.

**Response**

a. See the response to Question 19.

b. In accordance with the proposed TS 3.8.6, "Battery Parameters," Condition D, if one or more batteries with pilot cell electrolyte temperature is less than minimum established design limits, Required Action D.1 is entered to restore battery pilot cell temperature to greater than or equal to minimum established design limits within 12 hours. If the pilot cell temperature fails to meet the acceptance criteria as described above, there are no planned requirements to verify the electrolyte temperature of the remaining cells. However, actions taken to restore pilot cell electrolyte temperature will likely have an effect on the remaining battery cells temperatures.

   Low electrolyte temperature will more than likely be due to room ventilation problems and as described in the response to Question 12, LSCS procedure LOA-VX-101/201 would be entered to determine and correct the cause of the low switchgear room temperatures and to establish increased monitoring of the battery electrolyte temperatures.

**Question No. 15**

No mention is made of the 250 V battery charger ratings in the UFSAR text. UFSAR Figure 8.3-9 indicates a tie between the 250 V DC systems of Unit 1 and Unit 2. (Category 2.a)

a. Describe the 250 V battery charger ratings and confirm that each unit's 250 V DC system battery and battery charger have been sized to carry the combined loads of both units.

**Response**

The nameplate DC output rating data for the Unit 1 and Unit 2 Division 1 250 VDC battery chargers is 260V, 200A, and 52kW. UFSAR Figure 8.3-9 is correct and unit cross-tie breakers do exist between the LSCS Unit 1 and Unit 2 250 VDC systems. The unit cross-tie breakers are normally open during unit operation and administratively controlled by LSCS procedures LOS-DC-W1 and LOP-DC-02. The batteries are not sized to support accident mitigation on one unit with concurrent safe shutdown of the other unit. No cross-tie current is assumed for battery loading, therefore the associated 250 VDC division is considered inoperable if the associated unit cross-tie breakers are closed. Procedure LOP-DC-02 requires that the Unit 1 and Unit 2 Reactor Core Isolation Cooling (RCIC) systems be declared inoperable prior to closing the unit cross-tie breakers. In addition, closure of any bus tie breaker will result in a main control room annunciator alarm.

**Question No. 16**

If the loss of the battery charger is the result of loss of the AC supply to the battery charger(s) (e.g., loss of the AC motor control center or low voltage switchgear), identify what additional loads beyond the steady state DC loads will be placed on the battery during the 2-hour discharge, such as the addition of inverters, or uninterruptible power supplies under worst case conditions. Specify the anticipated loss in battery capacity and the expected time to recharge the battery upon recovery of AC power to the battery charger(s). (Category 2.a)

**Response**

The loss of a Division 1 or Division 2 battery charger, (i.e., a loss of the AC supply to the battery charger), will result in additional loads placed on the battery. These loads include annunciator panels, emergency lighting cabinets and the associated diesel generator DC lube oil pump. The change in loading for Division 3 would include the diesel generator DC lube oil pump. Additional loading on the battery during a loss of the Division 1 or Division 2 battery charger is bounded by a previously analyzed LSCS Station Blackout (SBO) event. The following table provides the expected time to recharge a battery after a 2-hour SBO event. These tables use SBO loading from LSCS Calculation D30, Revision 5A, "Station Blackout-Capability of 125 VDC and 250 VDC Batteries to Feed Loads During Station Blackout (SBO)," DC bus loads provided in the response to Question 2, and assumes a factor of 1.1 to compensate for battery loss in accordance with IEEE 946-1985.

| Battery | SBO 2 hour amp hour draw | 100% capacity amp hour rating | Charger output (amps) | Worst-case DC bus load (amps) | Expected time to recharge to 95% capacity |
|---|---|---|---|---|---|
| Unit 1 Division 1 125V | 364.5 | 1128 | 200 | 92.3 | 3.7 hours |
| Unit 1 Division 2 125V | 291.3 | 1128 | 200 | 66.3 | 2.4 hours |
| Unit 1 Division 3 125V | 45.9 | 308 | 50 | 5.0 | 1.1 hours |
| Unit 1 Division 1 250V | 652.5 | 1832 | 200 | 28.4 | 4.2 hours |

| Battery | SBO 2 hour amp hour draw | 100% capacity amp hour rating | Charger output (amps) | Worst-case DC bus load (amps) | Expected time to recharge to 95% capacity |
|---|---|---|---|---|---|
| Unit 2 Division 1 125V | 341.3 | 1128 | 200 | 74.8 | 3.0 hours |
| Unit 2 Division 2 125V | 266.5 | 1128 | 200 | 62.0 | 2.1 hours |
| Unit 2 Division 3 125V | 46.2 | 308 | 50 | 5.0 | 1.1 hours |
| Unit 2 Division 1 250V | 645.8 | 1832 | 200 | 28.4 | 4.1 hours |

**Question No. 17**

In order to demonstrate the design margin of the LaSalle batteries, provide the results of the battery sizing calculations that demonstrate the amount of total margin above the IEEE-485 sizing requirements (minimum temperature, aging, and margin for maintenance) that may be utilized during the 2 hours allotted to restore battery terminal voltage. (Category 2.a)

**Response**

The following tables represent the LOOP/LOCA battery sizing calculations. The remaining margin is a calculated value following the 4-hour duty cycle of the Design Basis Accident.

**Unit 1 LOOP/LOCA Battery Sizing**

| Battery | Temp. F | Design Margin | Aging Factor | Remaining Margin |
|---|---|---|---|---|
| Unit 1 Division1 250V | 65 | 1.00 | 1.25 | 5.1% |
| Unit 1 Division1 125V | 60 | 1.15 | 1.25 | 10.4% |
| Unit 1 Division 2 125V | 60 | 1.15 | 1.25 | 9.0% |
| Unit 1 Division 3 125V | 45 | 1.15 | 1.25 | 36.4% |

**Unit 2 LOOP/LOCA Battery Sizing**

| Battery | Temp. F | Design Margin | Aging Factor | Remaining Margin |
|---|---|---|---|---|
| Unit 2 Division 1 250V | 65 | 1.00 | 1.25 | 5.5% |
| Unit 2 Division 1 125V | 60 | 1.15 | 1.25 | 10.5% |
| Unit 2 Division 2 125V | 60 | 1.15 | 1.25 | 7.2% |
| Unit 2 Division 3 125V | 45 | 1.15 | 1.25 | 35.9% |

**Question No. 18**

In order to demonstrate prompt detection of battery charger problems that would require removal of the battery charger from service, identify the alarm and monitoring, including setpoints or acceptance criteria, available to the control room operator to identify a degrading battery charger including, but not limited to: (Category 2.a)

a. low DC voltage alarms on the battery charger,

b. low DC voltage alarms on the DC bus, and

c. operator shift rounds of the DC battery charger and DC bus.

**Response**

Battery amps, battery volts, charger amps, and charger voltage indications are available for the 250 VDC, and the Divisions 1, Division 2 and Division 3 125 VDC systems in the Main Control Room. The following tables summarized DC system alarms available in the Main Control Room.

**250 VDC Battery Charger Trouble (1PM01J-A109)**

| Alarm Condition | SER Typer Address | Setpoint |
|---|---|---|
| Battery charger output low | R0096 | 252.0 volts |
| Battery charger output breaker tripped | R0097 | Output breaker trip |
| Loss of AC voltage to battery charger | R0098 | AC power failure |

**250 VDC Battery Trouble (1PM01J-A108)**

| Alarm Condition | SER Typer Address | Setpoint |
|---|---|---|
| Hi battery discharge | R0714 | 9.4 amps |
| Hi battery charge rate | R0716 | 200 amps |
| Battery instrumentation failure | R0715 | Loss of instrumentation for alarms and local/remote ammeter indication |

**250 Volt DC Bus Under Voltage (1PM01J-A201)**

| Alarm Condition | SER Typer Address | Setpoint |
|---|---|---|
| Under voltage on bus | R0248 | < 244 volts |

**Div I 125 VDC Battery Charger Trouble (1PM01J-A309)**

| Alarm Condition | SER Typer Address | Setpoint |
|---|---|---|
| Battery charger DC voltage output low | R0104 | 1DC09E = 126.0 volts<br>1DC23E = 128.5 volts |
| Battery charger output breaker tripped | R0106 | Output breaker trip |
| Loss of AC voltage to battery charger | R0105 | AC power failure |
| Battery discharge rate high | R0640 | 13.3 amps |
| Battery instrumentation failure | R0648 | Loss of instrumentation for alarms and local/remote ammeter indication |
| Battery charge rate high | R0650 | 200 amps |

**125 Volt DC Div I Bus Under Voltage (1PM01J-A301)**

| Alarm Condition | SER Typer Address | Setpoint |
|---|---|---|
| Under voltage on bus | R0233 | < 122 volts |

**Div II 125 VDC Battery Charger Trouble (1PM01J-B104)**

| Alarm Condition | SER Typer Address | Setpoint |
|---|---|---|
| Battery charger DC voltage output low | R0985 | 1DC17E = 125.0 volts<br>1DC16E = 128.5 volts |
| Battery charger output breaker tripped | R0987 | Output breaker trip |
| Loss of AC voltage to battery charger | R0986 | AC power failure |
| Battery discharge rate high | R1246 | 8.1 amps |
| Battery instrumentation failure | R1059 | Loss of instrumentation for alarms and local/remote ammeter indication |
| Battery charge rate high | R1060 | 200 amps |

**125 Volt DC Div II Bus Under Voltage (1PM01J-B507)**

| Alarm Condition | SER Typer Address | Setpoint |
|---|---|---|
| Under voltage on bus | R1243 | < 122 volts |

**Div III HPCS 125 VDC System Trouble (1H13-P601-A301)**

| Alarm Condition | SER Typer Address | Setpoint |
|---|---|---|
| 125 VDC Bus 113 undervoltage | R0017 | < 122 volts |
| Div III battery discharge high | R0038 | 4.7 amps |
| Div III battery instrumentation failure | R0047 | Loss of instrumentation for alarms and local/remote ammeter indication |
| Div III battery charge rate high | R0054 | 37.5 amps |

EGC procedure OP-AA-102-102, "General Area Checks and Operator Field Rounds," provides requirements for plant general area checks including equipment checks to ensure shift operations personnel are aware of plant status. In addition, indication of battery parameters are available in the Main Control Room and are monitored in accordance with panel monitoring requirements of the EGC procedure OP-AA-103-102, "Watchstanding Practices."

**<u>Question No. 19</u>**

Specific gravity monitoring is used to measure the strength of a battery cell's electrolyte, which is an important component of the battery's chemical reaction, and provides an indication of the battery's state-of-charge. Float current monitoring may or may not provide an accurate indication of the battery's state-of-charge. Float current monitoring is based on a calculation that is dependent on several variables. The NRC staff has a concern with two variables of this calculation: the applied charging voltage and the cell resistance. A change in either of these variables may provide a false indication of the battery's state-of-charge.

Provide assurance that float current monitoring will provide an accurate indication of the battery's state-of-charge. (Category 2.a)

**Response**

Float current monitoring is the preferred method of determining battery state of charge for the following reasons:

- Battery state of charge involves charge-discharge reactions related to electric current flow.
- Float current monitoring is a more meaningful indicator of state of charge because current is the primary means of discharging and charging the battery.
- Specific gravity readings have an inherent time lag on both charge and discharge.

The basic charge-discharge reactions for lead-acid batteries are associated with electric current flow internal and external to the battery and with lead-sulfate conversion internal to the cells. As stated in Reference 5, if there is no lead sulfate to be converted, the battery is fully charged and true float behavior takes place.

At float voltage, the level of float current provides a clear indication of the battery state of charge at any time. If the current is higher than the established float current limit, then a recent discharge is indicated. If the current is at or below the established limit, there is reasonable assurance that the battery is charged. Float current monitoring during steady-state operations accurately indicates the battery state of charge.

Electric current is the primary means of charging and discharging the battery. Specific gravity readings are taken in the bulk electrolyte away from the active materials and are thus secondary indications. Hence specific gravity readings have an inherent time lag and are therefore less accurate in assessing the present state of charge during steady-state operations.

**Question No. 20**

The battery pilot cell is representative of the average battery cell in the battery. Provide assurance that a battery which has a battery pilot cell with a voltage of 2.07 volts or slightly greater will remain capable of performing its minimum designed function. (Category 2.a)

**Response**

Proposed SR 3.8.4.1 requires the battery terminal voltage to be maintained at greater than or equal to the minimum established float voltage. The lowest allowable float voltage at LSCS is 2.17V per cell for Divisions 1 and 2 and 2.20V per cell for Division 3. With the battery maintained at, or above, the minimum allowable float voltage, it is not possible for the entire battery to be floated at 2.13V (or 2.07V) per cell. This provides reasonable assurance that multiple cells would not be below 2.07V.

It is possible for a pilot cell (or any other battery cell) to develop a problem between surveillance tests that could cause its individual cell voltage to drop below 2.13V or 2.07V. If this condition were encountered, then the appropriate TS and/or TRM Action would be entered.

**Question No. 21**

As mentioned in Question 19, the battery pilot cell is representative of the average battery cell in the battery. Provide assurance that a battery with a battery pilot cell with an electrolyte temperature slightly greater than or equal to the minimum established design limit will remain capable of performing its minimum designed function. (Category 2.a)

**Response**

See the response to Question 12.

**Question No. 22**

Consistency with IEEE 450-1995 was used throughout your submittal as the justification for approval. The most recent version of IEEE 450 that has been endorsed by the NRC through Regulatory Guides (RGs) is IEEE Standard 450-1975. The RGs of mention are: RG 1.128, "Installation, Design, and Installation of Large Lead Storage Batteries for Nuclear Power Plants," and RG 1.129, "Maintenance, Testing, and Replacement of Large Lead Storage Batteries for Nuclear Power Plants." (Category 2.a)

a. Provide a plant-specific technical justification for each proposed change in lieu of referencing consistency with the IEEE Standard 450-1995.

b. Provide a copy of the proposed battery monitoring and the maintenance program identified in TS 5.5.

**Response**

a. Plant-specific technical justifications for the applicability of TSTF-360, Revision 1, “DC Electrical Rewrite,” are presented in Reference 1 Section 4.0, pages 8 through 15 and are consistent with the justifications presented in TSTF-360 without reliance on IEEE-450-1995. Justifications for any differences from the TSTF-360 changes were also provided in Section 4.0 of Reference 1 pages 15 through 19. Any references to IEEE-450-1995 in Reference 1 were either informational or were directed at the commitments to the monitoring program (i.e., TRM 3.8.d) that is required when adopting this change. IEEE-450-1995 was used as the basis for developing the monitoring program as noted on page 20 of Reference 1.

b. A draft copy of the new section in the LSCS owner controlled program Technical Requirements Manual (TRM), TRM 3.8.d “Battery Monitoring and Maintenance,” is provided in Attachment 2.

**References:**

1. Letter from K. R. Jury (Exelon Generation Corporation, LLC) to U.S. NRC, “Request for an Amendment to Technical Specifications Associated With Direct Current Electrical Power,” dated December 9, 2004

2. U.S. NRC to C. M. Crane (Exelon Generation Company, LLC), "LaSalle County Power Station, Units 1 and 2 – Request for Additional Information Related to Request for Amendment to Technical Specifications Associated With Direct Current Electrical Power," dated June 2, 2006

3. Jack Hohenstein, C&D Technologies, Incorporated, telephone voice mail information to Kent C. Nelson, Exelon Generation Company, LLC, July 27, 2006

4. Letter from S. N. Bailey, (NRC), to O. D. Kingsley, (Exelon Nuclear), "Issuance of Amendments," dated March 30, 2001

5. Milner, P.C., "Float Behavior of the Lead-Acid Battery System," The Bell System Technical Journal 49 (September 1970): 1249-1334

6. Technical Specifications Task Force (TSTF) Traveler TSTF-360, Revision 1, "DC Electrical Rewrite"

7. LSCS Engineering Design Change EC #333812, "Install Back-Up Unit 1 Division 2 125 Vdc Battery Charger"

8. LSCS Engineering Design Change EC #333810, "Install Back-Up Unit 1 Division 1 125 Vdc Battery Charger"

9. LSCS Engineering Design Change EC #350396, "Float Voltage and Current for the 125 Vdc and 250 Vdc Batteries for both Unit 1 & 2"

10. LSCS Engineering Design Change EC #359490, "Unit 1 and 2, Division 1, 2 and 3 125 Vdc Class 1E Battery Load Profiles for Service Test and Modified Performance Test"

11. LSCS Engineering Calculation D30, Revision 5A, "Station Blackout-Capability of 125V and 250V Batteries to Feed Loads During Station Blackout (SBO)"Performance Test"

12. LSCS Procedure LOP-DC-02, "DC System Unit Tie Operations," Revision 16

13. LSCS Operating Abnormal Procedure LOA-DC-101, "Unit 1 DC Power System Failure," Revision 9

14. LSCS Operating Abnormal Procedure LOA-DC-201, "Unit 2 DC Power System Failure," Revision 7

15. LSCS Operating Surveillance Procedure LOS-DC-Q2, "Battery Readings for Safety Related 250 VDC and Div 1, 2, 3 125 VDC Batteries," Revision 25

16. LSCS Operating Surveillance Procedure LOS-DC-W1, "Weekly Surveillance for Safety Related 250 VDC and 125 VDC Batteries and DC Distribution," Revision 41

17. EGC Procedure OP-AA-103-102, "Watchstanding Practices," Revision 6

18. LSCS Operating Abnormal Procedure LOA-VX-101, "Unit 1 Switchgear Heat Removal System Abnormal," Revision 5

19. LSCS Operating Abnormal Procedure LOA-VX-201, "Unit 2 Switchgear Heat Removal System Abnormal," Revision 6

20. LSCS Operating Surveillance Procedure LOS-AA-S101, "Unit 1 Shiftly Surveillance," Revision 38

21. LSCS Operating Surveillance Procedure LOS-AA-S201, "Unit 2 Shiftly Surveillance," Revision 42

22. EGC Operating Procedure OP-AA-102-102, "General Area Checks and Operator Field Rounds," Revision 5

23. Institute of Electrical and Electronic Engineers (IEEE) Standard 450-1995, "IEEE Recommended Practice for Maintenance, Testing, and Replacement of Vented Lead-Acid Batteries for Stationary Applications"

24. IEEE Standard 450-1975, "IEEE Recommended Practice for Maintenance, Testing, and Replacement of Large Lead Storage Batteries for Generating Stations and Substations"

25. IEEE Standard 946-1985, "IEEE Recommended Practice for the Design of Safety Related DC Auxiliary Power Systems for Nuclear Power Generating Stations"

26. IEEE Standard 485-1997, "IEEE Recommended Practice for Sizing Lead-Acid Batteries for Stationary Applications"

**ATTACHMENT 2**

**LaSalle County Station**
**Facility Operating License Nos. NPF-11 and NPF-18**

**Revised Technical Specification Bases Page**

**B 3.8.4-3**

BASES

BACKGROUND (continued)

between redundant Class 1E subsystems such as batteries, battery chargers, or distribution panels.

Each Division 1, 2, and 3 battery has adequate storage capacity to meet the duty cycle(s) discussed in the UFSAR, Section 8.3.2 (Ref. 4). The battery is designed with additional capacity above that required by the design duty cycle to allow for temperature variations and other factors. Based on LaSalle Station battery sizing calculations, Divisions 1 and 2 batteries have a margin of at least 5%. The Division 3 batteries have a margin of at least 10%.

The batteries for a DC electrical power subsystem are sized to produce required capacity at 80% of nameplate rating, corresponding to warranted capacity at end of life cycles and the 100% design demand. The minimum design voltage limit is 105/210 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 and 240 V for a 116 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 will maintain its capacity for 30 days without further charging per manufacturers instructions. Optimal long term performance however, is obtained by maintaining a float voltage 2.17 Vpc to 2.25 Vpc for Division 1 and Division 2 and maintaining a float voltage of 2.20 Vpc to 2.25 Vpc for Division 3. This provides adequate over-potential, which limits the formation of lead sulfate and self discharge. The nominal float voltage of 2.23 Vpc corresponds to a total float voltage output of 129.3 V for a 58 cell battery and 258.7 V for a 116 cell battery as discussed in the UFSAR, Section 8.3.2 (Ref. 4).

Each Division 1, 2, and 3 DC electrical power subsystem battery charger has ample power output capacity for the steady state operation of connected loads required during normal operation, while at the same time maintaining its battery bank fully charged. Each battery charger has sufficient capacity to restore the battery bank from the design minimum charge to its fully charged state within

(continued)

**ATTACHMENT 3**

**LaSalle County Station**
**Facility Operating License Nos. NPF-11 and NPF-18**

**Draft Copy of TRM 3.8.d "Battery Monitoring and Maintenance"**

## 3.8 ELECTRICAL POWER SYSTEMS

### 3.8.d Battery Monitoring and Maintenance

TLCO 3.8.d The Division 1, 2, and 3, and opposite unit Division 2 batteries shall be maintained in accordance with the Battery Monitoring and Maintenance Program of Technical Specification 5.5.14 with battery cell parameters within the limits of Table T3.8.d-1.

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

ACTIONS

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

| CONDITION | REQUIRED ACTION | COMPLETION TIME |
|---|---|---|
| A. ---------NOTE-------------- Required Actions A.4 and A.5, when applicable, shall be completed if this Condition is entered. ------------------------------ | A.1 Verify pilot cells electrolyte level and float voltage meet Table T3.8.d-1 Category C limits. | 1 hour |
| | AND | |
| One or more batteries with one or more battery cell parameters not within Table T3.8.d-1 Category A or B limits. | A.2 Verify battery cell parameters meet Table T3.8.d-1 Category C limits. | 24 hours<br>AND<br>Once per 7 days thereafter |
| | AND | |
| | | (continued) |

| CONDITION | REQUIRED ACTION | COMPLETION TIME |
|---|---|---|
| A. (continued) | A.3 Restore battery cell parameters to Table T3.8.d-1 Category A and B limits. | 31 days |
| | <u>AND</u> | |
| | A.4 -------------NOTE------------- Only applicable if electrolyte level is less than the limit. --------------------------------- | |
| | Conduct an equalizing charge of the affected battery cells(s). | 31 days |
| | <u>AND</u> | |
| | A.5 -------------NOTE------------- Only applicable if electrolyte level is less than the limit. --------------------------------- | |
| | Conduct IEEE-450 recommended testing of the affected battery cells(s). | 31 days |
| B. Required Action and associated Completion Time not met.<br><br><u>OR</u><br><br>One or more batteries with one or more Surveillance acceptance criteria of this Requirement not met for reasons other than Condition A. | B.1 Initiate action to prepare a corrective action program report outlining the action taken, the cause of failing to meet the acceptance criteria, and the plans and schedule for restoration. | Immediately |

SURVEILLANCE REQUIREMENTS

| SURVEILLANCE | | FREQUENCY |
|---|---|---|
| TSR 3.8.d.1 | Verify battery cell parameters meet Table T3.8.d-1 Category A limits. | 31 days |
| TSR 3.8.d.2 | Verify battery cell parameters meet Table T3.8.d-1 Category B limits. | 92 days<br><br>AND<br><br>Once within 7 days after battery discharge < 110 V for 125 V batteries and < 220 V for the 250 V battery<br><br>AND<br><br>Once within 7 days after battery overcharge > 150 V for 125 V batteries and > 300 V for the 250 V battery |
| TSR 3.8.d.3 | Verify average electrolyte temperature of representative cells is ≥ 60°F for 125 V batteries, and ≥ 65°F for the 250 V battery. | 92 days |
| TSR 3.8.d.4 | Verify no visible corrosion at battery terminals and connectors.<br><br>OR<br><br>Verify battery connection resistance is ≤ 1.5E-4 ohm for inter-cell connections, and ≤ 1.5E-4 ohm for terminal connections. | 92 days |

(continued)

| SURVEILLANCE | | FREQUENCY |
|---|---|---|
| TSR 3.8.d.5 | Verify battery cells, cell plates, and racks show no visual indication of physical damage or abnormal deterioration that could degrade battery performance. | 24 months |
| TSR 3.8.d.6 | Remove visible corrosion and verify battery cell to cell and terminal connections are coated with anti-corrosion material. | 24 months |
| TSR 3.8.d.7 | Verify battery connection resistance is ≤ 1.5E-4 ohm for inter-cell connections, and ≤ 1.5E-4 ohm for terminal connections. | 24 months |

Table T3.8.d-1 (page 1 of 1)
Battery Cell Parameter Requirements

| PARAMETER | CATEGORY A: LIMITS FOR EACH DESIGNATED PILOT CELL | CATEGORY B: LIMITS FOR EACH CONNECTED CELL | CATEGORY C: LIMITS FOR EACH CONNECTED CELL |
|---|---|---|---|
| Electrolyte Level | > Minimum level indication mark, and ≤ ¼ inch above maximum level indication mark[(a)] | > Minimum level indication mark, and ≤ ¼ inch above maximum level indication mark[(a)] | Above top of plates, and not overflowing |
| Float Voltage | ≥ 2.13 V | ≥ 2.13 V | > 2.07 V |
| Specific Gravity[(b)(c)] | ≥ 1.200 | ≥ 1.195<br><br><u>AND</u><br><br>Average of all connected cells > 1.205 | Not more than 0.020 below average of all connected cells<br><br><u>AND</u><br><br>Average of all connected cells ≥ 1.195 |

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

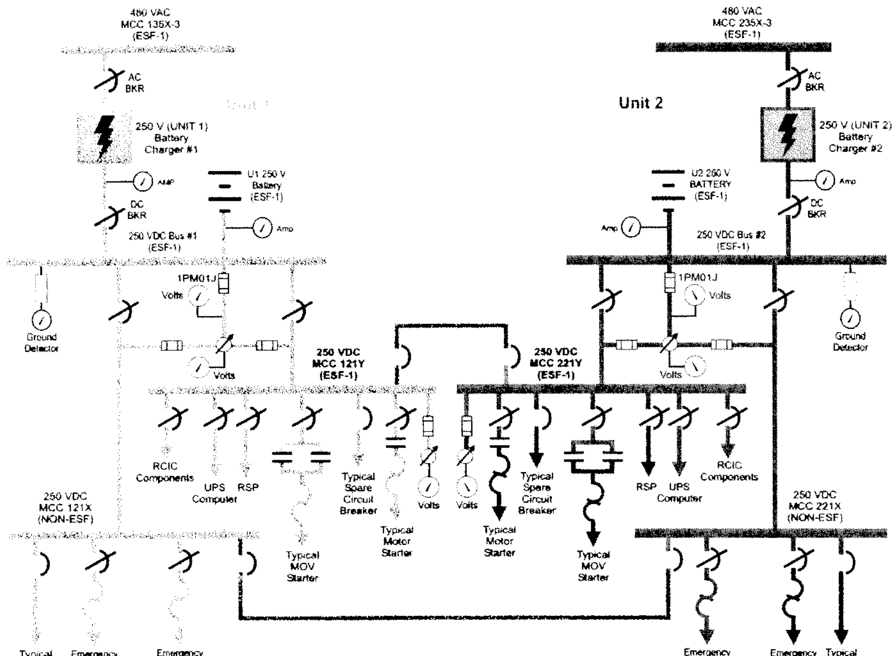
(b) Corrected for electrolyte temperature and level.

(c) A battery charging current of < 2 amps when on float charge is acceptable for meeting Category A and B specific gravity limits following a battery recharge, for a maximum of 7 days. When charging current is used to satisfy specific gravity requirements, specific gravity of each connected cell shall be measured prior to expiration of the 7 day allowance.

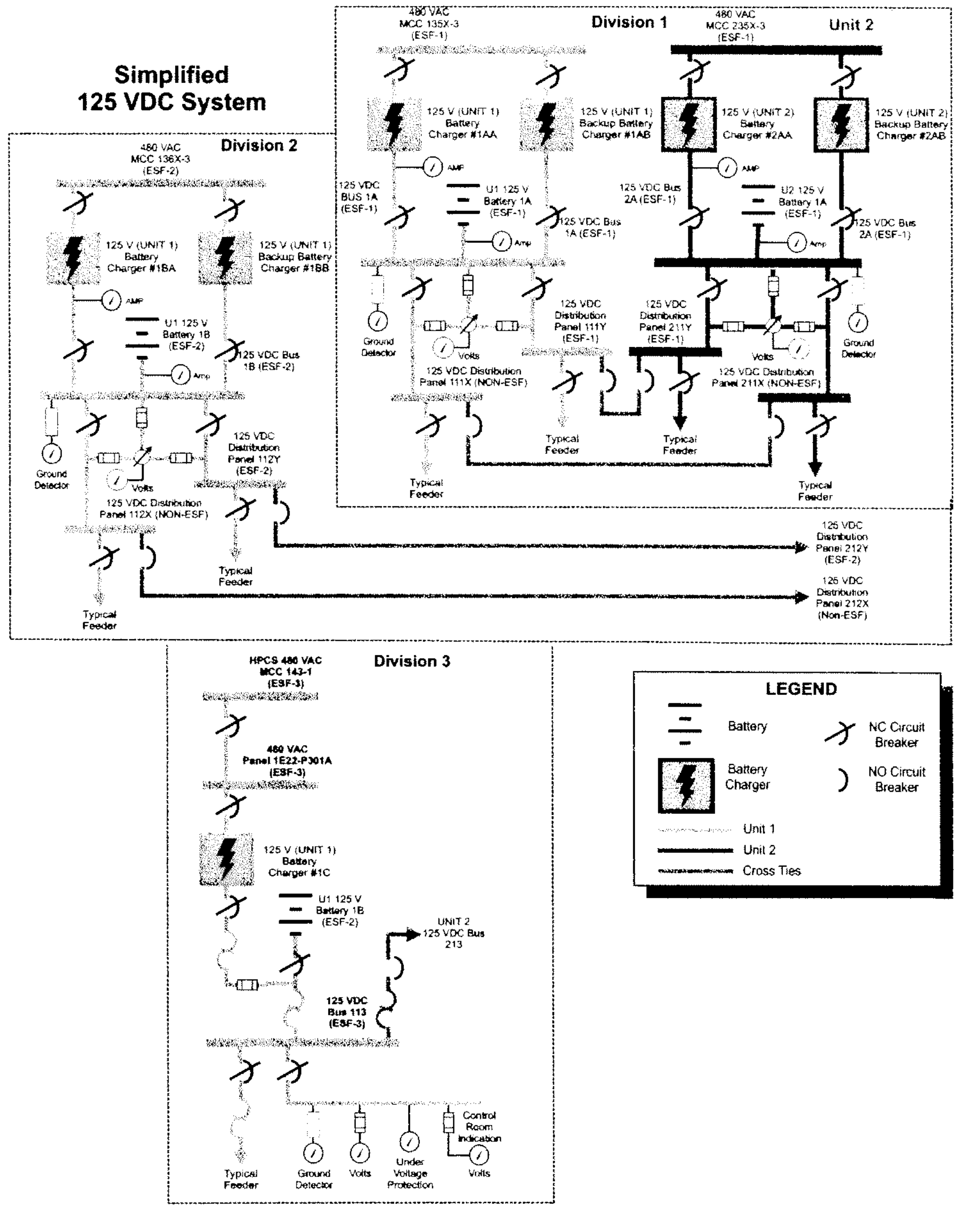
**ATTACHMENT 4**

**LaSalle County Station**
**Facility Operating License Nos. NPF-11 and NPF-18**

**Simplified Schematic of the LSCS DC Distribution**




**Simplified 250 VDC System**




**Simplified 125 VDC System**

**For Reference Only**
**Not A Controlled Document**