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Licensee: Southern California Edison Company

Facility: San Onofre Nuclear Generating Station, Units 2 and 3

Inspection Conducted: October 30 through November 8 and November 27 through November 30, 1989

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EXECUTIVE SUMMARY

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SOUTHERN CALIFORNIA EDISON COMPANY
SAN ONOFRE NUCLEAR GENERATING STATION UNITS 2 AND 3

During the periods of October 30 through November 8 and November 27 through November 30, 1989, a Safety Systems Functional Inspection (SSFI) was conducted at the San Onofre Nuclear Generating Station Units 2 and 3 and the Southern California Edison Company Nuclear Engineering offices in Irvine, California. The purpose of this inspection was to determine whether the electrical distribution system as designed and installed at San Onofre Units 2 and 3 would be capable of performing its intended safety functions. During the inspection, technical reviews of the calculations and related documents were conducted at the Nuclear Engineering offices in Irvine. Technical reviews of the design and installation were conducted during system walkdowns at the plant site.

As a result of the inspection, the team identified 15 specific deficiencies and 4 general areas of weakness. The first area of weakness concerned the inadequate translation of the design bases to component setpoints. Three of the team's findings involved setpoints that were found to be incorrect and were not consistent with the design basis of the associated equipment. These findings involved (1) diesel day tank level setpoints that were below the Technical Specification requirement, (2) diesel air receiver setpoints that would not ensure the specified five-start capability of the diesel generator, and (3) an inverter low voltage shutdown setpoint that was not in accordance with the design-basis calculations.

The second area of weakness concerned inadequate calibration and surveillance procedures. Three of the team's findings involved calibration and surveillance procedures that were found to be inadequate in ensuring that setpoints are properly translated into appropriate equipment settings. These findings included (1) a diesel day tank level surveillance procedure that did not specify when to perform a five-point calibration check or when only a single-point calibration check is required, (2) numerous discrepancies between installed equipment and a newly issued setpoint document, and (3) inconsistencies and errors in surveillance procedures and associated documents for calibrating the diesel fuel oil storage tank level measurement system.

These first two areas of weakness indicate a concern that, although equipment may have been properly selected and installed, the associated equipment settings are such that the performance of intended safety functions could be inhibited.

The third area of weakness was in the area of maintenance. The team's findings included the improper evaluation of recorded diesel piston measurements made during reassembly of the diesel generators, and numerous hardware deficiencies which were found after work on the batteries and the diesel generators had been completed. The team concluded that these findings were the apparent result of inattention to detail and are not indicative of a strong maintenance program.

The fourth area of weakness identified by the inspection team concerned the lack of formal calculations for key design parameters related to many of the electrical distribution systems. Calculations were found to be either missing or inadequate in the areas of (1) diesel loading, (2) 120-Vac control power voltage regulation, (3) dc motor-operated valves, and (4) containment penetration sizing and protection.

These four general areas of weakness were found to be applicable to both San Onofre Units 2 and 3. In addition, several other deficiencies were identified by the inspection team, including diesel stators that were not protected from a spuricus spray of the diesel room fire suppression system.

The team also identified several strengths during the inspection. The team found that (1) the diesels have ample load margin, (2) the coordination between various levels of protective devices is apparently adequate, and (3) the batteries are sufficiently sized to perform their design-basis functions. In addition, the current design-basis reconstitution program was seen as a way of correcting some of the weaknesses identified by the inspection team. The immediate actions taken as a result of the teams findings were both thorough and prompt.

1. INTRODUCTION

During recent inspections, NRC inspection teams have observed that the functionality of safety-related systems had been compromised as a result of design deficiencies introduced during design modifications of the electrical distribution system. In addition, problems have also been identified with the proper translation of the original design into the actual installed configuration of equipment. In order to access the adequacy of the electrical distribution system at San Onofre, a Safety Systems Functional Inspection (SSFI) specific to the electrical distribution system and associated equipment was performed by the inspection team.

The primary objective of this inspection was to determine whether the electrical distribution system would be capable of supplying adequate power to safety-related equipment under analyzed modes of plant operation. In order to accomplish this objective, the team reviewed calculations and associated documents as necessary to ensure that electrical power of acceptable voltage, current, and frequency would be available to safety-related equipment powered from the station electrical distribution system. The review included all portions of the onsite and offsite electrical distribution system beginning with, and including the station reserve auxiliary transformers, the 4160-Vac system, the diesel generators, the 480-Vac system, the station batteries, the 125-Vdc system, and the 120-Vac vital distribution system. In addition, a review was conducted of the mechanical systems required to support key pieces of electrical equipment. An onsite walkdown and review was also conducted of the maintenance, calibration, and surveillance activities for the above listed systems.

This inspection report is divided into three sections which present information on the team's findings in three different formats and at different levels of detail. Section 2 of the report contains a description of the general weaknesses identified by the inspection team and includes a brief description of the individual findings which support these conclusions. Sections 3, 4, and 5 of the report contain a brief description of each area reviewed by the inspection team along with a reference to detailed descriptions of each finding which are contained on the deficiency sheets of Appendix A to this report.

2. GENERAL AREAS OF WEAKNESS

As a result of the 15 specific deficiencies identified in this report, 4 general areas of weakness were identified by the inspection team. These general areas of weakness were found to be generic, and would be applicable to both San Onofre Units 2 and 3.

2.1 Inadequate Translation of the Design Basis to Setpoints

Three of the findings of this inspection were related to the inadequate translation of the design basis to equipment setpoints. The first finding involved the setpoints of the diesel day tank level control system. The setpoints for starting the diesel fuel oil transfer pump and for the day tank level alarm were too low and were not consistent with the Technical Specification minimum capacity limit of 325 gallons. In addition, it appeared that instrument inaccuracies and calibration uncertainties had not been taken into account in the setpoint calculations.

The second finding concerned the setpoints for the diesel air receivers. The setpoints for starting the air compressor and for the air receiver low pressure alarm were below the pressure required for five diesel starts determined during preoperational testing of one of the air receivers. In addition, the pressure that was established during testing of one receiver was not shown to be the worst case and may not envelope the specified pressure for five diesel starts by the other air receivers.

The third finding also concerned a setpoint that was not consistent with the design basis. The inverter low voltage shutdown setpoint was higher than that assumed in the design-basis calculations. Too high a setpoint could cause a premature shutdown of the inverters.

2.2 Inadequate Calibration and Surveillance Procedures

Three of the team's findings were related to inadequate operating and calibration procedures. The first finding concerned the calibration procedure for the diesel day tank level alarms and the level switches for starting the diesel fuel oil transfer pumps. Several deficiencies were noted with this procedure including the fact that a five-point calibration check of the instrumentation, including the sensor, is never required. In addition, the procedure did not indicate the applicable method for calibrating the instrument readout in percent of tank volume.

The second finding identified by the team concerned deficiencies in the procedures and instrument calibration data cards (ICDC) for the diesel fuel oil storage tank level measurement system. Specifically, the calibration procedures do not address how to relate the level transmitter output signal to the actual measured tank level. In addition, problems were identified with ICDC entries, with operator aid data, and with the level switch setpoints shown on the instrument setpoint list, the system descriptions, and on operating procedures.

The third finding concerned the newly issued setpoint document. In its walkdown of several pieces of equipment listed in the setpoint document, the team identified discrepancies between the setpoint document data and the as-installed equipment for three circuit breaker pickup settings and two circuit breaker frame sizes.

2.3 Maintenance Deficiencies

The team identified two findings that are indicative of poor maintenance practices. The first finding concerned the improper evaluation of piston clearance measurements that were taken during reassembly of one of the Unit 2 emergency diesel generators. Each piston clearance measurement was to have been evaluated against a similar measurement taken on the opposite side of each piston. Instead, the measurements were incorrectly evaluated against those taken during a previous outage. Furthermore, subtraction errors made during this evaluation were not identified by either a supervisory or quality assurance review process. These measurements also had been improperly evaluated during reassembly of another diesel generator in Unit 3. Although these particular measurements were not of a high degree of safety significance, the team was concerned that deficiencies such as these had not been identified by quality assurance or supervisory reviews.

The second maintenance deficiency identified by the team concerned loose bolts found on a diesel oil filter flange, loose bolts found on battery spacers, and incorrect bolts found on the terminal connections for the recently replaced Class 1E batteries. The new battery cells had only one bolt connection, instead of two, and required a larger bolt than that which previously had been used.

2.4 Inadequate Design Calculations

The fourth area of weakness concerned calculations that were inadequate to support the electrical system design basis. Several of the calculations were either missing or inadequate, including those for the diesel load study, 120-Vac control power voltage regulation, dc motor-operated valves, and containment penetration sizing and protection. The team found that the calculations for the diesel load study were nonconservative in that the Final Safety Analysis Report (FSAR) does not conservatively estimate pump motor loads on the diesel. The 120-Vac voltage regulation calculation reviewed by the team was found to be inadequate in that it assumed only a 3 rather than a true 7 percent voltage reduction at the 480-Vac motor control center bus. As a result, the supplied voltage to some contactors could fall below their 102-Vac rating.

During a review of the dc motor-operated valves, the team found that the licensee had not evaluated calculations that indicated a potential operability concern for four auxiliary feedwater motor-operated valves. As a result, new calculations were generated by the licensee which were deemed acceptable by the inspection team.

Finally, calculations could not be found for the sizing and protection for approximately 50 percent of the containment penetrations, however, a bounding calculation performed by the licensee during the inspection indicated that the design appeared to be adequate.

Although many of these issues were ultimately resolved during the inspection, the team considered the lack of formal calculations to support the current design basis of the Unit 2 and 3 electrical distribution systems as a weakness. It was noted that a design document reconstitution program has been initiated for San Onofre Units 2 and 3.

3.0 ELECTRICAL DESIGN REVIEW

3.1 Electrical Review Summary

The team reviewed and evaluated the San Onofre Unit 2 and 3 Class 1E electrical power systems by examining and assessing the technical acceptability of the design as defined by various design documents. It reviewed the design and the design control process for compliance with (1) General Design Criterion 17 of Appendix A to 10 CFR Part 50, (2) Criterion III of

Appendix B to 10 CFR Part 50, and (3) licensing commitments identified in the station's updated FSAR document. Also, to obtain a clearer understanding of the design, the team conducted interviews with cognizant licensee personnel and a walkdown of the Class 1E electrical systems.

Design documentation reviews included system descriptions, design reports, electrical design calculations (system loading, fault level, protection settings and coordination, voltage regulation, equipment sizing, etc.) design changes, nonconformance reports, and equipment specifications.

The team conducted specific reviews of (1) the station auxiliary reserve transformers, (2) the station unit auxiliary transformer, (3) the safety-related 4160-Vac and 480-Vac switchgear, (4) the motor control centers, (5) the diesel generator, (6) the batteries, (7) the inverters, (8) the 125-Vac and dc switchgear, (9) the battery chargers, and (10) other key pieces of electrical equipment.

3.2 4160-Vac System

The team reviewed several features of the 4160-Vac system including relay protection, light-load conditions, bus transfer schemes, and grounding. The following paragraphs contain the observations and deficiencies that were noted by the inspection team.

3.2.1 Relay Protection

The team reviewed the calculation for relay coordination and found it was lacking in regard to proper documentation and control. Important features were missing, such as references to the relay characteristic curves and the relay device numbers. The main coordination graphs did not have a checker's signature. The licensee is performing new calculations that include all proper references and backup data to provide proper traceability.

3.2.2 Backup Power Bus Transfer System

A "slow" bus transfer scheme is used when there is a need for an automatic feed of one unit's safety bus from the other unit's safety bus. If one division of one unit loses its normal source of supply, the equivalent division on the other unit provides backup power through the bus tie connection, provided all required permissives are actuated. The transfer scheme operates on the principle that it is safe to reenergize motors before they come to a stop, if the bus residual voltage has decayed to approximately 30 percent. The scheme uses a residual voltage relay to monitor the bus voltage and initiate a sequential closing of the bus tie breakers. The team reviewed the bus transfer scheme from the standpoint of the single-failure criterion, separation of redundant sources and load groups, transient state operating adequacy, and acceptability of response time. All these issues were acceptably addressed and the team had no concerns with regard to the bus transfer scheme.

3.2.3 Normal to Standby Power Source Transfer

The team reviewed the design of the transfer from the normal to the standby power source. The standby power source is a diesel generator dedicated to each 4160-Vac bus. The diesel generators are automatically started by either a safety injection actuation signal or a loss of voltage signal on the generator's respective bus. A transfer from the normal to standby power source occurs on a loss-of-voltage signal alone, a safety injection signal alone, or a safety injection signal with a loss-of-voltage signal. The team reviewed the circuitry and logic associated with the transfer schemes and found that the design is capable of performing the intended system functions.

3.2.4 Alternative Power Supply from the Main and Unit Auxiliary Transformer

There were no calculations to support supplying the system power from the main and unit auxiliary transformer which is an alternative source of emergency shutdown power that is described in the FSAR. The acceptability of this source was demonstrated by a specially designed preoperational test. The licensee is performing calculations to backup the conclusions of the preoperational test.

3.2.5 Voltage for Light-Load Conditions

The team observed that the use of transformer taps to keep voltages at acceptable levels during heavy-load conditions could result in an overvoltage condition during periods of light load. This could result in the application of voltages that are higher than allowed by equipment specifications. Because light-load conditions had not been analyzed, the licensee agreed to perform calculations for these conditions as part of its design basis reconstitution effort.

3.3 Emergency Diesel Generators

The team reviewed the emergency diesel generators (EDGs) in regard to loading conditions, ground fault protection, voltage regulation, and environmental qualification of the diesel stators and associated motor control centers.

3.3.1 EDG Voltage Regulation

The team reviewed the calculations regarding the adequacy of the EDGs to supply power to start and accelerate the safety-related loads necessary for safe shutdown and accident mitigation. Several inadequacies were noted with the calculations including the lack of proper references for calculational assumptions.

The team reviewed calculation E4C-011, which determined the voltage regulation conditions for the medium voltage system. The team found that this calculation failed to include the diesel generator as a possible source of supply for the medium-voltage system. The licensee indicated that no calculation exists and that, until a calculation is performed, the operability of this system is demonstrated by tests. As a result, the team reviewed the test reports included in Nonconformance Report (NCR) G-869, Revision 0, dated June 17, 1988, and Test Report 2PE-472-03, however, it could not interpret the test results properly because the report graphs were not totally legible. In addition, important relevant information such as the accuracy and speed of response of the test instrumentation was not included. Furthermore, the report did not analyze the effect of transformer inrush current which could adversely affect the initial voltage dip. In this regard, the team pointed out that the influence of this effect may or may not have been evaluated adequately during the test. The team indicated that the magnitude of the inrush current depends on the angle of the voltage vector the instant the breaker contacts close.

In addition to the review of the NCR G-869 test results, the team reviewed test results obtained during the recent Unit 2 outage. From these reviews, the team determined that power of sufficient voltage and frequency would be supplied by the diesel generator under worst-case conditions. This conclusion was based on the fact that, although certain nonconservative assumptions may have been taken during the licensee's evaluation of the test data, the test data showed that an adequate margin exists for specifications relating to voltage regulation, frequency decay, and voltage recovery.

The licensee is performing complete calculations for voltage regulation using a state-of-the-art transient analysis technique as part of their design-basis reconstitution effort.

3.3.2 EDG Loading Conditions

The team reviewed Calculation E4C-014 in regard to EDG loading conditions and found that the method of evaluating the magnitude of the loads was not spelled out in the calculation. During discussions with the licensee, the team learned that all motor electrical loads were developed from the brake horsepower conditions assuming a motor efficiency of 0.9. This approach was purported by the licensee to be conservative. Although the team could not verify the degree of conservatism included in this assumption, it did not consider that the calculation met normal standards for EDG computational accuracy. The licensee is performing new calculations that will address this concern. In the meantime, system acceptability is provided by the test results that are discussed in Section 3.3.1 above.

3.3.3 EDG Ground Fault Protection System

The team reviewed Calculation E4C-027 in regard to EDG ground fault protection and found it adequate. However, the calculation for the EDG grounding system was not available. The licensee attempted to locate the missing calculation but this was unsuccessful. The EDG grounding system is of a high impedance type, consisting of a potential transformer with the transformer primary connected between the generator neutral and ground. A voltage sensitive relay is connected across the transformer secondary. Upon the occurrence of a fault, the potential of the generator neutral becomes elevated relative to ground. When the secondary voltage reaches the pickup setting of the secondary relay, the relay actuates to provide an alarm. Although the general grounding system approach appeared to be adequate, the fact that the licensee could not locate any calculations for this system did not allow the evaluation of intrinsic protection details, such as the adequacy of the relay pickup voltage. The licensee stated that the missing calculations will be regenerated as part of their design-basis reconstitution effort.

3.3.4. EDG Winding Insulation

During the review of EDG Specification S023-403-12, Revision 2, dated October 3, 1975, the team found that the generator stator winding was not suitable for wet environmental conditions such as those that could result from seismically induced actuation of the diesel room fire suppression system.

The FSAR states that system components, whose continued function is not required but whose failure could reduce the functioning of any plant feature to an unacceptable level, be seismically designed and constructed so that a safe shutdown earthquake (SSE) would not cause such a failure. However, at the time of the inspection the licensee could not demonstrate that the fire suppression piping and system components satisfy this commitment. Consequently, the team was concerned that, under a postulated SSE, and an assumed loss of offsite power (LOOP), a seismically induced actuation of the fire protection system could spray water over the EDGs, rendering them inoperable. As a result of this finding, the licensee isolated the fire suppression system in the diesel generator rooms and posted fire watches until this issue is resolved. This item is described in detail in Appendix A, Deficiency Number 89-200-01.

3.3.5 EDG Room Motor Control Center & Control Panels

The team found that the motor control center (MCC), the engine control panel, and the generator control panel were not qualified for the 122°F maximum design ambient temperature in the EDG rooms. Also, this equipment was not qualified for the wet environment that could result from a seismically induced of the fire protection system as noted in Section 3.3.4 above.

The licensee prepared an operability assessment (OA) dated November 29, 1989, which demonstrated that continuing operation is acceptable on the basis of ambient temperature testing performed on similar equipment at another plant. The licensee expects to receive a report from the vendor, Square-D, by April 1990 that would confirm the qualification of this equipment for use at San Onofre. This item is described in detail in Appendix A, Deficiency Number 89-200-02.

3.4 480-Vac System

The team reviewed several components and features of the 480-Vac distribution system including the load center transformers, ground fault protection, motor overload protection, and voltage regulation.

3.4.1 Voltage for Motor Control Circuits

The team reviewed the adequacy of the control circuit design for the 480-Vac systems that are addressed in Calculation E4C-062. The team questioned the validity of the calculation assumption that the maximum 480-Vac bus voltage drop was 3 percent because this value did not agree with the 9 percent voltage drop calculated in the 480-Vac system voltage regulation calculation, E4C-012. The team also questioned the assumption that the 480-Vac to 120-Vac control transformer could deliver the inrush load current without incurring an intrinsic voltage drop. Upon further investigation, the team concluded that the calculations could not confirm whether the contactors supplied from these transformers would receive a sufficient voltage of 102 volts as established by the contactor manufacturer for them to close. Therefore, the team was concerned that some 480-Vac loads might not start under a degraded voltage condition.

As a result, the licensee stated they would test all contactors in which the voltage could fall below the pickup rating of 102 volts. Preliminary calculations suggested that the worst case voltage for certain untested contactors would be approximately 100.5 volts and that this would only occur during worst-case grid conditions. This finding is described in detail in Appendix A, Deficiency Number 89-200-03.

3.4.2 Load Center Transformer Taps

Calculation E4C-012, Revision 5, dated January 10, 1986, indicated that the load center transformer tap should be set at -2.5 percent. This was in contradiction to the test report of Test Procedure 2PE-472-03, where a tap setting of 0.0 had been indicated. Subsequently, the licensee stated that the zero tap was the actual tap position in the field, that this was the desired tap position, and that the calculations were incorrect. The transformer tap position affects the voltage regulation of all systems downstream of the 480-Vac load center bus. The team noted that this issue had been raised by a previous NRC inspection team approximately one year ago; however, the affected documentation had not been brought up to date. As a result, the licensee performed a preliminary calculation which indicated that the tap setting of 0.0 percent appeared to be correct.

Another deficiency found in relation to Calculation E4C-012 was that the source per unit (PU) voltage variation was not consistently taken into account. Although the FSAR specifies a minimum system voltage of 0.95 PU, this value of minimum voltage was not taken into account in calculation E4C-012. This omission is important because it adversely affects the voltage at the 480-Vac busses. The licensee's response to this concern was that new calculations will be made in the near future to incorporate the 0.95 PU source voltage. The team noted that ample margins appear to preclude any immediate safety concern.

3.4.3 Cable Short Circuit Protection

The team reviewed Calculation E4C-031 on cable sizing to accommodate available short circuit current and found it adequate. However, this calculation did not include cables from the MCCs to the 480-Vac loads. The licensee found that new calculations were needed because none existed to confirm the acceptability of these cables. A preliminary calculation performed by the licensee showed that the available short circuit currents at the supply side of the MCC cables could exceed the cable rating thresholds for insulation degradation. As a result, the licensee is performing an evaluation to show that, although insulation damage thresholds might be exceeded, the cable flammability point would not be reached.

3.4.4 Ground Fault Protection System

The 480-Vac system is an ungrounded system. A single ground detection scheme is provided for each load center bus. The ground detection circuit provides an alarm in the control room when a ground is detected. Once the fault is located, the affected circuit can be disconnected for repairs. With only one detector provided per bus, locating a fault can take a considerable amount of time and may be hindered if certain circuits cannot be opened when the plant is in operation. The team asked the licensee whether existing operating procedures imposed a time limit on operating the system in the presence of a ground fault. The licensee indicated that there is no established time limit for operation with grounds on the system, however, the operating procedures state that faults should be promptly cleared.

3.5 Class 1E, 125-Vdc Power System

The Class 1E dc power system for each unit at San Onofre consists of four separate and independent 125-Vdc systems. Each system is served by its own 300 ampere battery charger, which is the normal power source, and its own 58-cell, lead-calcium battery bank, which is the standby power source. Two battery banks, A and B, each have a capacity of 1260 ampere-hours; the other two, banks C and D, each have a capacity of 1500 ampere-hours. The battery chargers are served from Class 1E 480-Vac motor control centers. Two battery systems, A and B, are redundant and are sized so that they are capable of serving their loads for 90 minutes without their battery chargers in service. The two remaining battery systems, C and D, are also redundant and are sized for 8-hour load profiles that include the operation of the shutdown cooling system motor-operated isolation valves during the 8-hour period. A design criterion for each battery charger was that it be capable of supplying the largest combined demand of all steady-state and random loads while recharging its battery from the design minimum state to 95 percent of a fully charged state within 12 hours. Operation of the Class 1E 125-Vdc systems, including batteries and battery chargers is governed by Technical Specifications 3.8.2.1 and 3.8.2.2.

3.5.1 Battery and Battery Charger Sizing

The team reviewed the licensee's calculation for battery sizing, E4C-017, Revisions 9 and 10. Revision 9 was based on revised duty cycle loadings of the batteries resulting from plant design changes and on a minimum battery electrolyte temperature of 60°F. The duty cycle of the batteries that serve the inverters associated with the shutdown cooling system isolation valves was increased to 8 hours. End-of-discharge voltage was adjusted in the calculations to accommodate the shutdown setpoint for low dc input voltage to the 120-Vac instrument control power system inverters. The load imposed on the dc system by the inverters was significantly reduced based on actual field measurements. Revision 10 included a planned cross-tie of the Unit 2 battery systems C and D to allow maintenance of battery C during a Unit 2 shutdown or refueling. The team found that the calculation methodology and the calculations were acceptable for demonstrating the adequacy of the battery's design capacity.

The team also reviewed the licensee's calculation for battery charger sizing, E4C-020, Revision 5. This calculation referenced the battery sizing calculation E4C-017. The team found the methodology used to be acceptable; however, it noted that this calculation has not been updated to take into consideration the latest 125-Vdc system loading that was used in Revisions 9 and 10 of Calculation E4C-017. There was no documentation showing that the effect of the latest dc loading on the battery chargers had been analyzed. Since Revision 5 of Calculation E4C-020 indicated only 0.8 percent spare capacity for both battery chargers A and B, the team questioned the adequacy of the calculation. As a result, the licensee performed a new preliminary calculation that demonstrated that all the Class 1E chargers had at least 38 percent spare capacity. The improvement in capacity margin was due to the consideration of the actual measured dc loading imposed by the inverters rather than an assumed calculated number.

The team observed that the electric heaters installed to maintain the battery room temperature at or above the minimum 60°F, used in the battery sizing calculation, were not powered from Class 1E power systems. Thus, the design minimum electrolyte temperature of 60°F could not be ensured for the batteries. The licensee stated that without the heaters, the battery room temperatures could fall to 42°F. During the inspection period, the licensee performed a preliminary battery capacity calculation with an electrolyte temperature of 42°F using the methodology and load profiles from Calculation E4C-017. This calculation indicated that all batteries had adequate capacity at an electrolyte temperature of 42°F if the service life of battery A of both units was reduced. This finding is discussed in detail in Appendix A, Deficiency Number 89-200-04.

3.5.2 Voltage Regulation

The team reviewed two licensee calculations for voltage regulation of the Class 1E 125-Vdc systems: E4C-13, Revision 6, and DC-2642, Revision 0. The team found the methodology used in both calculations to be acceptable and noted that Section 4 of calculation E4C-013 was superseded by calculation DC-2642. Both calculations referenced the battery sizing calculation E4C-017 for loading, but not the latest revision.

Calculation DC-2642 was performed to verify operability of the Class 1E 125-Vdc loads when supplied from the batteries operating at "end-of-life" conditions during the 90 minute period following a design basis event. The results showed that less than the minimum specified starting voltage would be available for several Class 1E dc motor-operated valves under these conditions. The evaluation criterion for the calculation states that the minimum starting voltage shall be 75 percent of nominal (125-Vdc being the nameplate rating) as specified by the manufacturer. The motor-operated valves of concern are in the auxiliary feedwater systems of both units and and are identified as control valves 2HV-4705 and 3HV-4705; isolation valves 2HV-4715, 3HV-4715, 2HV-4730, and 3HV-4730; and turbine stop valves 2HV-4716 and 3HV-4716. Further discussion on the degraded voltage operation of these motor operated valves is contained in Section 3.8 of this report.

3.5.3 Short Circuit Analysis

The team reviewed the licensee's 125-Vdc short circuit calculation, E4C-010, Revision 5. Revisions 4 and 5 to E4C-010 were performed to reflect as-built conditions and the battery manufacturer's recommended method for calculating battery short circuit capability. The method used considers battery cell 1-minute discharge rates. The values used in the calculation were based on a temperature of 77°F and were not corrected for elevated temperatures that could be reached before activating the battery room alarm setpoint of 95°F. The short circuit contribution for the Class 1E systems considered the battery chargers as well as the batteries. No significant motor contributors exist from these buses. The short circuit currents calculated for the Class 1E dc systems were shown to be less than 68 percent of their installed switchboard and circuit breaker ratings.

The team found the calculation methodology used in E4C-010 acceptable; however, the one-minute discharge rates had not been corrected for electrolyte temperatures that could approach 95°F. This would yield a battery fault contribution that was perhaps 10 percent higher than that calculated. A preliminary calculation performed by the licensee during the inspection indicated that the total fault duty would still be within the 20,000-ampere rating of the equipment.

3.5.4 Protection and Protection Coordination

The team reviewed the 125-Vdc breaker setting calculations and coordination analyses provided in calculations E4C-050, Revision 12, and the Appendix R compliance analysis, Document 90035AB, Revision 2. Breaker settings developed in these calculations and analyses were compared to the licensee's electrical setpoint list, Document 90042, Revision 0. The team found that acceptable breaker coordination was demonstrated by these calculations and analyses; however, some breaker frame sizes and trip settings were listed incorrectly in the setpoint list. This item is discussed in further detail in Appendix A, Deficiency Number 89-200-05.

3.6 Class IE 120-Vac Instrument Control Power System

The team noted that the Class 1E 120-Vac instrument control power system for each Unit consists of four separate and independent 120-Vac, 60 hertz, single phase systems. Each system is served by its own 20-kVA static type inverter which has a nominal 120-Vac, 60 hertz output with a nominal 125-Vdc input. A design criteria for the inverters is that they produce rated kVA output at 120 volts ± 2 percent, at 60 ± 1 hertz, with a maximum harmonic distortion less that 5 percent, and with inverter input dc voltage variations between 105 and 140 volts. Provisions were made to transfer the loads of inverter A or C and B or D to alternate 25-kVA, 120-Vac backup sources. Operation of inverters from their backup sources is governed by Technical Specification 3.8.3.1 and 3.8.3.2.

3.6.1 Inverter Load Control

A formal calculation to determine and control the design loading of the 20 kVA, 120-Vac vital bus inverters had not been performed by the licensee. The licensee informed the team that design loading of the inverters, including load changes, are tracked using the four 120-Vac vital bus panel board one-line diagrams. These diagrams indicate the various loads served by the panelboards and include the volt-ampere loading on each feeder circuit. The loading was understood, by the inspection team, to be either nameplate ratings of devices served or estimates. There was no indication that an independent design verification or review of the loading had been performed by the licensee. A formal design calculation, that complies with ANSI N45.2.11 would have documented the sources for the data used, listed the assumptions used with justifications, listed applicable references, and would then have been subjected to an independent review and verification. The results of these informal calculations indicate that the loading on inverters 2Y002 and 3Y002 was 19.66-kVA, which is within 2 percent of the inverter ratings of 20-kVA.

As a result of this small margin, and in order to demonstrate that the inverters were not overloaded, the licensee measured the dc voltage and current input to the inverter units. These measurements indicated that the dc power input to the inverters under worst-case conditions would be less than 13-kW. Thus, the team found that the loading on the 120-Vac instrument control power system inverters was acceptable.

3.6.2 Inverter Shutdown on Low dc Input Voltage

As noted in Section 3.5.1, the end-of-discharge voltage used in the battery calculation, E4C-017, Revision 9, was adjusted to accommodate a new setpoint for low dc input voltage to the inverter. The new setpoint, 104 ± 1 volts, was based on vendor information which indicated that the inverters could maintain acceptable output characteristics with a dc input voltage of 103 volts. The team found that the inverter shutdown setpoint of 104 ± 1 volts had not been implemented at the plant site. The actual setpoint, reported in Maintenance Procedure SO23-II.185, was 105 + 0.25/-2 volts. As a result of this finding, the licensee instituted action to implement the correct setpoint. Further discussion of this item is contained in Appendix A, Deficiency Number 89-200-06.

3.7 Electrical Containment Penetrations

The team noted that the licensee had committed to NRC Regulatory Guide 1.63 for the application and installation of the electrical containment penetration assemblies used at San Onofre Units 2 and 3. The licensee had reported that the penetration assemblies were designed and able to withstand, without loss of mechanical integrity, the maximum anticipated fault current vs time that could occur on individual circuits as a result of a single random failure of a circuit overcurrent protective device. Medium-voltage (4160-Vac) and low voltage power (480-Vac) penetration circuits are protected by load feeder circuit breakers in the usual manner. Backup protection for the individual circuits is provided by bus main or alternate supply circuit breakers. The maximum anticipated fault currents in low-voltage control circuits (120-Vac and 125-Vdc) had been demonstrated, in most cases, by Calculation E4C-046 to be within the current withstand capability of the applied penetration assemblies and, thus, backup protection was not required. In those control circuit cases in which the anticipated fault current could exceed the penetration capability, backup protective devices (fuses or subfeeder breakers) were applied.

Technical Specification 3.8.4.1 for San Onofre Units 2 and 3 states that all containment penetration conductor overcurrent protective devices shown in Table 3.8-1 shall be operable. Calculation E4C-046 was performed to demonstrate compliance with Regulatory Guide 1.63 and to analyze the acceptability of the penetration conductor overcurrent protective devices. The inspection team noted that only about half of the protective devices listed in Technical Specification Table 3.8-1 had been addressed by the calculation. Preliminary calculations performed by the licensee during the inspection demonstrated the acceptable application of the devices that had not been included in calculation E4C-046.

3.8 <u>Motor-Operated Valve Voltage Requirements</u>

The team reviewed the ac and dc voltage available for operation of motor-operated valves (MOVs). Specific attention was paid to the dc MOVs because problems with low dc voltage had been identified during a previous NRC inspection of the auxiliary feedwater system conducted during June of 1988 (see Inspection Report 50-361, 50-362/88-10). As a result of the previous findings, the licensee was asked to provide the calculations and test data for dc MOV performance. After the 1988 inspection, the licensee had performed tests at the actual degraded voltage conditions expected for the four subject dc MOVs.

Upon review of this test data, it was determined that, although the motor actuators were shown to be able to develop enough torque to adequately stroke the valve, the test data did not demonstrate that adequate torque would be available to actuate the motor actuator torque switches under degraded voltage conditions. Failure to actuate the MOV torque switch could have resulted in motor damage. In addition, calculations based on assumed cable impedances and previously measured MOVATS thrust data indicated the motor actuators would not be able to develop the required thrust under degraded voltage conditions. Although this data had been collected, it had not been properly evaluated by the licensee. As a result, the licensee was asked to justify the operability of the four MOVs.

As a result of this finding, the licensee performed new calculations based on the actual measured voltage drops in the MOV circuits. These calculations indicated that, under the worst-case motor terminal voltage, the subject motors would be capable of developing 10 foot-pounds of torque, which would be sufficient to actuate the torque switches.

Although this issue has subsequently been resolved, the team noted that at the time of the inspection the available data indicated potentially inoperable MOVs and that this data had not been evaluated by the licensee.

4.0 MECHANICAL DESIGN REVIEW

4.1 Mechanical Review Summary

The team reviewed and evaluated the adequacy of the mechanical system design and design implementation for the support of the electrical distribution systems (EDS).

The team's review included a system walkdown and detailed review of engineering, licensing, and plant operations documents associated with mechanical systems in support of the EDS System, including the following:

- Updated FSAR and Technical Specifications
- Selected modifications and safety evaluations associated with the emergency diesel generator and associated mechanical support systems
- Mechanical systems calculations, including diesel generator fuel transfer, air start, and cooling systems; diesel generator and battery room ventilation systems; and significant safety related pump motor loads
- Process & instrumentation diagrams (P&IDs) for diesel generator support systems
- Flow diagrams and layout drawings for diesel generator and battery rooms
- Diesel generator manufacturer technical manuals, selected schematics, and detailed component drawings
- Procurement specifications for major mechanical systems components in support of the diesel generator system, including pump performance curves and motor data sheets
- Nonconformance reports (NCRs) applicable to mechanical systems in support of the diesel generator

The team found no specific discrepancies in its review of plant modifications and associated safety evaluations, flow diagrams and P&IDs; the diesel generator technical manual; procurement specifications for the diesel generator and supporting system major components; and the licensee's response to NRC documents and correspondence. However, several deficiencies were noted concerning the mechanical support systems. These deficiencies are detailed in Section 4.2 of this report.

4.2 Diesel Generator Systems

4.2.1 Fuel Oil Storage Tank

The team identified two findings pertaining to the fuel oil storage tank; an inadequate analysis of the minimum required storage volume and the lack of plant abnormal operating instructions to ensure an unobstructed tank vent.

4.2.1.1 Fuel Oil Storage Tank Minimum Required Volume

In its review of calculation M16.4 the team found that the minimum volume for the fuel oil storage tank was 47,174 gallons, which is greater than the Technical Specification 3.8.1.1.b.2 requirement of 47,000 gallons.

The team further determined that the method of calculation was inconsistent with the FSAR, Section 9.5.4.1, which references American National Standards Institute (ANSI) Standard N195. The calculation method did not include the full requirements of the standard's time-dependent method for determining the "minimum storage capacity" because it excluded provisions for adequate testing volume and the 10 percent margin requirement. In addition, because the fuel consumption rate is increased at higher diesel loads, the team determined that the calculation was inadequate for the latest FSAR loads listed in Table 8.3-1. Although the licensee has identified inconsistencies in minimum storage capacity determined for modes 5 and 6 operation, no calculational update had been made for modes 1 through 4. However, the team's review of the existing tank level setpoint (118 inches from the bottom of the tank) showed that adequate margin exists above the present analyzed condition.

4.2.1.2 Abnormal Operating Instruction

Contrary to the FSAR Section 9.5.4.2.2, the team could find no abnormal operating instruction to ensure that the diesel fuel oil storage tank vent is unobstructed following a postulated tornado, nor provision for removing the blind flange, located in a missile-protected portion of the transfer pump house, if the vent is found to be damaged from a tornadic missile. Without an unobstructed vent, fuel transfer to the emergency diesel generator day tank cannot be assured. This item is also identified in Appendix A, Deficiency Number 89-200-07.

4.2.2 Day Tank Volume

The team reviewed the level switch setpoint for the fuel oil day tank that starts the fuel transfer pump. From this review, the team determined that the level switch setpoint is such that it does not ensure 325 gallons of minimum usable volume in the day tank as required by Technical Specifications 3.8.1.1.b.1 and 3.8.1.2.b.1. The team determined that setting accuracies and instrument loop accuracies were not adequately addressed in establishing this setpoint.

The team also determined that the minimum useable volume of 325 gallons was not in compliance with FSAR Section 9.5.4.1 in that it was not determined in accordance with the referenced standard, ANSI N195. This item is further detailed in Appendix A, Deficiency Number 89-200-08.

4.2.3 Starting Air Receiver Pressure

The team reviewed the 165 psig alarm setpoint for the diesel starting air receivers. Each air receiver is designed to provide sufficient capacity for five starts of the diesel generator, with an initial pressure determined by preoperational testing. However, the diesels were unable to start five times during the preoperational tests performed with an initial air receiver pressure of 175 psig. A retest, performed without actually starting the diesel generators, and also with an initial pressure of 175 psig, resulted in three of the four air receivers being accepted, however the test criteria were not sufficient to ensure a five start diesel capability. The test criteria required the demonstration of a cranking capacity for each simulated start of 3 seconds or 2 to 3 engine revolutions. As a result, even though the diesel engine rotated as little as 0.1 revolutions during some of the tests, the tests were considered acceptable based on the 3 second time requirement. A final series of tests were performed for the fourth air receiver, after replacement of all four starting motors, and with an initial pressure of 195 psig. This last series of tests demonstrated that one of the diesel air receivers could supply enough air to its diesel generator set to meet both the 3 seconds and the 2 to 3 engine revolution requirement. However, both the present alarm (165 psig) and air compressor start (182) setpoints are lower than 195 psig. Furthermore, the acceptance of worst-case conditions for an air receiver system in which "new" starting motors were used was not considered by the team to be a valid basis for ensuring the five-start capability for all of the air receivers. This item described further in Appendix A, Deficiency Number 89-200-09.

4.2.4 Diesel Generator Mechanical Loads Calculations

In its review of Calculation E4C-014, the team could not find a detailed analysis for determining safety-related pump motor loads; however, the licensee stated that the inputs used were conservative. As a result, the team reviewed seven pump motor loads using manufacturer's performance curves and motor data sheets. The team determined that the values used in E4C-014 were nonconservative and that the totals could be 50 to 100-kW more than those that were used. Furthermore, the calculation had not been updated to reflect the latest loads identified in the FSAR Table 8.3-1, nor did these loads reflect the higher values determined using the manufacturer's data referenced above. The use of higher loads would result in higher fuel consumption rates and, therefore, would affect the analysis for the calculations pertaining to fuel oil day tank and fuel oil storage tank minimum volume. This item is further described in Appendix A, Deficiency Number 89-200-10.

4.2.5 Cooling Water Expansion Tank

In its review of the diesel generator system cooling water expansion tank, the team identified that the device for overpressure protection was a vent cap (similar to a radiator cap) with a 7-psig relief setting. This device is a non-code component that is installed on a tank that is classified as ASME Section III Class 3. This non-code device will not ensure an unobstructed vent for air trapped in the expansion tank pursuant to FSAR Section 9.5.5.2. Furthermore, the team could not find this active component in the plant's ASME Section XI Valve Inservice Testing Program, nor any evidence that the component had undergone functional testing subsequent to a post-modification test performed in 1988. As a result, the licensee has committed to replace the vent cap with an ASME Section III code-approved device. This item is further detailed in Appendix A, Deficiency Number 89-200-11.

5.0 ONSITE REVIEW

5.1 Onsite Inspection Summary

The onsite inspection team reviewed portions of the electrical distribution and associated subsystems. The review included a walkdown of various safety-related electrical and instrumentation and control (I&C) components including an overview of the associated procedures, maintenance orders, instructions, and drawings. This review concentrated on key features of the electrical distribution system. The team performed several walkthrough inspections in the Unit 2 and 3 control building, auxiliary building, and emergency diesel generator rooms. The team found that the overall cleanliness of the plant was acceptable. Various examinations of physical separation and the protection of cable trays with fire retardant blankets were performed in the control building. Redundant safety divisions and nonsafety cable trays were found to be clearly identified. No apparent problems were identified with the separation of redundant Class 1E electrical divisions. However, the team did identify several deficient conditions as discussed below. The licensee stated that corrective actions were initiated to resolve or evaluate these deficiencies:

(1) A loose nut was found on the diesel generator 2G002 cylinder engine oil filter cover following the completion of maintenance activities on the unit.

(2) A U-Bolt hanger upstream of valve S2-2420-MV-111 that supports the starting air line for diesel generator 2G003 was loose.

(3) Six loose instrument hangers were found that support the instrument tubing going to cell-receivers 2T-277 and 2T-276 for Diesel Generator 2G003.

(4) Although not shown on the P&ID or piping drawings, what appeared to be an orifice plate was found at a flange connection in the starting air line downstream of valve S-3-2420-MV-112 for diesel generator 3G003. Also, the fasteners that make up this flange had less than full thread engagement. The licensee generated NCR No. 3-2508 to determine the orifice configuration and correct the flange connection. Upon further examination the system engineer noted that the orifice was a spacer with an inner diameter that was approximately 0.020-inch larger than the inner diameter of the flange. The licensee issued an interim design change notice to Drawing 5023-403-12-297, Revision 1, to properly document the existence of the spacer.

(5) Cables were not being supported in their respective cable trays above MCC-B5. The cables in question were routed in a loop fashion out of and back into the cable tray. A hemp rope was hanging down from a cable tray in this area. Also, some vertically run cables were not supported in cable tray 1CARB4 above circuit breaker 2A0412.

(6) A grounding cable wall anchor support was found missing adjacent to the control room emergency a/c unit E-419 transfer switch panel.

(7) A conduit box cover was found missing next to conduit 19XF04.

(8) Three bags of uncontrolled spare fuses were found in the 125 volt battery charger 2B003. The licensee later determined that these spare fuses had been provided by the vendor, and removed them from the area.

(9) Several examples of uncontrolled operational aids were found. They were as follows:

(a) Label tape used for identification of components and setpoints was found inside the 125 V Battery Charger 3B003.

(b) A grease pencil was used to mark the faces of the gauges showing dc volts and dc amperes for the 2B003 inverters. The same condition existed on the gauges showing ac volts, dc volts, and dc amperes for the Y003 inverter.

(c) Label tape used for the identification of components was found in the Y006 shutdown cooling inverter.

Although none of the above items constituted significant safety concerns, the number of conditions identified indicates a lack of attention to detail and the fact that licensee personnel may be failing to identify and correct material defects.

In addition to the general inspections described above, the team performed detailed reviews of certain diesel and battery maintenance activities, and conducted reviews of several instrumentation and control calibration/surveillance procedures. The following sections of the report detail the teams findings in these areas.

5.2 Diesel Maintenance Activities

The inspection team reviewed surveillance activities associated with the EDGs. The activities reviewed were covered in Maintenance Order (MO) 88121953000 and Maintenance Procedure No. SO23-I-2.11, Revision 6, TCN 6.4, "Diesel Generator Surveillance Inspection."

On October 31, 1989, the inspection team noted craftsmen performing work on the Unit 2 diesel generator, 2G003. The work in progress was the torquing of the diesel access cover bolts following the performance of surveillance activities on the diesel generator. Further investigation into this activity revealed that the craftsmen performing the work, at the time of the inspection, did not have a procedure in their possession. It was determined from a conversation with the craftsmen that the foreman had removed the procedure from the job site immediately prior to the inspection. Further review of this activity revealed that there was confusion when performing paragraph 6.4.5.3.5.1 of procedure SO23-I-2.11, pertaining to the measurement and evaluation of diesel piston to head clearances. The procedure required the craftsmen, after taking the measurements using a compressed lead wire, to calculate and record the difference between the current front and rear readings. Instead, the craftsmen had apparently subtracted the front and the rear readings not from each other, but from readings taken during a previous outage which were also required to be recorded. In addition, although a recorded reading differed by 0.006-inch, which exceeded the acceptance criteria of less than or equal to 0.005-inch, no engineering evaluation had been performed. The licensee initiated action to correct this deficient condition that required rework.

Further review of this area was accomplished by the inspection team to determine any generic impact. A review was performed on the same activity recently performed on other diesel generators. This review indicated that the piston measurements had also been improperly evaluated on the Unit 3 diesel generator 3G002 under MO 89012335000.

Upon review of the procedures, the inspection team noted that no quality control (QC) inspections or verifications had been performed by the QC organization. The licensee QC organization investigated the circumstances surrounding the above work and determined that it was following procedure QCI-G-007, Revision 3, "Quality Control Planning and Inspection Guidelines," that does not require QC witnessed/hold points during work on the diesel. As a result the team expressed the concern that deficiencies such as those identified are not being corrected by the licensees current program implementation. This item is also discussed in Appendix A, Deficiency Number 89-200-12.

5.3 Battery Maintenance Activities

The inspection team reviewed the work activities associated with the 125-Vdc station battery replacement. The details of these activities were covered in MOs 89041705000, "Cell No. 25-2D1 - Replacement," MO 89032068000, "Cell No. 51-2D1 - Replacement," and MO 87103296000, "Cells Nos. 6, 21, 26, 30, 34, 35, 36, 37, 38, 40, 42, 51, and 58 - 2D2 - Replacements." These work activities were initiated as a result of a copper migration phenomenon identified in NCRs 2-2639, 2-2035, 2-2238. Per correspondence between the licensee and the battery manufacturer, Exide, the manufacturer had recommended replacing the affected cells. This condition had also been addressed by NRC Information Notice No. 89-17: "Contamination and Degradation of Safety-Related Battery Cells." The team conducted a walkdown of the recently completed battery replacement. The walkdown and associated document review revealed the following deficiencies:

One plastic battery spacer tube was missing and several 5/8-inch steel rod jam nuts supporting the spacers were loose. This condition indicated that the second nut was not torqued to the required value of 15 foot pounds. This torque requirement is specified in maintenance instruction EA-15467, "Installing Clamp Assemblies On Seismic Racks for G Cells." In addition, the recorded M&TE used when accomplishing the above MOs did not reference a specific torque wrench for the 15 foot pound torquing requirement. The licensee initiated action to correct the deficient condition in accordance with MO 89110824000.

Incorrect bolts were used in making the battery terminal Nos. 25, 26, 51, and 52 interconnections. The bolts used were 1/4-inch-20, however, the requirement was to use a 5/16-inch-18 bolt. Upon identification of these conditions, the licensee initiated action to correct the deficient condition in accordance with MO 89111041000 and NCR 2-3052. The team noted that the subject MOs did not contain specific work instruction but only referenced technical manuals and drawings without identifying what specific sections were applicable. This may have contributed to the condition that resulted in the use of the incorrect bolts.

There was a single QC inspection point identified in each MO referenced above. This one QC inspection point was for all work pertaining to the replacement of each battery bank. This one inspection point did not state what attributes of the completed work were to be verified, and based on questioning of the QC Inspector who signed off this point, there was uncertainty as to the actual meaning of the sign-off. Upon identification of this condition, the licensee initiated a memorandum to review QC activities. The team expressed concern that, although QC inspection points might be included in some procedures, the inspection points or sign-offs apparently do not indicate what particular activities or conditions are to be verified by the inspector. This item is also discussed in Appendix A, Deficiency Number 89-200-13.

5.4 Calibration and Surveillance Procedures

The team reviewed procedures for Class 1E battery surveillance testing, procedures for CO-type overcurrent relay testing and calibration, procedures for a 4-kV bus transfer test, and a procedure for the emergency diesel generator test. In addition, a detailed review was conducted of the calibration and surveillance procedures for the diesel fuel oil day tank and fuel oil storage tanks.

5.4.1 Battery Surveillance Test Procedure

Procedure SO123-I-2.5, Revision 0, TCN-0-13, was written to demonstrate that the Class 1E batteries are capable of delivering acceptable power in an "as-found" condition in accordance with design-basis conditions for accident mitigation. Step 3.6 of the prerequisite section of this procedure requires that other procedures, SO123-I-2.2 and SO123-I-2.3, must be completed prior to this test. These procedures allow battery enhancements such as the equalizing of cells and the cleaning and tightening of interconnections. These enhancements to the battery, prior to performance of the service test void the objective of the test, which is to verify the capacity of the battery in an "as found" condition. Also, such actions are contrary to the battery service test criteria stipulated in the Institute of Electrical and Electronics Engineers Standard 450-1975. The licensee's engineers informed the team that, although it appears that enhancements are allowed by the service test procedure, no such actions were performed and the batteries were tested in their "as-found" condition. In addition, a later step in the test procedure warns against making these type of enhancements. As a result, the licensee agreed to correct the affected procedures as necessary to eliminate the conflicting statements.

5.4.2 Overcurrent Relay Testing

The team reviewed Procedure SO123-II-11.1, TCN 1-7, Revision 1, "CO Relay Test and Calibration" for the initial calibration as well as for the routine calibration checks of CO-type overcurrent relays. Step 6.7.13 of this procedure requires verification that the pickup voltage of HGA-type auxiliary relays is less than or equal to 105 volts. These auxiliary relays work in conjunction with the overcurrent CO-type relays. The team noted that during worst-case conditions the voltage at the HGA-type auxiliary relays can drop to 102 volts. Therefore, pickup of these relays should be verified for a minimum value of 102 volts instead of 105 volts as specified by the procedure. The licensee informed the team that affected procedures will be revised to include the lowest possible voltage of 102 volts.

5.4.3 4 KV Bus Transfer Test

The team reviewed Procedure SO123-3-3.19, Revision 3, "4-kV Bus Transfer Test" which demonstrates that on loss of power to a 4-kV safety bus, the bus would be connected automatically to its counterpart bus in the other unit. The team noted that the test procedure does not verify two key design requirements; (1) that the transfer occurs at or below 30 percent residual voltage, and (2) that the transfer occurs within a 5-second time period. The licensee informed the team that verification of 30 percent voltage was not required because the undervoltage (UV) relays are set at 30 percent. The team agreed but pointed out that if credit is taken for the UV relay settings, then the setting of the UV relays should be verified prior to the transfer test. The licensee agreed to revise the procedure to incorporate steps for verification of the UV relay settings and of bus transfer time.

5.4.4 Molded Case Circuit Breaker Testing

The team reviewed Procedure SO123-I-4.7, TCN 0-6 for the periodic testing of molded case circuit breakers. Procedures at San Onofre require periodic testing of all safety-related molded case circuit breakers such that all breakers are tested approximately once every third refueling outage. During the procedural review, the following deficiencies were identified.

(1) Paragraph 3.3 of the procedure requests the maintenance planner to specify acceptance criteria for breaker trip times, for the thermal test of Paragraph 6.4.1.1, and for the non-adjustable instantaneous trip test of Paragraph 6.4.2.1. The trip times are supposed to be taken from the vendor's time-current curves. The team felt that the acceptance criteria should more appropriately be supplied by the engineering staff due to the technical nature of the time-current curves, and because the time-current curves for breakers can change as described in NRC Information Notice 89-21. In addition, the test criteria should confirm the circuit breakers performance is within the bounds established in design-basis coordination calculations.

(2) Paragraph 6.4 requires the performance of paragraphs 6.4.1 and 6.4.2 for thermal magnetic breakers with non-adjustable instantaneous trips and the performance of paragraphs 6.4.3 for breakers with magnetic only adjustable instantaneous trips. The procedure does not specify what paragraphs are applicable for thermal magnetic breakers with adjustable instantaneous trips.

The licensee stated that the testing procedure would be changed as necessary to correct these deficiencies.

5.4.5 Diesel Generator Fuel Oil Day Tank Level Calibration

Technical Specification 3.8.1.1 requires that a minimum of 325 gallons of diesel fuel oil be maintained in the day tanks for each diesel generator set. To ensure that this requirement was being met, the team reviewed the level measurement system, its surveillance requirements, and calculated data on tank volume. The team identified four problems during this review: (1) inadequate, incorrect, and inconsistent calibration data on the Instrument Calibration Data Cards for the diesel fuel oil level analog measurement system and level actuated switches; (2) calibration procedures that were inadequate to confirm the operability of the level measurement system transmitters; (3) inconsistent information in the operator aids that provide data on the quantity of fuel oil in the day tanks; and (4) numerous discrepancies in level switch setpoints and the "as-built" configuration of the level measurement system as shown on drawings, system descriptions, and procedures.

The team asked the licensee to supply surveillance data to demonstrate that the day tank level measurement system had been calibrated and that level switch setpoints were set consistent with requirements specified on the instrument setpoint list. The licensee provided a copy of MO 89010154 under which the previous calibration of the Unit 2, train A diesel fuel oil day tank level instrumentation was accomplished. Because a number of problems were encountered in the review of the test results, the team requested additional calibration data specified on the instrument calibration data cards (ICDCs) for the level measurement systems for all the fuel oil day tanks.

On the basis of its review of this data, the team could not confirm that the level measurement system had been properly calibrated. First, the measurement range of the level transmitters was incorrectly specified on the ICDC as being from 0 to 39.75 inches and 0 to 42 inches. Subsequent investigation by the licensee confirmed that the actual range of the level measurement transmitter is from 5-1/4 to 41-1/4 inches of tank level. Because of the lack of correct calibration data on the ICDCs, the level measurement systems cannot be calibrated in accordance with existing procedures.

Other errors were also found in the ICDC data. For example, the input signal for 2LSL-5970-1 was stated as 4 to 20 milliamps rather than the actual measurement loop signal which is 0 to 200 microamps. The accuracy of 2LT-5970-1 was stated as ± 10 percent and was inconsistent with the accuracy of ± 2 percent that was stated on the ICDCs for the rest of the day tank level transmitters. The range of level actuated switches, 2LCH/LSH-5933-1 and -2, was stated as 0 to 120 inches and was inconsistent with the fact that the maximum level in the diesel fuel oil day tank is only about 42 inches.

The level transmitters use reed switches, actuated by a magnet enclosed in a float assembly, to provide a signal that is proportional to the level of fuel oil in the day tanks. As a consequence, the span of the level measurement system is fixed by the physical configuration of the level sensor. The only calibration adjustment that can be made is the setting of the voltage that is applied to the sensor. The calibration procedure SO123-II-9.245 for the level transmitter includes a 5 point check of the transmitter output, over the range of the level measurement, by varying tank level or by manually positioning the float for the level sensor. However, the calibration procedure permits an alternate calibration method that only confirms the output of the level sensor at the existing level of fuel oil in the day tank. This does not confirm the operability of the transmitter by changes in float and reed switch position.

The day tank level transmitter is essential for the successful operation of the diesel generator. First, the automatic starting of the primary diesel fuel oil transfer pump to restore day tank level is dependent on the level measurement signal. Second, the alarm that would alert the operator of the need to restore tank level by manually starting the backup transfer pump on a failure of automatic transfer pump, is also dependent upon the same level measurement signal. In response to this concern, the licensee initiated a change to the calibration procedure to ensure that the diesel fuel oil day tank level transmitters would be subjected to a five point calibration check.

During the review of the calibration data for the diesel fuel oil level indication, the team questioned the calibration of the local level indicator scale, which is nonlinear with respect to the level measurement signal. The licensee's explanation was that the level indicator is calibrated in percent of total tank volume. In response to a request for data on tank level and the corresponding volume of fuel oil in the day tank, the licensee provided a copy of a memorandum from D. E. Nunn, "Technical Specification Tank Level Limits, SONGS 2/3," dated August 31, 1982, which provides a table of actual day tank level in inches versus percent level (based on the 42-inch-diameter cylindrical day tank) and usable volume in gallons.

The usable volume is based on the location of the diesel fuel oil suction line that is above the bottom of the tank. This data is also included in an operator aid that is maintained in the control room and is identified as Document 3-034. The calibration of the day tank fuel oil level indicator, in units of percent volume, was inconsistent with the operator aid that provides the usable gallons of fuel in terms of percent level. The licensee is investigating this matter to determine an appropriate resolution of this discrepancy.

Finally, the team noted a number of drawing and system description errors with regard to the day tank level measurement system.

(1) Drawing 40110B showed 2LCH-5933-1 connected to alarm 2UA-160 and 2LSH-5933-1 connected to the fuel oil storage transfer pump control circuit. These connections are the reverse of the as-built condition of these circuits.

(2) Drawing 30345, Sheet 1, showed a contact of 2LSL-5970-1 that was described as "open on low low level" as operating local annunciator window 2-1-1, "Day Tank Level Low." The level switch reference should be 2LSLL-5970-1, which was properly described as noted. Also, the annunciator engraving should be "Day Tank Level Low Low" to correctly indicate that it is actuated at the second low level setting, consistent with the convention used for identifying alarms.

(3) The drawing reference for the day tank low level switch relay contact, K48, in the diesel fuel transfer pump control circuit, on Drawing 30327 was shown as S023-403-12-74, which has been superseded by Drawing 30345, Sheet 1.

(4) Alarm response procedure S023-5-2.35.1, pages 36 and 62, reference Vendor Manual/Print S023-403-12-74 which has been superseded as noted in Item 3 above. Also, the initiating device for window 2-1-1 on page 36 should be noted as LSLL-5970-1 with the appropriate setpoint.

(5) System Description SD-S023-750 page 138, showed the LSLL-5970-1 setpoint as 22 inches, page 142 showed the LSL-5970-1 setpoint as 22.25 inches from the bottom of the tank, and page 126 showed the LSL-5970-1 setpoint as 27.5 inches and the LSLL-5970-1 setpoints as 25.5 inches. These settings are not consistent with the values specified on the instrument setpoint list.

(6) Surveillance Operating Instruction S023-3-23 stated that a day tank (T-133) indicated level of 58.2 percent corresponds to 325 gallons of fuel oil. As noted above the indicated level range has been calibrated in percent of tank volume and not in percent of tank level.

This item is also discussed in Appendix A, Deficiency Number 89-200-14.

5.4.6 Diesel Generator Fuel Oil Storage Tank Level Calibration

Technical Specification 3.8.1.1.b.2 requires a minimum of 47,000 gallons of fuel oil storage for each diesel generator set when operating in Modes 1 through 4, and Technical Specification 3.8.1.2.b.2 requires a minimum of 37,000 gallons of fuel oil storage when operating in Modes 5 and 6. Because of the number of problems encountered with level measurement system for the fuel oil day tanks, a review of the level measurement system calibration requirements and the ICDC data for the fuel oil storage tanks was undertaken by the team.

The team identified three problems during this review: (1) the inadequate calibration data and procedures for the storage tank level measurement system; (2) inaccurate operator aid data on the quantity of usable fuel oil in the storage tanks, which is used in verifying compliance to Technical Specification requirements; and (3) discrepancies in level setpoints as shown on the system descriptions and operating procedures.

The ICDC data stated that the level transmitter range is 0 to 144 inches. However, the level measurement signal has a zero offset with respect to tank level, similar to that for the day tank level measurement.

The calibration of the level measurement system is performed using the same general procedures, S0123-II-9.245, as noted above for the diesel fuel oil day tank level measurement system. Because there is no practical means to vary the level of fuel oil in the storage tank, the only check on the operability of the level transmitter is that provided by a single-point check, which is a comparison of actual level with indicated level. The actual tank level is determined by "stabbing" the tank level through a standpipe connection that bottoms out in a sump that is 30 inches below the reference bottom of the tank. The calibration procedures do not address the steps required for relating the difference in actual measured level to the transmitter measurement of tank level.

Because of the lack of correct ICDC calibration data on the range of the level measurement (i.e., span, zero offset, and range), the storage tank level measurement system cannot be calibrated in accordance with the existing procedures. In addition, the procedures for a single-point check of the transmitter calibration are incomplete because of a lack of data to relate actual measured level, referenced to the bottom of the sump, to measured tank level based on the level transmitter output signal.

The operator aid identified as Document 3-034, notes that zero percent "control room (indicated) level" was at an actual tank level of 6 inches. However, it was identified as 6.5 inches on a sketch provided by the licensee.

A level switch is used to trip the transfer pumps when the level falls to 13 inches in the storage tank and this precludes any further transfer of fuel oil from the storage tank. In contrast, the operator aid indicated that there was approximately 2450 gallons of usable fuel oil in the tank at the level at which the level switch trips the transfer pumps.

Finally, the team found discrepancies in the level switch setpoints shown on the instrument setpoint list, system descriptions, and operating procedures.

(1) The LSH setpoint was noted as 11'-3" (135") on pages 126 and 142 of the system description, SD-S023-750, and page 37 of the operating procedure S023-5-2.35.1. This was inconsistent with the instrument setpoint list (ISL) which specifies the setting as 144 inches.

(2) The LSLL setpoint is noted as 6" on page 126 and page 143 of system description SD-SO23-750. This is inconsistent with the ISL that specifies a setpoint of 13 inches.

This item is also discussed in Appendix A, Deficiency Number 89-200-15.

5.4.7 4160-Vac Loss of Voltage Circuit Testing

Loss of voltage at the 4160-Vac Class 1E buses is sensed by undervoltage relays to effect a transfer to an alternate offsite power source. Loss of voltage signals (LOVS) are also used to start the diesel generator that provides the onsite Class 1E emergency power source for the bus. To assess the operability of the loss of voltage circuits, the team reviewed the test data for the Unit 2 train A loss of voltage circuits and compared them with the instrument and test procedure, SO2-II-11.1. In addition, the previous test results for these circuits conducted under MO 87030253 were reviewed.

Four channels of undervoltage sensors are provided so that safety actions are initiated if any two out of four channels are in a tripped state. The surveillance tests verify that safety actuation signals are produced for each of the six possible combinations of two out of four channels being tripped. Overall, the team concluded that the surveillance tests verify the operability of the LOVS system.

The team observed that the acceptance criterion for relays 127R1 through 127R4 was stated as 32 ± 1.6 volts in the test procedure and conflicted with the setting of 36 V as stated in the electrical setpoint list (ESL). In response to this discrepancy, the licensee provided the calculation for the relay trip settings that verified that the undervoltage relays were properly set at 32 volts. A copy of interim design change notice (DCN) No. ABG-2688 was provided that was issued to update the ESL with the correct setting.

5.4.8 4160-Vac Breaker Control Circuit Testing

Time delay relays are used in the control circuits for the 4160-Vac switchgear breakers to obtain actuation, trip, and interlock functions within the proper time sequence. The team reviewed procedure SO23-II-11.152, "Circuit Device Tests and Overall Functional Test," which is used to verify the operability of the diesel generator feeder breaker. The surveillance requirements include the testing of relays in the control circuit to determine if pickup and dropout voltages for relay coils are within acceptable limits.

The team reviewed MO 87030275, which implemented the applicable procedure to verify the time delay relay settings for the 4160-Vac diesel generator feeder breaker. A final step in the test procedure calls for a functional test to verify that the control circuits operate in accordance with the elementary diagrams. Because this procedure includes generic requirements for breaker control circuits, the actual steps performed by the test technician during the circuit functional test are not defined. Therefore, the team requested a walkdown of the actual steps taken to perform a functional test of the diesel generator breaker, 2A06. The licensee noted that the testing is performed to the extent practical without the need for using jumpers or lifting leads. When such steps are required, they are noted on the proper form in accordance with the requirements of the test procedure to ensure that all circuits are restored to their original configuration. Overall, the team concluded that a thorough check of all circuit components was performed.

During the walkdown of the diesel generator feeder breaker functional test, the team observed that the safety injection actuation signal provided by relay K401, contacts 1H-1J in the breaker trip circuit, was incorrectly shown as a normally open contact. In response, the licensee issued interim DCN No. AB-1622-E to reflect the as-built condition with the relay contact shown as a normally closed contact.

APPENDIX A

Deficiency Sheets

Deficiency Number 89-200-01

Deficiency Title: Emergency Diesel Generator Winding Insulation

Description of Discrepant Condition:

During the review of the emergency diesel generator (EDG) specification, S023-403-12, Revision 2, dated October 3, 1975, the team questioned whether the generator stator winding was specified to be suitable for wet environmental conditions, such as could be present upon a spurious actuation of the sprinkler fire suppression system.

After consultation with the generator manufacturer, Ideal Electric Co., the licensee determined that the generator windings were not designed to withstand water spray conditions such as those resulting from actuation of the fire suppression system.

The diesel room sprinkler system is of a dry-pipe design. A dry-pipe design requires actuation of two redundant infrared sensors in order to open the valve that fills the pipe with water. Actual suppression action occurs when the sprinkler head fusible links melt under the elevated temperature caused by a fire. The reliability inherent in the pre-action system design should preclude spurious actuation. However, in the case of a seismic event, the licensee could not demonstrate that the pre-action valve would not trip, thereby charging the system. In addition, the fire suppression system pipe is of the threaded type, which the licensee could not show was designed to prevent leakage under a safe shutdown earthquake (SSE). Similar concerns may exist in regard to the ability of sprinkler heads to withstand SSE conditions.

The team was concerned that under a postulated SSE, the seismically induced simultaneous failures of the water inlet valves, as well as the pipes, could spray water over the EDG's, rendering them inoperative. As a result of this finding the licensee took immediate compensatory action by isolating the EDG fire suppression systems and stationing fire watches in each EDG room.

Requirements:

Regulatory Guide 1.32 and IEEE 308 (paragraph 6.2.5) states that "...features shall be incorporated in the design of the standby power supply so that any design basis event will not cause failures in redundant generating sources." These requirements are also included in the station FSAR, Section 8.1.4.3.6.

Criterion III of 10 CFR Part 50, Appendix B requires measures be established for the selection and review for suitability of materials and equipment that are essential to the safety-related functions of the systems.

References:

- o NRC Regulatory Guide 1.32, Revision 2, "Criteria for Safety Related Electric Power Systems for Nuclear Power Plants."
- o IEEE 308, 1980, "IEEE Standard Criteria for Class 1E Power Systems for Nuclear Power Generating Stations."
- o SCE Specification S023-403-12, Revision 2, "Emergency Diesel Generators Specification."

Deficiency Number 89-200-02

Deficiency Title: Unqualified Motor Control Centers in Emergency Diesel Generator Rooms

Description of Discrepant Condition:

During the inspection, the team questioned the qualification of the motor control centers (MCCs) in the diesel generator rooms to the design ambient temperature of 122°F.

Upon investigation by the licensee, it was determined that the MCC's were not qualified for 122°F, but for 104°F. The manufacturer of the MCC, Square D, had informed Bechtel in 1981 that testing would have to be conducted to demonstrate operability at the higher temperature. No action was taken at that time, and at the time of the inspection no attempt had been made by the licensee to qualify the MCCs for the 122°F design ambient condition. As a result, the licensee prepared an operability assessment dated November 29, 1989 which documented the licensee's basis for allowing continued operation until the MCCs can be qualified by the vendor. The team found the operability assessment acceptable due to the fact that similar Square D MCCs have been qualified for more severe conditions at other plant sites. The licensee expects to receive the qualification documentation from Square D near April of 1990.

Requirements:

Regulatory Guide 1.32 and IEEE 308 (paragraph 6.1.2) states that "...The Class 1E power systems shall provide acceptable power under the conditions stated in the design basis." These requirements are also included in the station FSAR, Section 8.1.4.3.6.

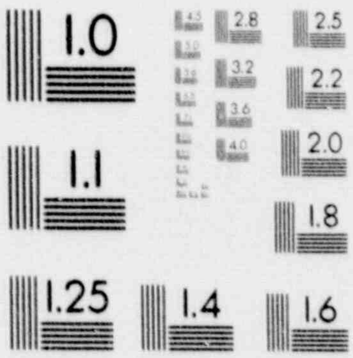
Criterion III of 10 CFR Part 50, Appendix B requires measures be established for the selection and review for suitability of materials and equipment that are essential to the safety-related functions of the systems.

References:

- FSAR Table 3.11-1.
- NRC Regulatory Guide 1.32, Revision 2, "Criteria for Safety Related Electric Power Systems for Nuclear Power Plants."
- IEEE 308, 1980, "IEEE Standard Criteria for Class 1E Power Systems for Nuclear Power Generating Stations."

2

IMAGE EVALUATION TEST TARGET (MT-3)



150mm

6″

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(716) 265-1600

2

IMAGE EVALUATION TEST TARGET (MT-3)

150mm

6″

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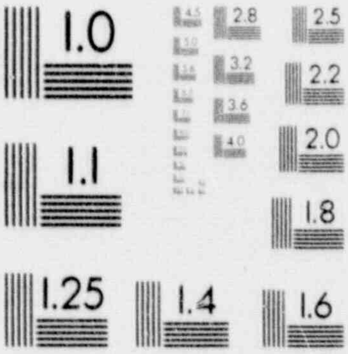
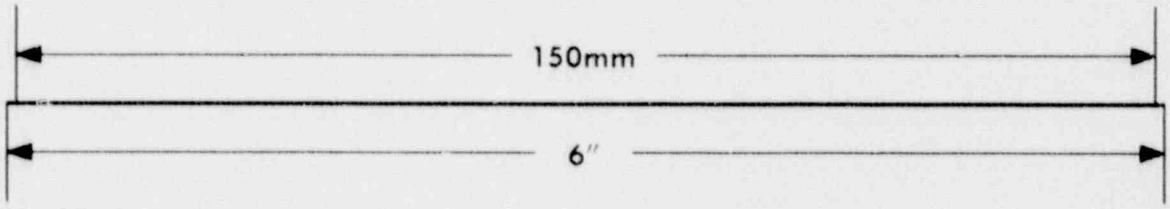
2

IMAGE EVALUATION TEST TARGET (MT-3)





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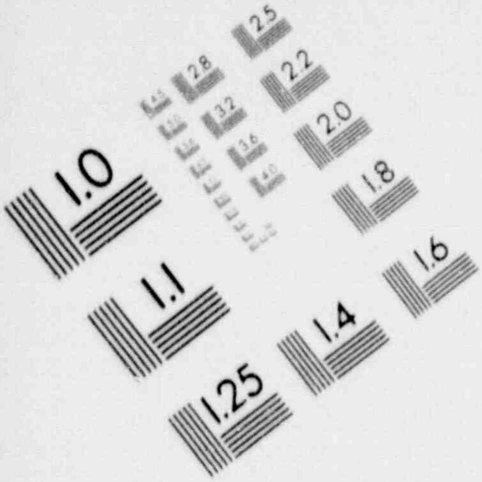
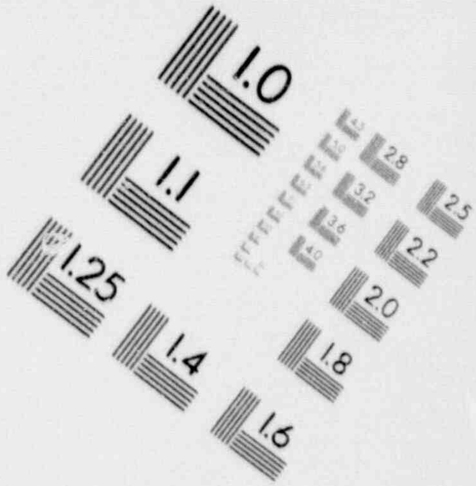
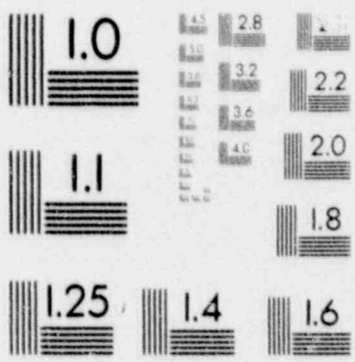
2

IMAGE EVALUATION TEST TARGET (MT-3)







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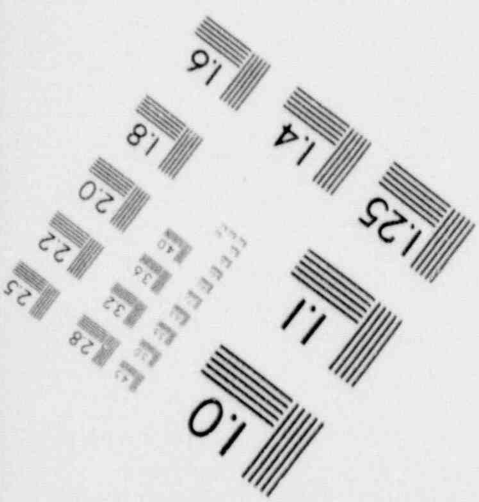

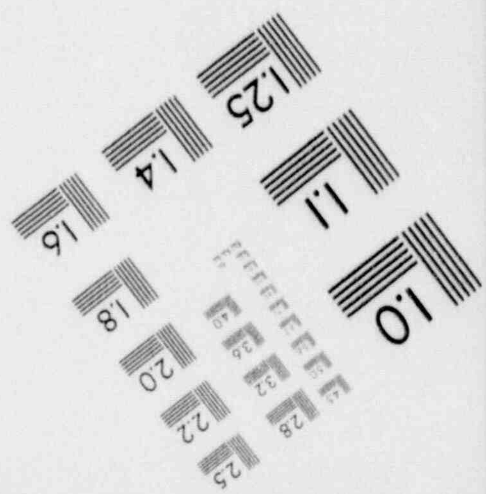

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Deficiency Number 89-200-03

Deficiency Title: Inadequate 120-Vac Control Power

Description of Discrepant Condition:

During the review of Calculation E4C-062 for the 120-Vac control circuits, the team determined that under worst-case conditions, the voltage at some contactor coils could drop below the contactor pickup rating of 102-Vac. The calculation had been performed using two invalid assumptions and as a result had incorrectly indicated that the voltage at the contactors would not fall below 105 Vac. The calculation assumed the 480-Vac bus voltage would never drop more than 3 percent of its nominal value when actually it could drop as much as 9 percent as stated in calculation E4C-012. Secondly, the calculation assumed that the control transformers, which step down the control voltage from 480-Vac to 120-Vac, would put out full rated voltage during inrush currents of as much as 200 percent.

Using the correct assumptions, the licensee reperformed the calculations. The new calculations showed that the voltage at some contactor coils could fall below the contactor pickup rating of 102-Vac. As a result, the licensee has agreed to test all contactors in which the voltage could fall below 102-Vac. A preliminary calculation has shown the worst-case voltage to be approximately 100.5-Vac.

Requirements:

Regulatory Guide 1.32 and IEEE 308 require that the Class 1E loads be designed to perform their functions adequately for the design variations of voltage in the Class 1E system. These requirements are also included in the station's FSAR, Section 8.1.4.3.6.

Criterion III of 10 CFR Part 50, Appendix B requires measures be established for the selection and review for suitability of materials and equipment that are essential to the safety-related functions of the systems.

References:

o NRC Regulatory Guide 1.32, Revision 2, "Criteria for Safety Related Electric Power Systems for Nuclear Power Plants."
o IEEE 308, 1980, "IEEE Standard Criteria for Class 1E Power Systems for Nuclear Power Generating Stations."
o SCE Calculation E4C-062, Revision 1, "Maximum Control Cable Lengths."
o SCE Calculation E4C-012, Revision 5, "Short Circuit Studies, M.V. Systems."

Deficiency Number 89-200-04

Deficiency Title: Inadequate Assurance of Battery Temperature

Description of Discrepant Condition:

The team reviewed the battery room emergency ventilation system and determined that no design provision had been made to ensure that the battery temperature will remain above 60°F. The existing design provides a heater in the normal, non-1E ventilation unit, as a common supply to all battery rooms, and provides a common non-1E exhaust. The emergency ventilation system consists of 1E powered exhaust fans only, one for each pair of battery rooms, using infiltration from corridors as the source of supply air. Since the minimum design temperature for outside air is 36°F and corridor air temperatures can be 50°F, a potential decrease in battery room temperature below 60°F can exist under postulated loss-of-coolant-accident (LOCA) or loss-of-offsite-power (LOOP) conditions. The team found that neither the mechanical systems calculation M-73-51, nor the electrical battery sizing calculation E4C-017 addressed this low temperature concern.

For normal operation, although there is a high temperature alarm set at 95°F, there is no corollary low temperature alarm in the battery room. The team identified that the plant surveillance operating instruction, S023-3-3.21 does check the battery room common exhaust temperature each shift (i.e., every eight hours) to ensure that the room temperature is equal to or greater than 65°F (the battery room temperature is normally controlled at 77°F). However, the team determined that the failure of the non-1E heater during normal operation with the outside air temperature at 36°F could occur between eight hour shift surveillances and could result in temperatures significantly lower than 60°F.

Failure of the plant battery room H-Vac systems to maintain battery room temperature at or above the 60°F design minimum established for electrolyte temperature can result in decreased battery capacity and capability to meet its intended safety-related function.

Because of the above team concern, the licensee performed a revision to mechanical systems calculation, M-73-51 (i.e., as Supplement A), which resulted in the conclusion that the battery room temperatures could be as low as 42.3°F when loss of the non-1E heater is considered. A preliminary electrical calculation was subsequently performed by the licensee to determine the battery capacity based on a 42°F electrolyte temperature. This calculation indicated that all batteries, except battery A of both units (2B007 for Unit 2 and 3B007 for Unit 3), would have acceptable performance to the 80 percent of rated capacity at end-of-life as recommended by IEEE 450-1975. Battery A would have acceptable performance down to 85 percent of rated capacity. However, the plant battery maintenance test results indicated that neither Battery 2B007 or 3B007 was near the 85 percent capability. A battery performance test was reported to have been made on battery 2B007 on May 22, 1987, which indicated a 96.8 percent capacity; while tests on battery 3B007 on January 22, 1987, indicated a 106 percent capacity.

Therefore, based on the Technical Specifications Section 4.8.2.1 and the industry accepted assumption of one percent yearly degradation of capacity, the team concluded that the present battery capacity appeared acceptable in the event of a loss of the battery room heaters. However, Battery A operation would now be limited on reaching 85 percent instead of 80 percent of capacity.

Requirement:

Technical Specification 4.8.2.1.b.3 requires that the average eletrolyte temperature of 10 connected cells be above 60°F.

Criterion III of 10 CFR Part 50, Appendix B requires measures be established for the selection and review for suitability of materials and equipment that are essential to the safety-related functions of the systems.

References:

- Technical Specification 4.8.2.1.b.3, "DC Sources, Electrolyte Temperature."
- Bechtel Calculation M-73-51, Revision 1, dated July 22, 1975, "Auxiliary Building - Control Area, EL-50', Battery Rooms-Heat Load Calculations."
- SCE Supplement A to Calculation M-73-51 (Revision 2), dated November 27, 1989.
- SCE Calculation E4C-017, Revision 9, dated August 21, 1989, "125-Vdc Battery Sizing."
- IEEE 450-1975, "Recommended Practice for Maintenance, Testing and Replacement of Large Lead Storage Batteries for Generating Stations and Substations."

Deficiency Number 89-200-05

Deficiency Title: Electrical Setpoint List Errors

Description of Discrepant Condition:

During the inspection, a review was conducted of the licensee's newly issued setpoint list. The electrical setpoint list, Document 90042, Revision 0, included the sensor amp tap setting and sensor pickup setting for 24 molded case circuit breakers used in the 125-Vdc system for Unit 2. A like number was included for Unit 3. The list referenced the low voltage power circuit breaker calculation E4C-50, Revision 12, and the circuit breaker coordination analysis, Document 900035AB, Revision 2. The list was in disagreement with these references in the case of two breaker sensor amp tap settings and frame sizes (breakers 2D303 and 2D403) and in the case of three sensor pickup settings (breakers 2D303, 2D403, and 2D405). As a result of this finding, the licensee performed a walkdown of over 80 percent of the information contained in the setpoint document. From the walkdown it was determined that approximately 4 percent of the information in the setpoint document was in error. Following the walkdown, the licensee issued eight interim design change notices to correct the setpoint document. Two of the change notices interim DCN Nos. ABG-2690 and ABG-2705 corrected the settings discussed in this finding.

Requirements:

Criterion III of 10 CFR Part 50, Appendix B requires measures be established to ensure the design basis is correctly translated into specifications, drawings, procedures, and instructions.

References:

- o SCE Calculation E4C-050, Revision 12, dated May 30, 1985, "Low Voltage Power Circuit Breaker Settings."
- o SCE Document 90035AB, Revision 2, dated November 1987, "Breaker Coordination Analysis for San Onofre Nuclear Generating Station Unit 2 and 3."
- o SCE Document 90042, Revision 0, dated December 14, 1988, "Quality Class 1E Electrical Setpoint List (ESL): Unit 2 and 3."
- o SCE Interim DCN No. ABG-2690, dated November 3, 1989, "Electrical Setpoint List."
- o SCE Interim DCN No. ABG-2705, dated November 20, 1989, "Electrical Setpoint List."
- o 10 CFR Part 50, Appendix B, Criterion VI, "Document Control."

Deficiency Number 89-200-06

Deficiency Title: Inverter Low dc Input Voltage Shutdown Setpoint Not in Accordance With Calculation

Description of Discrepant Condition:

The "end-of-discharge" voltages for the Class 1E 125-Vdc system batteries as developed and used in the battery sizing calculation E4C-017, Revision 9, were based on the requirement for the low dc input voltage shutdown setpoint for the class IE 120-Vac instrument control power system inverters. The value of the inverter low dc input voltage shutdown setpoint used in the calculation was 104 volts ±1.414 volts for uncertainty, drift, and repeatability. This value, and a statement that the setpoint for the inverter low input voltage shutdown be revised to 104 ±1 volt were documented in Attachment 2 to Calculation E4C-017. However, the inspection team at the site was informed by the licensee site personnel that the setpoint being used was 105 + 0.25/-2 volts.

The design inspection team was advised by the licensee's design personnel that the implementation of the revised inverter shutdown setpoint of 104 ± 1 volt should have been via a site initiated field change notice. The field change notice had apparently never been issued. As a result, the licensee issued Nonconformance Report 2-3093 on November 27, 1989, to correct the disagreement in the inverter low dc input voltage shutdown setpoint between calculation E4C-017 and the actual field conditions. The inspection team was advised that the maintenance procedure S023-II-11.185, will be revised to indicate the correct trip setpoint of 104 ±1 volts.

Requirement:

Criterion III of 10 CFR Part 50, Appendix B requires measures be established to ensure the design basis is correctly translated into specifications, drawings, procedures, and instructions.

References:

- SCE Calculation E4C-017, Revision 9, dated August 21 1989, "125-Vdc Battery sizing."
- SCE NCR No. 2-3093, Revision 0, dated November 27, 1989, "Vital Bus Inverters."
- SCE Maintenance Procedure S023-II-11.185.
- 10 CFR Part 50, Appendix B, Criterion III, "Design Control."

Deficiency Number 89-200-07

Deficiency Title: Lack of Abnormal Operating Procedure For Tornadic Conditions

Description of Discrepant Condition:

From the team's review of the FSAR Section 9.5.4, it was determined that the portion of the vent line above the diesel fuel oil transfer pump house roof is not protected from tornadic missiles. The FSAR states that, "In the event of damage caused by a missile, a blind flange, which is fitted to a tee off the vent line below the transfer pump roof, can be removed to assure tank venting."

Contrary to the above, the licensee did not have abnormal operating instructions to ensure that the diesel fuel storage tank vent was unobstructed following a tornado, and no provision for removing the blind flange in the event of damage by a tornadic missile. In addition, the team was told that apparently no abnormal operating procedures exist for responding to a tornadic event.

Requirements:

10 CFR Part 50, Appendix B, Criterion III, "Design Control" states that measures shall be established to assure that applicable regulatory requirements and the design basis, as defined in Paragraph 50.2 and as specified in the licensee application, for those structures, systems, and components, are correctly translated into specifications, drawings, procedures, and instructions.

References:

o FSAR Paragraph 9.5.4.2.2 "System Operation."

Deficiency Number 89-200-08

Deficiency Title: Inadequate Diesel Day Tank Level Setpoints

Description of Discrepant Condition:

The team reviewed Calculation M-16.1 and the "SONGS Units 2 and 3 Plant Set Point List" and determined that the fuel oil day tank low-level (pump start) and low-level (alarm) setpoints were not consistent with the Technical Specification limit on day tank volume.

The Technical Specifications require a minimum volume of 325 gallons for all modes of operation. The team determined that the level in the day tank where the transfer pump was energized, including level switch setting and instrumentation tolerances was not consistent with the minimum volume requirement.

Due to the fact that the pump suction location is two inches from the bottom of the tank, an actual volume of 334 gallons would be required to be maintained. Using a strapping table which equates tank level to volume, 334 gallons equates to a level of 24.3 inches. To this level an additional 2 to 3 inches would be required to be added to account for calibration uncertainties, instrumentation inaccuracies, drift, repeatability, and vortexing concerns. Therefore, the minimum value for the setpoint should have been between 26.3 and 27.3 inches and not 25.2 ± 1 inch, as indicated in the Setpoint List (Report 90030).

As a result of this finding, the licensee issue Nonconformance Reports (NCRs) NCR 2-3050 and 3-2512 for the Unit 2 and Unit 3 diesel generators. These NCRs provided an interim disposition to maintain at least 75 percent level (approximately 406 gallons) in the day tanks when the diesel engine is not running and manually starting the fuel transfer pump prior to running diesel engine surveillance tests or within 10 minutes after it has been started. The team evaluated these interim administrative controls as conservative. In addition, a review was conducted of calculation JC-EGA-006 performed to correct the setpoint discrepancies identified by the team. The team identified the following discrepancies in the new calculations:

(1) The potential overlap of the cutoff reset level switch LCH-5993-1 (or -2) with the auto start level switch LSL-5970-1 (or -2) for the fuel transfer pump.

(2) The calculation assumption did not reference the origin of the accuracy for rack equipment calibration accuracy (Rca).

(3) In the assumptions, the number of past calibration data sets used to derive the instrument loop drift accuracy was not specified. The time duration was also not specified for the drift stated.

Requirements:

Technical Specifications 3.8.1.1.b.1 and 3.8.1.2.b.1 require "a fuel day tank containing a minimum volume of 325 gallons of fuel."

FSAR Section 9.5.4.2.1.3 states, "The volume in each day tank permits over 1 hour of operation of its associated diesel engine installation at the largest operating load indicated in Section 8.3 without resupply from a diesel generator fuel oil storage tank."

Criterion III of 10 CFR Part 50, Appendix B requires measures be established to ensure the design basis is correctly translated into specifications, drawings, procedures, and instructions.

References:

- Bechtel Calculation M-16.1, Revision 1, dated May 31, 1978, "Diesel Fuel Transfer Pump Sizing."
- SCE Report 90030, "SONGS Units 2 and 3 Plant Set Point List," dated August 14, 1989.
- SCE Document S023-403-12-2-1-0, dated June 17, 1986, Homer R. Dulin Company Procedure HRD-ESO-23, Tank No. 2T-133, "Tank Gauging And Calibration Calculation."
- FSAR Table 8.3-1, Revision 4, dated February 1988, "List of Loads Supplied to Class 1E ac System."
- SCE Calculation M-0016-006, dated November 22, 1989, "DG Day Tank Capacity and Technical Specification Requirements" (Preliminary).
- SCE Calculation JC-EGA-006, dated November 24, 1989, "Fuel Level Setpoints for Diesel Generator Fuel Day Tank" (Preliminary).
- SCE Minor Modification Package No. 2-6795.OSM, "Diesel Generator Fuel Oil Day Tank Level Settings" (undated, Preliminary).

Deficiency Number 89-200-09

Deficiency Title: Inadequate Air Receiver Pressure For Diesel Generators

Description of Discrepant Condition:

Each emergency diesel generator (EDG) set is comprised of an electrical generator in between two diesel engines. Each engine is fitted with two sets of redundant air motors, for a total of four sets of starting motors per EDG set.

Each air receiver (64 cubic feet) provides air to one set of starting motors on each engine, located on opposing engine banks (i.e., right bank on one engine; left bank on the other engine), such that one air receiver is sufficient to provide the necessary starting air for the EDG. Each air receiver was tested by the licensee during plant preoperational testing to establish the receiver pressure required to provide for five cold starts of the EDG.

During this testing, a failed attempt was made to start the diesels five times with a starting air receiver pressure of 175 psig. A retest, performed without actually starting the diesel generators, and also with an initial pressure of 175 psig, resulted in three of the four air receivers being accepted, however the test criteria were not sufficient to ensure a five start diesel capability. The test criteria required the demonstration of a cranking capacity for each simulated start of 3 seconds or 2 to 3 engine revolutions. As a result, even though the diesel engine rotated as little as 0.1 revolutions during some of the tests, the tests were considered acceptable based on the 3 second time requirement. A final series of tests were performed for the fourth air receiver, after replacement of all four starting motors, and with an initial pressure of 195 psig. This last series of tests demonstrated that one of the diesel air receivers could supply enough air to its diesel generator set to meet both the 3 seconds and the 2 to 3 engine revolution requirement.

No documentation that could demonstrate that this one air receiver represented the worst-case was presented by the licensee. Furthermore, the team's review of the present air receiver low pressure alarm setpoint identified it to be 165 psig, not 195 psig. The review of the air compressor control setpoints identified the air compressor to be actuated "on" at 182 psig and "off" at 200 psig. Consequently, both the "air receiver alarm" and the "air compressor on" setpoints were found to be below the 195 psig value established during testing of air receiver C-012B. In addition, the acceptance of the test of air receiver C-012B as the worst-case is not considered valid by the team to ensure a five start capability of all air receivers.

As a result, the licensee issued Nonconformance Report No. G-998 to maintain at least one air receiver per air start system train at a pressure of 195 psig until this issue can be resolved.

Requirements:

Paragraph 9.5.6.2.1.3 of the FSAR states that "each starting air system is equipped with one air receiver. Each air receiver 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."

Criterion III of 10 CFR Part 50, Appendix B requires measures be established to ensure the design basis is correctly translated into specifications, drawings, procedures, and instructions.

References:

- Report No. 90030, "SONGS Units 2 and 3 Plant Set Point List," dated August 14, 1989.
- SCE Procedure 2PE-600-01, Revision 0, dated April 21, 1981, "Diesel Generator Fuel System and Mechanical Test," with Test Change Notices (TCNs) through TCN 22 and Test Exception Reports (TERs) through TER 35.
- SCE Procedure S023-5-2.4, Revision 1, with TCNs 1-24, dated July 26, 1989, "Plant Auxiliary 63B Alarm Response Procedure" p. 44.
- NCR G-998, dated November 21, 1989, "Emergency Diesel Generators."
- NRC Standard Review Plan (NUREG-75/087), dated November 24, 1975 and Revision 1.

Deficiency Number 89-200-10

Deficiency Title: Diesel Generator Load Calculation Nonconservative

Description of Discrepant Condition:

The team reviewed the FSAR Table 8.3-1 which listed the Class 1E ac loads applied to the emergency diesel generators. In order to verify the accuracy of the FSAR table data, a review was conducted of several safety significant pump motor loads using the applicable certified performance curves and motor data sheets. From this review, the team determined that the loads listed in the latest FSAR Table 8.3-1 for significant safety-related pump motors were nonconservative; therefore, the total could be 50 to 100-kW more than that identified. The team determined that calculations using certified performance curves and runout or maximum pressure-head conditions resulted in higher horsepower for the auxiliary feedwater, low pressure safety injection, containment spray, and charging pumps. In addition, application of specific motor data sheet motor efficiencies resulted in a net increase in the calculated kW load. Due to the large margin between the diesel output rating and the postulated loads, the team identified no immediate safety concern; however, the resulting increase in KW demand could have an effect on corresponding diesel fuel consumption rates. These consumption rates are used in calculations for the diesel day tank and fuel oil storage tank.

Requirements:

FSAR Section 8.3.1.1.3, "Class 1E, AC System," states that Table 8.3-1 provides a listing of the Class 1E AC Systems loads and their respective buses.

Criterion III of 10 CFR Part 50, Appendix B requires measures be established to ensure the design basis is correctly translated into specifications, drawings, procedures, and instructions.

References:

- FSAR Section 8.3.1.1.3, "Class 1E, ac System."
- FSAR Table 8.3-1, Revision 4, dated February 1988, "List of Loads Supplied by Class 1E, ac System."
- SCE Calculation E4C-014, Revision 6, "Diesel Generator Sizing."
- Manufacturer's certified performance curves and motor data sheets for AFW, LPSI, CS, and charging pumps.

Deficiency Number 89-200-11

Deficiency Title: Inadequate Overpressure Protection for Diesel Cooling Water Expansion Tank

Description of Discrepant Condition:

During its review of plant modification DCP 2-6554.33 TM, "Cooling Water Makeup Line for Train A DG," the team found that the diesel cooling water expansion tank was fitted with a non-ASME code pressure cap. This cap is relied on for relief and flow restriction and performs a safety-related function. Contrary to the requirements of ASME Section III, the cap is not a code device and could not be relied on to perform its safety-related function.

In addition, this device was not included in the plant's ASME Section XI Valve Inservice Test (IST) Program. The team identified that the last recorded test of this device was performed as part of DCP 2/3-6554.33 post-modification testing, using Procedure SO2/SO3-XXVI-9.6554..33.1 for Unit Nos. 2/3, respectively. This testing was performed on February 1, 1988 and April 12, 1988, respectively. The team found that no subsequent testing had been performed.

Requirements:

1. FSAR Table 3.2-1 identifies diesel generator cooling water system tanks as III-3 (ASME Section III, Class 3). ASME Section III requires overpressure protection for pressure vessels with a ASME Code relief device.

2. 10 CFR 50.55a(g) "Inservice Inspection Requirements" gives requirements for inservice tests to verify operational readiness of pumps and valves whose function is required for safety and system pressure tests.

References:

- FSAR Table 3.2-1, "Equipment Classification," FSAR 9.5.5, D.G. Cooling Water System.
- ASME Boiler and Pressure Vessel Code, Section III.
- ASME Boiler and Pressure Vessel Code, Section XI.
- SCE Plant Modification, DCP-2-6554.33 TM, Revision 0, and PFC 2-87-6554.33, Revision 1, dated February 2, 1988, "Cooling Water Makeup Line for Train A DG."
- SCE Test Procedure SO2-XXVI-9.6554..33.1, Revision 0, dated February 4, 1988, "Diesel Generator Expansion Tank Emergency Refill Line Flow and Pressure Verification Test" (DCP 2-6554.33, Revision 0, post-modification test).
- SCE Test Procedure SO3-XXVI-9.6554.9..33.1, Revision 0, dated April 13, 1988, "Diesel Generator Expansion Tank Emergency Refill Line Flow and Pressure Verification Test" (DCP 3-6554.33, Revision 0, post-modification test).

Deficiency Number 89-200-12

Deficiency Title: Improper Measurements Taken During Diesel Reassembly

Description of Discrepant Condition:

During a walkdown inspection conducted by the NRC team on October 31, 1989, a number of deficiencies were noted concerning certain maintenance activities on the emergency diesel generators. The activities in question were related to the reassembly of the Unit 2 MG-003 diesel generator. The team observed craftsmen torquing bolts on access covers of the diesel generator without a procedure present at the job site. Upon questioning the craftsmen, the team was told that the applicable procedures had just been removed from the job site by the maintenance foreman. The applicable procedures for the work in progress were Maintenance Order 88121953000 and Maintenance Procedure SO123-I-2.11, Revision 6. The team requested the working copies of these procedures and noted that measurements pertaining to piston clearances had been improperly evaluated during a previous step of the procedure. Paragraph 6.4.5.3.5.1 of Procedure SO23-I-2.11 required the craftsmen to record two lead wire measurements which were taken between the front and rear of each diesel piston and the cylinder head. The recorded measurements were then to be subtracted from one another with a resulting value of less than 0.005 inch stated as the acceptance criteria. In addition, the procedure required the recording of the same measurements taken during the last refueling outage. Instead of subtracting the current front and rear readings, the craftsmen apparently subtracted the current from the previous readings. In some cases, the resultant number recorded in the procedure could not have been achieved by subtracting any of the four current or previous readings. As a result, the team requested the completed copy of the same procedure for the Unit 3 diesel generator. Review of this procedure indicated that the same measurements had been improperly evaluated.

The team also identified the fact that no quality control QC sign-offs or verifications had been specified for the performance of this work. The licensee stated that the QC planning guidelines did not require QC verifications to be performed on diesel generator work. Although the licensee's procedures do not require QC verifications for this type of work, the team expressed the concern that mistakes such as those identified are apparently not being identified or corrected under the licensee's current program implementation.

Requirements:

Criterion V of 10 CFR Part 50, Appendix B requires activities affecting quality be accomplished in accordance with appropriate procedures.

References:

- SCE Maintenance Procedure SO123-I-2.11, Revision 6, TCN 6-4, "Diesel Generator Surveillance Inspection."
- SCE Quality Control Planning Guidelines, Revision 4.

Deficiency Number 89-200-13

Deficiency Title: Hardware Deficiencies Found During Maintenance Walkthrough

Description of Discrepant Condition:

During a walkdown and review of the maintenance activities associated with the recently completed battery replacement, the following deficiencies were noted:

(1) One plastic battery spacer tube was missing and several 5/8-inch steel rod jam nuts supporting the spacers were loose. This condition indicated that the second nut was not torqued to the required value of 15 foot-pounds. This torque requirement is specified in maintenance instruction EA-15467, "Installing Clamp Assemblies on Seismic Racks for G Cells." In addition, the recorded measurement and test equipment used when accomplishing the above work did not reference a specific torque wrench for the 15 foot pound torquing requirement. The licensee initiated action to correct the deficient condition in accordance with MO 89110824000.

(2) Incorrect bolts were used in making the battery terminal Nos. 25, 26, 52, and 52 interconnections. The bolts used were 1/4-inch-20, however, the requirement was to use a 5/16-inch-18 bolt. Upon identification of these conditions, the licensee initiated action to correct the deficient condition in accordance with MO 89111041000 and NCR 2-3052. The team noted that the subject maintenance orders did not contain specific work instructions but only referenced technical manuals and drawings without identifying what specific sections that were applicable. This may have contributed to the use of the incorrect bolts.

(3) There was a single QC inspection point identified in each maintenance order referenced above. This one QC inspection point was for all work pertaining to the replacement of each battery bank. This one inspection point did not state what attributes of the completed work to be verified and based on questioning of the QC inspector which signed off this point, there was uncertainty as to the actual meaning of the sign-off. Upon identification of this condition, the licensee initiated a memorandum to review quality control activities. The team expressed concern that, although QC witness points might be included in some procedures, the witness points or sign-offs apparently do not indicate what particular activities or conditions are to be verified by the inspector.

In addition to the above deficiencies, several other unrelated hardware deficiencies were found during the team's walkdown inspections of Units 2 and 3. The following additional deficiencies were noted by the inspection team.

(1) One loose nut was found on the engine oil filter cover for diesel generator 2G002. One loose U-bolt hanger was found that supported the starting air line upstream of valve S2-2420-MV-111 for diesel generator 2G003.

(2) Inadequate thread engagement was found on the fasteners for a spacer flange located on the SG003 diesel generator air start line downstream of valve S-3-2420-MV-112.

Requirements:

Criterion V of 10 CFR Part 50, Appendix B requires activities affecting quality be accomplished in accordance with appropriate procedures.

Criterion III of 10 CFR Part 50, Appendix B requires measures be established for the selection and review for suitability of materials and equipment that are essential to the safety-related functions of the systems.

References:

Exide Vendor Manual S023-301-2-36, Revision 0 and Revision 1.

Deficiency Number 89-200-14

Deficiency Title: Deficiencies in Diesel Fuel Oil Day Tank Level Calibration

Description of Discrepant Condition:

During the team's review of the calibration of the day tank level instrumentation systems, several deficiencies were noted with the calibration methodology, the calibration procedures, and the associated instrument calibration data cards (ICDCs). The diesel fuel oil level measurement system consists of two separate sensors for fuel oil level. The first consists of an analog measurement of day tank level with a local control panel level indicator. Two bistable devices, tag items LSL and LSLL, with contact (switch) outputs on low and low-low level, are provided as an integral part of the level indicator. The second level sensor is a float actuated switch device with two contact outputs, tag items LCH and LSH, on control-high and high level. The instrument setpoint list (ISL) specified the setpoints for the level switch/control devices as follows: LSLL at 20 inches, LSL at 25.2 inches, LCH at 35 inches, and LSH at 40 inches, with all settings noted as being measured from the bottom of the day tank. The primary diesel fuel oil transfer pump, which transfers fuel oil from the large underground storage tank to the day tank, is started when the day tank level reaches the LSL setpoint (25.2 inches) and is stopped when the level is restored to the LCH setpoint (35 inches). A control room alarm window indicates "Diesel G002 Fuel Oil Day Tank Trouble" at the LSLL setpoint (20") and at the LSH setpoint (40 inches).

The analog level indication system sensor consists of a series of resistors, forming a voltage divider network, that are located in a tube and inserted into a tank. Reed switches, actuated by a magnet in a float surrounding the sensing tube, are used to tap off an electrical signal that is proportional to the height of the liquid in the tank. The only calibration adjustment that is available is via the "Full Ref" toggle switch which allows the adjustment of the voltage signal provided to the voltage divider network. A "Calibrate" potentiometer allows the full reference voltage to be adjusted to provide a full span output signal of 200 micro amps.

The team requested surveillance test data to demonstrate that the day tank level measurement system had been properly calibrated and that the level switch devices had been set at the settings specified in the ISL. The licensee provided a copy of maintenance order (MO) 87040434 and MO 89010154 under which the last two calibration tests for the Unit 2, Train A diesel generator day tank analog level measurement system had been performed. The MOs calls out the performance of an electronic loop verification of the day tank level measurement per test procedure SO123-II-8.10.1, "Electronic Loop Verification." This procedure (step 6.14), in turn, required the calibration of the measurement loop transmitter in accordance with the applicable procedure that is listed in the procedure list as SO23-II-9.245, "Gems 36000 and 51000 Series TLI System Modular Receiver Transmitter and Indicator Calibration."

The level transmitter calibration procedure, SO23-II-9.245, is general in nature and is used for all Gems tank level indicating (TLI) systems. Under Section 6.0 of the procedure, Note 4 states that calibration of the receiver and indicator will be accomplished by positioning the transmitter float either manually or by varying sump liquid level. This procedure includes a five-point check that the level transmitter output is within acceptable limits. An alternate calibration method is allowed when tank level cannot be changed or the level transmitter cannot be removed to position the float. The alternate method uses a potentiometer to simulate the float movement in the level transmitter.

As noted above, the only calibration adjustment that is available for the level transmitter is the adjustment of the voltage applied to the voltage divider network. Therefore, changing the position of the level sensor float, either manually or by changing tank level, provides a means of verifying the operability of the float and reed switches in the level sensor. The alternate calibration method simulates the level sensor by the use of a potentiometer to vary the transmitter output signal. This permits the calibration of the remaining components in the measurement loop; however, it does not confirm the operability of the level sensor that is obtained by confirming changes in float position and the operation of the voltage sensing reed switches.

The team reviewed the calibration test data from two previous surveillances for the Unit 2 Train A diesel generator day tank level transmitter measurement system. A number of problems prevented the team from confirming that the system had been properly calibrated. Additional problems were encountered during the review of ICDCs for the the day tank level measurement systems. Examples of these problems are the following:

(1) The level transmitter ICDC did not provide sufficient data to define the level transmitter measurement range. The following data was noted on the ICDC:

2LT-5970-1	0-39.75 inches/0-100 percent
2LT-5970-2	0-42 inches
3LT-5970-1	0-42 inches/0-200 micro amps
3LT-5970-2	0.330 to 1.518 K-ohms

As a result of this finding, on November 14, 1989, level transmitter 2LT-5970-1 was removed and determined to have a measurement span of 36-3/16 inches, as recorded on an updated ICDC. The licensee provided the team a sketch of the location of the level transmitter in the day tank that identified zero inches for the level measurement span as corresponding to a tank level of 5-1/4 inches. Hence, the range of the level transmitter is 5-1/4 to 41-7/16 inches in terms of actual tank level.

(2) With respect to the results of previous level instrument calibrations, there was inconsistency in stating the calibration test instrument accuracy in regard to the model and the range scale of the test instrument being used. The team observed that three different models of the test instrument were used in performing calibrations (Fluke 8060A, 8050A, and 8600A). The test instrument accuracies stated for each of the range scales used were not consistent; that is, in some instances the same scale was identified as having different accuracies.

(3) The setpoint list specified level switch setpoints in inches as measured from the bottom of the day tank. The level switches are calibrated to actuate alarms or to start and stop the transfer pumps by simulating the input signal to a level switch (bistable trip unit) to verify that the desired action occurs at the specified setpoint. However, the ICDC's did not provide data to equate the level setpoints, in inches of tank level, to the simulated level measurement signal which has a range of 0 to 200 micro amps. As a result, the team was unable to confirm that the level instrumentation had been calibrated at the appropriate setpoints. Furthermore, the lack of adequate calibration data precludes the calibration of the level instrumentation in accordance with the existing calibration procedures.

(4) The procedure for calibrating the day tank level indicating meter, 2LI-5970-1, did not state whether the meter scale is to be calibrated in terms of percent level or percent tank volume. Apparently, the level indicator scale was calibrated in terms of percent tank volume, since the relationship between the level indicator input signal and scale units is nonlinear. However, the calibration data on the ICDC did not contain sufficient information to equate the level measurement signal to the volume of fuel oil in the day tank.

Requirements:

Technical Specification 3.8.1.1.a.4 requires 325 gallons of diesel fuel oil in the day tanks.

Criterion III of 10 CFR Part 50, Appendix B requires measures be established to ensure the design basis is correctly translated into specifications, drawings, procedures, and instructions.

References:

o SCE Calibration Procedure, SO123-II-9.245, "Gems 36000 and 51000 Series TLI System Transmitter and Indicator Calibration."
o Technical Specification, Section 3.8.1.1.a.4.

Deficiency Number 89-200-15

Deficiency Title: Deficiencies in Diesel Fuel Storage Tank Level Calibration

Description of Discrepant Condition:

During the inspection, the team reviewed the documents and procedures associated with the calibration of the diesel generator fuel oil storage tank level measurement system. The team identified three problems during this review. The first concerned inadequate calibration data and procedures. The second concerned inadequate operator aid data on the quantity of usable fuel oil in the storage tank which is used in verifying compliance with Technical Specification requirements. The third concerned discrepancies in level setpoints as shown on system descriptions and operating procedures.

(1) The ICDC data stated that the level transmitter range was 0 to 144 inches. However, the level measurement signal has a 6-inch zero offset with respect to tank level. The level transmitter is a float-type device similar to that used for the day tank level measurement.

The calibration of the level measurement system is performed using the same general procedure, SO123-II-9.245, as noted previously for the diesel fuel oil day tank level measurement system. Because there is no practical means to vary the level of fuel oil in the storage tank, the only check on the operability of the level transmitter is that provided by a single-point check that is a comparison of actual level to indicated level. The actual level is determined by "stabbing" the tank through a standpipe connection that bottoms out in a sump that is 30 inches below the reference bottom of the tank. The calibration procedures did not address the steps required for relating the difference in actual measured level to the level transmitter output signal.

Because of the lack of correct ICDC calibration data on the range of the level measurement (i.e., zero offset and range), the storage tank level measurement system cannot be calibrated in accordance with existing procedures. In addition, the procedures for a single-point check of the transmitter calibration are incomplete because of a lack of data to relate actual measured level, referenced to the bottom of the sump, to measured tank level based on the level transmitter output signal.

(2) The operator aid, Document 3-034, noted that zero percent "control room (indicated) level" was at an actual tank level of 6 inches. However, it was identified as 6.5 inches on a sketch provided by the licensee.

In addition, a level switch is used to trip the transfer pump when the level falls to 13 inches in the storage tank. This precludes any further transfer of fuel oil from the storage tank. In contrast, the operator aid indicated that there was approximately 2450 gallons of usable fuel oil in the tank at the level at which the level switch trips the transfer pumps.

(3) Finally, discrepancies were found in the level switch setpoints shown on the instrument setpoint list, system descriptions, and operating procedures.

(a) The LSH setpoint was noted as 11'-3" (135") on pages 126 and 142 of the system description, SD-SO23-750, and page 37 of the alarm response procedure, SO23-5-2.35.1. This was inconsistent with the instrument setpoint list (ISL) which specifies the setting as 144 inches.

(b) The LLSL setpoint was noted as 6" on pages 126 and 143 of the system description SD-SO23-750. This was inconsistent with the ISL, which specified a setpoint of 13 inches.

Requirements:

Technical Specification 3.8.1.1.b.2 requires a minimum of 47,000 gallons of fuel oil storage for each diesel generator set when operating in Modes 1 through 4 and a minimum of 37,000 gallons of fuel oil storage when operating in Modes 5 and 6.

Criterion III of 10 CFR Part 50, Appendix B requires measures be established to ensure the design basis is correctly translated into specifications, drawings, procedures, and instructions.

References:

- SCE Alarm Response Procedure SO23-5-2.35.1, "Diesel Generator G-002 Local Annunciator Panel 0160 Alarm Response."
- SCE System Description SD-SO23-750, "Emergency Diesel Generator."
- Technical Specification Section 3.8.1.1.b.2.
- SCE Procedure SO123-II-9.245, "Gems 36000 and 51000 Series TLI System Transmitter and Indicator Calibration."
- SCE Operator Aid 3-034.

APPENDIX B

Persons Contacted

The following list contains those persons contacted or interviewed by the team during the inspection. Those persons marked with an asterisk (*) also attended the exit meeting.

SCE Irvine Personnel

Name	Position
M. Duong	Nuclear Engineering Design Organization
A. Mosaddegh	Nuclear Engineering Design Organization
A. Thiel	Nuclear Engineering Design Organization
*F. Nandy	NOD
B. Basu	Control Group Supervisor
R. Bower	Supervisor, I&C, Station Maintenance
A. Grande	Electrical Engineer
*A. Kaneko	Electrical Discipline Supervisor
J. Keelin	Mechanical Engineer
A. Mationg	Electrical Engineer
R. O'Neal	Engineering and Construction
R. Rice	Control Discipline Supervisor
R. St. Onge	Control Group Supervisor
P. Strand	Control Engineer
C. Duong	E&C Electrical
E. Lim	E&C Electrical
*J. Mearns	E&C Nuclear
*M. Merlo	Manager, NEDO
*J. Rainsberry	Licensing U-2/3
*R. Allen	Mechanical Engineering Supervisor
*C. Kramer	Mechanical Engineering
K. Hara	Electrical Engineering (Diesel Loads)
*D. Rosenblum	Manager NRA
*J. Reilly	STEC
*D. Nunn	NE&C
*D. Shull	NOD
R. Erickson	SDG&E

SCE Station Personnel

Name	Position
*K. Johnson	Supervising Engineer - NSSS Engineering
C. Carossino	Senior Compliance Engineer - Compliance
G. Valdivia	Engineer
R. Baker	Engineer
M. Speer	Lead Engineer
*H. Merter	Supervisor of Maintenance Engineering and Services
H. Schutler	Senior Engineer

M. Trillo	Shift Superintendent
T. Graham	Electrical Engineer - NSSS Section
D. Knapp	NPEO (Nuclear Plant Equipment Operator)
J. Peattie	Upgrade Foreman
D. Herbst	Manager Site QA
B. Hammer	QC Supervisor - Acting QC Manager
F. Bolton	QC Supervisor
R. Devoid	QA Engineer
D. Stickney	COG Engineer
R. Sarouham	QA Engineer
S. Khamamkar	COG Engineer
D. Pjonter	Electrical Foreman
D. Stonechipher	Site QC Manager
D. Noon	QC Inspector
G. Lear	Electrical Engineer
K. Thind	Electrical Engineer
J. Simpson	Senior Electrical Engineer
F. Vogel	Upgrade Planner
J. Umbreit	Planner
C. Johnson	Foreman
R. Lamar	Electrician
D. Sharrett	Electrician
E. Gordon	Test Technician "A"
*B. Bridenbecker	VP/Site Manager
*L. Cash	NGS

NRC Personnel

Name	Position
J. Wilcox	NRR
G. Lainas	NRR
S. Forsberg	Visiting Inspector
J. Haller	Consultant
J. Houghton	Consultant
O. Mazzoni	Consultant
S. Athavale	NRR
T. Dunning	NRR
F. Gee	Region V
F. Huey	Region V
B. Grimes	NRR
J. Jacobson	NRR
G. Imbro	NRR
C. Trammell	NRR
C. Caldwell	Region V