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SUBJECT: Provides response to 881129 request for addl info re adequacy of demonstrated station battery capacity.

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September 21, 1989

U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, D.C. 20555

Gentlemen:

Subject: Docket Nos. 50-361 and 50-362
Response to Request for Additional Information
125 Volt Battery Capacity (TAC Nos. 71194 and 71195)
San Onofre Nuclear Generating Station
Units 2 and 3

References: A. NRC (D. Hickman) to SCE (Kenneth P. Baskin) request for additional information dated November 29, 1988, Subject: 125 Vdc Station Batteries

B. NRC (D. Hickman) to SCE (Harold B. Ray) request for additional information dated August 24, 1989; Subject: 125 Vdc Station Batteries

C. Safety Evaluation of the Natural Circulation Cooldown Test at San Onofre Nuclear Generating Station Units 2 and 3, dated February 24, 1988

This letter provides the response from the Southern California Edison Company (SCE) to Reference (A) regarding the adequacy of demonstrated Station battery capacity. As discussed below, SCE has demonstrated adequate battery capacity for current battery loads. However, SCE has also discovered a related condition that would have prevented the batteries from providing power to the SDCS suction isolation valves when required in the NRC RSB 5-1 shutdown scenario and the response to a specific small break LOCA event. Whereas this condition existed during earlier plant cycles, it does not exist today.

By References (A) and (B), the NRC requested SCE to provide additional information regarding the adequacy of demonstrated battery capacity to allow alignment of the shutdown cooling system (SDCS) suction isolation valves following postulated accidents or a natural circulation cooldown, assuming a loss of offsite power and a single failure. The Reference (A) request was prompted by SCE's Licensee Event Report (LER) No. 88-019, dated August 31, 1988, which identified that an apparent inconsistency within the FSAR regarding battery design duty cycles resulted in the 18-month interval battery service test not adequately demonstrating the required design duty cycles for battery banks C and D. Battery banks C and D supply A.C. power, via separate inverters, to the two series 10-inch SDCS suction isolation valves.

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The LER stated that the batteries are required to operate up to six hours following an accident to support shutdown cooling valve operation. Reference (A) observed that the FSAR would require the batteries to operate for some time beyond six hours. FSAR Section 6.3.3.4.1 indicates that at six hours following an accident, a determination is made whether or not to go onto shutdown cooling and some additional time would be required to continue to cool the RCS with the steam generators until the shutdown cooling entry temperature is achieved. Additionally, Reference (A) noted that the LER did not address the battery capacity required to align shutdown cooling from the control room following a natural circulation cooldown with a loss of offsite power and most limiting single failure, the NRC Branch Technical Position RSB 5-1 scenario. Based on the natural circulation cooldown test which was conducted at San Onofre to demonstrate compliance with RSB 5-1, Reference (A) noted that the battery capacity to be demonstrated by the eight hour battery performance test, described in the LER as a corrective action, may not be adequate to ensure that the design requirements are met.

In the standard RSB 5-1 scenario, the plant is maintained in hot standby for four hours prior to commencing the natural circulation cooldown and depressurization to shutdown cooling entry conditions. The natural circulation cooldown test required 8 hours and 36 minutes to reach shutdown cooling entry conditions after the cooldown was begun. Thus, a battery capacity in excess of twelve hours or alternative actions would be required. No alternative actions to address this situation have been previously reviewed by the NRC.

During the natural circulation test, the cooldown rate was limited by a requirement to not allow void formation in the reactor vessel upper head region. This area cools the slowest because the reactor coolant in this area is relatively stagnant during natural circulation. A restriction on void formation in the upper head region was consistent with the prevalent thinking at the time of the SONGS natural circulation test. Subsequently, this restriction was removed by NRC approval of CEN-152, Combustion Engineering Emergency Procedure Guidelines, and recognition of the advantages of void formation by Reference C. With the formation of a void in the upper head region, the natural circulation cooldown rate is no longer limited by the cooling of the upper head metal mass. Consistent with the approved emergency procedure guidelines, controlled voiding in the upper head during a natural circulation cooldown is an integral part of the SONGS 2/3 emergency operating instruction (EOI) for loss of offsite power. With void formation the plant can be cooled to shutdown cooling entry conditions in less than six hours. The San Onofre Units 2 and 3 emergency operating instructions were revised during the Unit 2 cycle 4 refueling outage to provide guidance to commence plant cooldown following a loss of offsite power event. By not waiting in hot standby for 4 hours and not waiting for the upper head metal mass to cool, the total cool down time will be 6 hours or less.

During Cycles 1 and 3, the C and D batteries were given an 8 hour discharge test. However, for Cycle 2 only a 90 minute service test was performed for these batteries. At Cycle 4 refueling, both batteries were replaced "in kind" and given an 8 hour performance test. This is sufficient time to satisfy the 6 hours needed to satisfy the RSB 5-1 shutdown scenario (6 hour natural circulation cool down time) for the battery load profile in Cycles 4 and beyond. It does not verify adequate battery capacity during Cycles 1 through 3 because the EOI's had not yet been revised to include guidance to initiate plant cooldown following a loss of offsite power event. However, as discussed below, a recent review of

the associated battery inverters makes the issue of battery capacity during Cycles 1 through 3 moot. As a result, SCE will not reevaluate battery capacity for those cycles.

As discussed above, our operating procedures provide guidance to commence plant cooldown following a loss of offsite power event. This fact alone reduces the NRC's 12 hour 36 minute RSB 5-1 cooldown to 8 hours 36 minutes for San Onofre Units 2 and 3. Additionally, as discussed above, this time is reduced further by not waiting for the upper head metal mass to cool. As a result, the NRC's RSB 5-1 cooldown scenario can be accomplished in less than six hours, as implemented at San Onofre Units 2 and 3.

Therefore, the eight hour battery performance test completed during the Cycle 4 refueling outage demonstrates that San Onofre Units 2 and 3 will be able to align the shutdown cooling system to the RCS following a natural circulation cooldown with a loss of offsite power. SCE considers that this discussion satisfies the NRC request to demonstrate that the 8 hour battery performance test is adequate to demonstrate compliance with RSB 5-1.

SCE has also concluded that the above mentioned 8 hour battery performance test demonstrates adequate battery capacity to align shutdown cooling to the RCS following a small break LOCA. As stated in FSAR Section 6.3.3.4.1, additional time beyond 6 hours could be required prior to reaching SDC alignment temperature and pressure following a small beak LOCA. The additional time required would be longest for the smallest LOCA referenced in this FSAR section. For this LOCA (.0001 ft^2), the plant would need to reduce pressure from 1318 psia (at T=6 hours) to the SDC alignment pressure (400 psia). Based on the sequence of events presented in FSAR Section 5.4.7.2.5.3.G, this pressure reduction from 1318 psia to 400 psia can be completed with auxiliary spray in less than 1 hour. Therefore, for the most limiting small break LOCA, the plant would be able to reach SDC alignment conditions within 7 hours following event initiation. Therefore, the 8 hour battery performance test bounds the requirement to align SDCS (operate SDCS valves with Station Batteries) to the RCS following a small break LOCA. SCE will revise applicable sections of the FSAR to clearly reflect these requirements for the Station Batteries as part of our next update to the FSAR.

Prior to return to service from the Unit 2 Cycle 5 refueling outage, the current battery calculation for the existing batteries (applicable to both Units 2 and 3) will be revised to include SDC valve operation after six hours (but before 8 hours) in the load profile and the battery tested for this revised load profile. Service tests performed thereafter will be performed in accordance with this revised load profile.

As a related issue, but separate from the above discussion, it was identified that a design deficiency with the C and D battery inverters that was identified in LER No. 88-027, would have prevented Units 2 and 3 from being able to satisfy the NRC RSB 5-1 shutdown scenario. Specifically, the inverter low voltage shutdown circuit senses input voltage down stream of a power supply filter inductor rather than at the input terminals. As the SDCS isolation valves are operated, a voltage drop across the inductor occurs and the inverter shuts down at a battery input voltage of approximately 115 volts rather than the designed minimum voltage of 105 volts (inverter trip setpoint). As reported in the LER, in the unlikely event of a design basis accident coincident with a loss of

offsite power and a failure of a diesel generator occurred, alignment of the SDC system may not have occurred prior to the battery decaying below 115 volts. In this situation, residual heat removal could be provided by an operable steam generator until the SDC valves could be opened.

SCE has evaluated this past condition described above and determined that the inverters would have reached the undervoltage trip setpoint as seen by the batteries before 6 hours into the NRC RSB 5-1 shutdown scenario or the response to the small break LOCA event. Thus, even if SCE could show by calculation or test that the C and D batteries had sufficient capacity during Cycles 1 through 3 to satisfy the NRC's RSB 5-1 shutdown scenario, the SDC inverters would have prematurely shutdown and prevented the operation of the SCDS valves. This inverter design deficiency was temporarily corrected by lowering the inverter trip setpoint to accommodate the voltage drop for both Units 2 and 3 during the Unit 3 Cycle 4 refueling outage. SCE is currently testing a permanent correction to this situation.

In summary, during Cycles 1, 2 and 3 and the first 9 months of Unit 2 Cycle 4, San Onofre Units 2 and 3 were not in compliance with the requirements of NRC RSB 5-1 or the need to align shutdown cooling following certain small break LOCA events due to an inverter design deficiency. As stated previously, this condition has been corrected and does not now exist. The applicable sections of the FSAR will be corrected during the next scheduled update.

Should you have any additional questions regarding this subject, please call me.

Very truly yours,

cc: J. B. Martin, Regional Administrator, NRC Region V
C. Caldwell, NRC Senior Resident Inspector, San Onofre Units 1, 2 and 3