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

Gentlemen:

Subject: Docket Nos. 50-361 and 50-362
Electrical Safety System Functional Inspection
San Onofre Nuclear Generating Station
Units 2 and 3

This letter responds to the Electrical Safety System Functional Inspection (SSFI) conducted at San Onofre Units 2 and 3 on October 30 through November 30, 1989 (NRC Inspection Report Nos. 50-361/89-200 and 50-362/89-200 dated January 12, 1990). The purpose of the inspection was to determine whether the electrical distribution system as designed, installed, and configured at San Onofre Units 2 and 3 would be capable of performing its intended safety functions. As a result of the inspection, the NRC identified fifteen specific deficiencies related to the electrical distribution system. These deficiencies are summarized in Appendix A to the inspection report.

The NRC requested SCE to inform them of the action taken related to the fifteen deficiencies and the date that these actions will be completed. The Enclosure to this letter provides SCE's assessment of each of the deficiencies and the action being taken relative to each item. The schedule for completion of each item is also provided.

In our evaluation of the NRC findings related to engineering work, we paid particular attention to which findings related to engineering work performed prior to our efforts to upgrade our engineering programs and which findings related to current engineering work. In general, the findings were directed at work performed before our 1989 engineering upgrade efforts. The strengths identified during the inspection associated with the thoroughness and promptness of the immediate actions taken as a result of NRC findings and with the ongoing design basis documentation effort are consistent with our assessment that the

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more recent work reflects the benefits of our upgrade program. Although much work is yet to be done in future years, especially with our design basis documentation effort, it appears that our efforts so far are meeting with success.

In our review of the findings related to maintenance, we noted that several of the same issues were identified during the Maintenance Team Inspection conducted at San Onofre in June and July of 1989 (NRC Inspection Report No. 50-361/89-16). SCE shares the NRC's concern with the apparent inattention to detail in the maintenance area. SCE has devoted significant management attention to this area as a result of both this inspection and the Maintenance Team Inspection. We clearly understand the need for enhanced diligence and attention to detail, and are developing corrective actions to address this area.

In addition to the fifteen specific deficiencies, the inspection report also identified four general areas of weakness. These weaknesses are: (1) inadequate translation of the design basis to setpoints, (2) inadequate calibration and surveillance procedures, (3) maintenance deficiencies, and (4) inadequate design calculations. Each of these weaknesses is discussed below.

Inadequate Translation of the Design Basis to Setpoints

The NRC findings related to the adequacy of setpoints identified an area that may not have been addressed by other programs currently in progress. Therefore, in response to the NRC findings in this area, SCE has initiated a comprehensive program to reevaluate all safety-related controls setpoints at San Onofre Units 2 and 3. This program includes: (1) performing loop accuracy calculations, (2) reviewing calibration techniques and tolerances, (3) reviewing setpoint values to establish consistency with the design bases, and (4) resolution of any inconsistencies identified. This program is projected to involve about 100 man-years of work over the next three years. A similar evaluation for San Onofre Unit 1 setpoints will be initiated following completion of the design basis document program. Additionally, the specific items regarding setpoints identified by the NRC during the inspection will be corrected, as discussed for each item in the Enclosure.

Inadequate Calibration and Surveillance Procedures

One specific aspect of the program discussed above to reevaluate setpoints will be the review of calibration techniques and tolerances. This review will serve to ensure consistency with the setpoint calculations, as well as to identify

deficiencies in the calibration and surveillance procedures that require correction. In addition, the specific items identified by the inspection team will be corrected as identified in the Enclosure.

Maintenance Deficiencies

Immediately following the inspection, the Maintenance Manager reviewed the specific findings with maintenance personnel during the quarterly crew meetings held in December 1989. In addition, enhancements will be made to the training program to include documentation requirements and supervisory review requirements in mandatory retraining programs for crafts, planners and supervisors.

Prior to completion of the inspection, SCE conducted an interdisciplinary review of a sample of the maintenance work completed during the recent Unit 2 refueling outage. This review confirmed that there were weaknesses in planning and implementation of some work packages. None of the individual deficiencies identified were safety significant; but, collectively they indicated a lack of attention to detail in maintenance work performed at San Onofre. A similar conclusion was reached by the Maintenance Team Inspection. A detailed action plan has been prepared to address weaknesses identified by SCE's internal review, the Maintenance Team Inspection, and the SSFI. As a check on the effectiveness of the corrective actions, the Nuclear Oversight Division will increase field surveillances of major maintenance work activities during the next several refueling outages.

Inadequate Design Calculations

The adequacy of electrical design calculations was an area identified during the SSFI conducted in 1988 (NRC Inspection Report Nos. 50-361/88-10 and 50-362/88-10). As a result of that inspection, SCE embarked on a program to perform new formal electrical calculations for San Onofre Units 1, 2 and 3. A major portion of this program has been started for San Onofre Unit 1. For Units 2 and 3, the majority of the electrical calculations are scheduled to be generated in 1990. SCE has obtained enhanced computer capabilities and software to support this effort. These calculations will include: auxiliary power system voltage regulation, short circuit, transformer and bus loading; diesel generator loading; motor starting; motor starter control circuit voltages; containment penetration protection; and DC power system voltage regulation, short circuit, equipment loading and sizing.

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Outside of the electrical area, in 1988 SCE initiated a Design Basis Documentation program. This program is systematically reviewing each of the safety-related systems at San Onofre Units 1, 2 and 3 and is specifically determining the status of calculations needed to demonstrate system functional performance requirements are met. Where available, surveillance and/or startup testing records may be used in lieu of calculations. Update of existing calculations or reconstitution of missing or incomplete calculations is evaluated as each system is reviewed.

If you have any questions on this information, please let me know.

Very truly yours,

Enclosure

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

ENCLOSURE

SCE ACTIONS RELATED TO NRC ELECTRICAL SSFI DEFICIENCIES

1. Item: Emergency Diesel Generator Winding Insulation

Assessment: The fire sprinkler system in the diesel generator building is of a dry-pipe design with an actuation valve located outside the building. Two infrared sensors must activate to open the valve. Further, actual suppression will not occur unless the sprinkler head fusible links melt due to a fire. This type of design is considered highly reliable and inadvertent sprinkler actuation is not typically postulated. However, there was no analysis which demonstrated that the actuation valve, the sprinkler piping and the sprinkler head fusible links would not fail due to a seismic event. This postulated failure could lead to spraying the generator stator which is not qualified for this condition. Since the sprinkler system was designed as a dry-pipe design, this potential failure mode was not previously considered. Although there are other dry-pipe design sprinkler systems in the plant, there are no safety-related components in these areas susceptible to failure due to inadvertent sprinkler actuation.

Action: As an interim measure, SCE isolated the fire suppression system and established a fire watch for the diesel generator buildings. Since the inspection, SCE has performed seismic analyses which demonstrate that the fusible links and the fire sprinkler piping in the proximity of the diesel generator stator will maintain their integrity in a seismic event and not spray the stator. The fire suppression system has been returned to service. Action on this item is complete.

2. Item: Unqualified Motor Control Centers in Emergency Diesel Generator Rooms

Assessment: The design ambient temperature of the diesel generator rooms is 122°F with the diesels operating. For purposes of Environmental Qualification, this is considered a mild environment. However, the design of the Motor Control Centers in these rooms was based on an ambient temperature of 104°F. Although this was identified in 1981, action was not completed to qualify the Motor Control Centers to 122°F.

Action: An evaluation performed during the inspection determined that the Motor Control Centers are acceptable based on qualification of similar Motor Control Centers at other plant sites. A final evaluation, based on receipt of additional vendor information, will be completed by May 31, 1990. Other Motor Control Centers located in mild areas of the plant were reviewed and found to have been designed consistent with the design ambient temperatures.

3. Item: Inadequate 120-Vac Control Power

Assessment: 120 Vac motor contactors are designed to pick up at voltages of 85% of rated, or at 102 Vac. The original plant design calculations for the 120 Vac control circuits determined that the voltage at all contactors would not fall below 105 Vac. However, the inspection team identified that these calculations included two errors: (1) the worst case voltage drop at the 480 Vac bus was assumed to be 3% instead of the 9% determined in another calculation, and (2) the 480 to 120 Vac transformers were assumed to put out full rated voltage during inrush currents of as much as 200 percent. New calculations performed during the inspection identified several cases where the worst case voltage at the motor contactors could be below 102 Vac.

Action: Testing of a sample of Unit 2 motor contactors in which the coil voltage could fall below the rated pickup voltage of 102 Vac has been completed and the results demonstrate that these contactors would operate properly under worst case voltage conditions. Based upon these tests, we have a high confidence that all the motor contactors are acceptable. However, in order to gain full confidence that all motor contactors are acceptable, the Unit 3 and the balance of Unit 2 motor starters which could fall below 102 Vac, will be tested during the Unit 3 Cycle 5 refueling outage scheduled to begin in April 1990 and the future Unit 2 Cycle 6 outages, respectively.

4. Item: Inadequate Assurance of Battery Temperature

Assessment: The design basis minimum battery electrolyte temperature is 60°F. The design basis minimum outside temperature is 36°F. Although the battery rooms include a heater in the normal non-1E HVAC unit, there is no 1E heater unit. In the event of failure of the non-1E heater, there is no documentation that the battery electrolyte will be maintained above 60°F in the event of worst case winter outside air conditions if no operator action is taken. Battery electrolyte temperatures below 60°F can result in decreased battery capacity.

Action: An evaluation performed during the inspection determined that the room temperature could drop to 42°F in the event of a heater failure during the worst case winter outside air conditions if no operator action is taken. The station operating procedures require the operator to monitor the battery room exhaust temperature on a shiftly basis and take compensatory actions to ensure the Technical Specification minimum battery temperature is always maintained. Further, the interim evaluation determined that even if the temperature dropped to 42°F, the batteries had sufficient margin to support the required emergency loads at this reduced operating temperature, considering the age of the existing batteries.

SCE will install appropriate temperature indication or alarms such that the operators will be aware when battery room temperature falls below 65°F to allow time to correct this condition through the use of portable heating equipment before the battery room reaches 60°F. This modification will be made during the Cycle 6 outages for Units 2 and 3. The batteries have sufficient capacity to perform their safety functions at 42°F through the end of Cycle 5 operation.

5. Item: Electrical Setpoint List Errors

Assessment: In 1988, SCE initiated efforts to compile the Electrical Setpoint List, to document and control the setpoints for electrical components. During the inspection, walkdowns performed by SCE identified that about 4% of the line entries in this document included errors. Although most of these errors were editorial (wrong manufacturer, wrong model number, etc.), a number of the errors were related to actual setpoint values (e.g., breaker sensor amp tap setting and sensor pickup setting). None of the errors identified were concluded to be significant.

Action: As a result of the SSFI findings, SCE performed a walkdown of the setpoint document. Values and information which were found to be in error were corrected. In addition, an initial setpoint list for Unit 1 and updated setpoint lists for Units 2 and 3 will be formally issued by June 30, 1990.

6. Item: Invertor Low dc Input Voltage Shutdown Setpoint Not in Accordance With Calculation

Assessment: The battery sizing calculation used the maximum anticipated low voltage at the inverters as 104 + 1.414 volts. This was based on the inverter low voltage setpoint of 104±1 volt with an allowance for drift and repeatability. An attachment to the calculation indicated that the setpoint for the inverter low input voltage shutdown should be revised to 104±1 Volts. This revision to the setpoint was never implemented at the site. The setpoint being used at the site was 105 + 0.25/-2 Volts. The potential small error in the setpoint (105.25 versus 105 Volts) would not have had any effect on battery capacity.

Action: The calibration procedure was revised December 1989, and the manuals were revised in February 1990 to be consistent with the tolerance specified in the calculation. Action on this item is complete.

7. Item: Lack of Abnormal Operating Procedure For Tornadic Conditions

Assessment: FSAR Section 9.5.4 identified that the vent line above the diesel fuel oil transfer pump house roof is not protected from tornado missiles. The FSAR indicated that if the vent line was damaged, a blind flange on the line below the roof can be removed to assure tank venting. However, there is no abnormal operating instruction to ensure this action is taken. Further, there is no procedure for responding to a tornado.

Action: Action associated with removal of the flange on the fuel tank vent, was incorporated in a revision to the Natural Disaster/Severe Weather abnormal operating instruction. This revision was implemented March 5, 1990.

8. Item: Inadequate Diesel Day Tank Level Setpoints

Assessment: The minimum required volume of fuel oil in the diesel generator day tank is 325 gallons as indicated in Technical Specifications 3.8.1.1.b.1 and 3.8.1.2.b.1. This volume is verified on a 7 or 31 day frequency in accordance with Surveillance Requirement 4.8.1.1.2.a.1. In addition, the fuel transfer pump automatically energizes at a preset level to ensure this minimum volume is maintained; however, this automatic transfer is not required by the Technical Specifications. The inspection team identified that the level setpoint at which the transfer pump was energized, as well as the low-level alarm setpoint, were not consistent with the minimum volume of 325 gallons if worst case setpoint tolerances were considered.

Action: A design change package is being processed to formally establish revised setpoints for the day tank. Until this is finalized, administrative controls have been established for the operators to maintain the day tanks full and to manually start the transfer pumps when the engines are started. These modifications will be installed no later than the Cycle 6 refueling outages for Units 2 and 3.

9. Item: Inadequate Air Receiver Pressure For Diesel Generators

Assessment: The diesel generators are provided to ensure electrical power is available to supply safety-related equipment required for safe shutdown or accident mitigation. One of the design requirements in FSAR Section 9.5.6.2.1.3 is that each diesel is provided with an air receiver which is capable of cranking a cold diesel engine five times without recharging the receiver. Each cranking cycle duration is approximately three seconds or consists of two to three engine revolutions. Starting air system controls were set to maintain a minimum air receiver pressure of 182 psig based on initial startup testing. The testing demonstrated that each starting air system, with a starting air receiver pressure of 175 psig, met the criteria of 3 second cranking duration on 5 attempts. However, upon review of the basis upon which the starting air system test results were accepted, it was determined that although cranking cycles for all tests were at least 3 seconds in duration, the number of crankshaft revolutions in some tests was not sufficient to ensure that a diesel start would occur. This had been demonstrated for only one air receiver at an initial pressure of 195 psig. Although this is a discrepancy with the original design basis for the air receivers, this would not have affected operation of the diesel generators.

Action: The results of the evaluation of diesel generator air receiver pressure were reported to the NRC in Licensee Event Report No. 2-89-007 on December 21, 1989. As interim corrective action, at least one receiver for each diesel generator is being maintained at a minimum pressure of 195 psig. At this pressure tests are available which demonstrate sufficient receiver capacity. An engineering evaluation has determined that modifications to the air system will be necessary to increase the receiver capacity to provide the necessary margin and reliability for long-term operation. A design change package is being developed to provide for the additional capacity. These modifications will be installed no later than the Cycle 6 refueling outages for Units 2 and 3.

10. Item: Diesel Generator Load Calculation Non-Conservative

Assessment: FSAR Table 8.3-1 lists the Class 1E ac loads applied to the diesel generators. Several of the loads listed in Table 8.3-1 for pump motors appear to be nonconservative relative to data from performance curves and motor data sheets. However, there is adequate margin between the diesel generator rating and the postulated loading listed in Table 8.3-1; therefore, these changes will not affect the ability of the diesel generator to perform its intended safety function.

Action: The basis for diesel generator loading calculations is being revised using conservative values for pump motor loads for various operating modes post-accident. The expected completion is September 30, 1990. Because of the approximate 20% margin between the calculated and the rated loading, we are confident that there is sufficient margin in the diesel generator design to accommodate any increase in loading determined as a result of this effort.

11. Item: Inadequate Overpressure Protection for Diesel Cooling Water Expansion Tank

Assessment: The diesel jacket cooling water expansion tank is an ASME Section III tank. However, it is fitted with a non-ASME code filler cap which also serves as overpressure protection. This was provided as part of the original vendor package design. Available data show that a sample of the existing pressure relief caps was satisfactorily tested and shown to provide adequate overpressure test protection for the diesel jacket cooling water expansion tank even though they were not ASME qualified.

Action: A temporary modification was installed to provide tested relief valves for all tanks until ASME relief valves can be obtained. ASME Code relief valves will be installed on the expansion tanks to provide overpressure protection. A design change package is in process which will provide for the addition of these valves. The installation is dependent upon material delivery. The expected delivery date for the relief valves is by the end of December 1990. Installation will be completed within two months of delivery.

12. Item: Improper Measurements Taken During Diesel Reassembly

Assessment: During a walkdown of the diesel generators, the inspection team observed craftsmen torquing bolts without a procedure at the job side. The procedure had just been removed from the job site by the foreman, because the only remaining activity was completion of torquing 2 of 72 handhole cover bolts. When the procedure was later reviewed, it was determined that lead wire measurements pertaining to piston clearances had been improperly evaluated. A similar error was observed in the same procedure for the Unit 3 diesels. The inspection team also noted that no quality control signoffs had been specified for the performance of this work.

Action: The Maintenance Manager reviewed the findings with maintenance personnel in December 1989. Enhancements will be made to the training program to include documentation requirements and supervisory review requirements for crafts, planners and supervisors. Appropriate lesson plans will be revised by June 1, 1990. All training will be completed by June 1, 1992. Relative to the lead wire checks, the procedure has been revised to eliminate these checks because they are not relevant as bearing wear indicators.

With respect to Quality Control involvement, this job was a surveillance that is repetitive in nature and controlled by procedure, QCI G-007, "Quality Control and Inspection Guidelines." Attachment 1 to this procedure provides for limited Quality Control involvement for this type of activity. Notwithstanding this, SCE will review surveillance maintenance procedures to assess the quality impact and, where appropriate, establish quality hold and/or witness points to verify program compliance. In addition, QCI G-007 will be revised to require the QC Planner to review surveillance procedures for activities that warrant quality control oversight and place appropriate quality points in the work plan.

13. Item: Hardware Deficiencies Found During Maintenance Walkthrough

Assessment: During walkdowns of maintenance activities for the batteries and diesel generators, the inspection team identified several discrepancies. Specific items included: (1) a missing battery spacer, (2) incorrect bolts on battery terminals, (3) loose nut on diesel engine oil filter cover, and (4) inadequate thread engagement on diesel air start line spacer flange.

Action: The specific deficiencies identified during the inspection have been corrected. In addition, a detailed action plan was prepared to address weaknesses identified by our internal review, by the Maintenance Team Inspection and by the SSFI. As a check on the effectiveness of our corrective actions, the Nuclear Oversight Division will increase their field surveillances of major maintenance work activities during the next several refueling outages.

14. Item: Deficiencies in Diesel Fuel Oil Day Tank Level Calibration

Assessment: The level measurement system for the diesel fuel oil day tank consists of two separate sensors: an analog level indication system and a float activated switch device. After reviewing the calibration procedure and previous test data, the inspection team identified problems with the instrument calibration data cards. Based on the existing information, the inspection team was unable to confirm that the system had been properly calibrated.

Action: The calibration procedure has been revised. In addition, errors on the instrument calibration data cards have been corrected. Action on this item is complete.

15. Item: Deficiencies in Diesel Fuel Storage Tank Level Calibration

Assessment: After reviewing documents and procedures associated with the calibration of the diesel generator fuel oil storage tank level measurement system, the inspection team identified three problems: (1) inadequate and incomplete calibration procedures, (2) inadequate operator aid data, and (3) discrepancies between documents on the level setpoints.

Action: SCE will review the diesel fuel storage tank level setpoints and calibration in conjunction with the overall setpoint reconstitution program. The evaluation of the storage tank level setpoints is expected to be complete by September 1, 1990. We are confident that there is sufficient margin in the fuel storage tank calculations to accommodate any errors that may be identified in this effort.