UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

SOUTHERN CALIFORNIA EDISON COMPANY

SAN DIEGO GAS AND ELECTRIC COMPANY

DOCKET NO. 50-206

SAN ONOFRE NUCLEAR GENERATING STATION, UNIT NO. 1

AMENDMENT TO PROVISIONAL OPERATING LICENSE

Amendment No. 136
License No. DPR-13

1. The Nuclear Regulatory Commission (the Commission) has found that:

   A. The application for amendment by Southern California Edison Company and San Diego Gas and Electric Company (the licensee) dated June 5, 1990, as supplemented by letters dated September 26 and September 28, 1990, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's regulations set forth in 10 CFR Chapter I;

   B. The facility will operate in conformity with the application, the provisions of the Act, and the regulations of the Commission;

   C. There is reasonable assurance (i) that the activities authorized by this amendment can be conducted without endangering the health and safety of the public, and (ii) that such activities will be conducted in compliance with the Commission's regulations;

   D. The issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public; and

   E. The issuance of this amendment is in accordance with 10 CFR Part 51 of the Commission's regulations and all applicable requirements have been satisfied.

2. Accordingly, the license is amended by deleting License Condition 3.L in its entirety and by changes to the Technical Specifications as indicated in the attachment to this license amendment, and paragraph 3.B. of Provisional Operating License No. DPR-13 is hereby amended to read as follows:

   B. Technical Specifications

   The Technical Specifications contained in Appendix A, as revised through Amendment No. 136, are hereby incorporated in the license. Southern California Edison Company shall operate the facility in accordance with the Technical Specifications, except where otherwise stated in specific license conditions.

3. This license amendment is effective as of the date of its issuance and must be fully implemented no later than 30 days from the date of issuance.

FOR THE NUCLEAR REGULATORY COMMISSION

H. Rood for

James E. Dyer, Acting Director
Project Directorate V
Division of Reactor Projects III,
IV, V and Special Projects
Office of Nuclear Reactor Regulation

Attachment:
Changes to the Technical
Specifications

Date of Issuance: November 8, 1990

ATTACHMENT TO LICENSE AMENDMENT NO. 136

PROVISIONAL OPERATING LICENSE NO. DPR-13

DOCKET NO. 50-206

Revise Appendix A Technical Specifications by removing the pages identified below and inserting the enclosed pages. The revised pages are identified by the captioned amendment number and contain marginal lines indicating the area of change.

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TECHNICAL SPECIFICATIONS

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3.7 AUXILIARY ELECTRICAL SUPPLY

3.7.1 ELECTRICAL SUPPLY: OPERATING

APPLICABILITY: MODES 1, 2, 3, and 4

OBJECTIVE: To define those conditions of electrical power availability necessary to provide for safe reactor operation and to provide for the continuing availability of engineered safeguards.

SPECIFICATION:

a. One Southern California Edison Company and one San Diego Gas & Electric Company high voltage transmission line to the switchyard and two transmission circuits from the switchyard, one immediate and one delayed access, to the onsite safety-related distribution system shall be OPERABLE. This configuration constitutes the two required offsite circuits.

b. Two redundant and independent diesel generators shall be OPERABLE each with a total connected design load not to exceed 6,000 kW and with:

   1. A separate day tank containing a minimum of 290 gallons of fuel,

   2. A separate fuel storage system containing a minimum of 37,500 gallons of fuel, and

   3. A separate fuel transfer pump.

c. Train A Emergency AC Buses shall be OPERABLE, comprised of:

   1. 4,160 volt Bus 1C,
   2. 480 volt Buses 1 and 3, and associated station service transformers with tie breaker open.

d. Train B Emergency AC Buses shall be OPERABLE, comprised of:

   1. 4,160 volt Bus 2C,
   2. 480 volt Buses 2 and 4, and associated station service transformers with tie breaker open.

e. 120 volt AC Vital Buses 1, 2, 3, 3A, and 4 energized from associated inverters connected to DC Bus 1.

f. 120 volt AC Vital Buses 5 and 6 energized from associated inverters connected to DC Bus 2.

g. 125 volt DC Bus 1 shall be OPERABLE and energized from Battery No. 1, with at least one full capacity charger.

h. 125 volt DC Bus 2 shall be OPERABLE and energized from Battery No. 2, with at least one full capacity charger.

i. Two trains of Safeguards Load Sequencing Systems (SLSS) shall be OPERABLE.*

j. The MOV-850C Uninterruptible Power Supply (UPS) shall be OPERABLE and energized from the battery with its full capacity charger.**

k. Manual Transfer Switch 7 (MTS-7) shall be OPERABLE and energized from MCC-2.

l. Manual Transfer Switch 8 (MTS-8) shall be OPERABLE and energized from MCC-4.

ACTION:

A. With one of the required offsite circuits inoperable, demonstrate the operability of the remaining AC sources by performing Surveillance Requirement A of Technical Specification 4.4 within one hour and at least once per 8 hours thereafter and Surveillance Requirement B.1.a within 24 hours. Restore the circuit to OPERABLE status within 72 hours or be in at least HOT STANDBY within the next 6 hours and in COLD SHUTDOWN within the following 30 hours.

B. If one diesel generator is declared inoperable, demonstrate the operability of the two offsite transmission circuits and the remaining diesel generator by performing Surveillance Requirement A of Technical Specification 4.4 within one hour and at least once per 8 hours thereafter and Surveillance Requirement B.1.a within 24 hours. Restore the inoperable diesel generator to OPERABLE status within 72 hours or be in at least HOT STANDBY within the next 6 hours and in COLD SHUTDOWN within the following 30 hours.

C. With one offsite circuit and one diesel generator of the above required AC electrical power sources inoperable, demonstrate the operability of the remaining AC sources by performing Surveillance Requirement A of Technical Specification 4.4 within one hour and at least once per 8 hours thereafter and Surveillance Requirement B.1.a within 8 hours. Restore at least one of the inoperable sources to OPERABLE status within 12 hours or be in at least HOT STANDBY within the next 6 hours and in COLD SHUTDOWN within the following 30 hours. Have at least two offsite circuits and two diesel generators OPERABLE within 72 hours from the time of initial loss or be in at least HOT STANDBY within the next 6 hours and in COLD SHUTDOWN within the following 30 hours.

D. With one diesel generator inoperable as in B or C above, verify that: (1) all required systems, subsystems, trains,

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*The automatic load function may be blocked in Mode 3 at a pressurizer pressure $\leq$ 1,900 psig.

**Applicable in MODES 1, 2, and 3 above 500 psig.

components, and devices that depend on the remaining OPERABLE diesel generator as a source of emergency power are also OPERABLE; and (2) the steam-driven auxiliary feedwater pump is OPERABLE in MODES 1, 2, and 3. If these conditions are not satisfied within 2 hours, be in at least HOT STANDBY within the next 6 hours and in COLD SHUTDOWN within the following 30 hours.

E. With two required offsite circuits inoperable, demonstrate the operability of two diesel generators by performing Surveillance Requirement B.1.a of Technical Specification 4.4 within 8 hours, unless the diesel generators are already operating. Restore at least one of the inoperable sources to OPERABLE status within 24 hours or be in at least HOT STANDBY within the next 4 hours. Have at least two offsite circuits and two diesel generators OPERABLE within 72 hours from the time of initial loss or be in at least HOT STANDBY within the next 6 hours and in COLD SHUTDOWN within the following 30 hours.

F. With two of the above required diesel generators inoperable, demonstrate the operability of two offsite circuits by performing Surveillance Requirement A of Technical Specification 4.4 within one hour and at least once per 2 hours thereafter. Restore at least one of the inoperable diesel generators to OPERABLE status within 2 hours or be in at least HOT STANDBY within the next 6 hours and in COLD SHUTDOWN within the following 30 hours. Restore both diesel generators to OPERABLE status within 72 hours from time of initial loss or be in at least HOT STANDBY within the next 6 hours and in COLD SHUTDOWN within the following 30 hours.

G. With less than the above trains of Emergency AC buses OPERABLE, restore the inoperable buses within 8 hours or be in at least HOT STANDBY within the next 6 hours and in COLD SHUTDOWN within the following 30 hours.

H. With one AC Vital Bus either not energized from its associated inverter, or with the inverter not connected to its associated DC Bus: (1) re-energize the AC Vital Bus within 2 hours or be in at least HOT STANDBY within the next 6 hours and in COLD SHUTDOWN within the following 30 hours; and (2) re-energize the AC Vital Bus from its associated inverter connected to its associated DC bus within 24 hours or be in at least HOT STANDBY within the next 6 hours and in COLD SHUTDOWN within the following 30 hours.

I. With one DC bus inoperable or not energized from its associated battery and at least one full capacity charger, re-energize the DC Bus from its associated battery and at least one full capacity charger within 2 hours or be in at least HOT STANDBY within the next 6 hours and in COLD SHUTDOWN within the following 30 hours.

J. With one Safeguards Load Sequencing System inoperable, restore the inoperable sequencer to OPERABLE status within 72 hours or be in at least HOT STANDBY within the next 6 hours and in COLD SHUTDOWN within the following 30 hours.

K. With the MOV-850C UPS inoperable, or not energized from its associated battery and its full capacity charger, restore the UPS to OPERABLE status and re-energize the UPS from its associated battery and its full capacity charger within 72 hours or be in at least HOT STANDBY within the next 6 hours and in COLD SHUTDOWN within the following 30 hours.

L. With MTS-7 inoperable or not energized from MCC-2, restore MTS-7 to OPERABLE status and re-energize MTS-7 from MCC-2 within 2 hours or be in at least HOT STANDBY within the next 6 hours and in COLD SHUTDOWN within the following 30 hours.

M. With MTS-8 inoperable or not energized from MCC-4, restore MTS-8 to OPERABLE status and re-energize MTS-8 from MCC-4 within 72 hours or be in at least HOT STANDBY within the next 6 hours and in COLD SHUTDOWN within the following 30 hours.

BASIS: The station is connected electrically to the Southern California Edison Company and San Diego Gas & Electric Company system via either of two physically independent high voltage transmission routes composed of four Southern California Edison Company high voltage lines and four San Diego Gas & Electric Company high voltage lines.

Of the four Southern California Edison Company lines, any one can serve as a source of power to the station auxiliaries at any time. Similarly, any of the four San Diego Gas & Electric Company lines can serve as a source of power to the station auxiliaries at any time. By specifying one transmission line from each of the two physically independent high voltage transmission routes, redundancy of sources of auxiliary power for an orderly shutdown is provided.

Similarly, either transformer A or B, along with transformer C, provide redundancy of 4,160 volt power to the auxiliary equipment, and in particular to the safety injection trains. In addition, each 4160 volt bus has an onsite diesel generator as backup.

In MODES 1, 2, 3 and 4, two diesel generators provide the necessary redundancy to protect against a failure of one of the diesel generator systems or in case one diesel generator system is taken out for maintenance, without requiring a reactor shutdown. This also eliminates the necessity for depending on one diesel generator to operate for extended periods without shutdown if it were required for post-accident conditions.

When one diesel generator is inoperable, there is an additional ACTION requirement to verify that all required systems, subsystems, trains, components and devices, that depend on the remaining OPERABLE diesel generator as a source of emergency power, are also OPERABLE. In addition, the ACTION STATEMENT requires a verification that the steam-driven auxiliary feedwater pump is OPERABLE in MODES 1, 2, and 3.

These requirements are intended to provide assurance that a loss of offsite power event will not result in a complete loss of safety function of critical systems during the period one of the diesel generators is inoperable. The term verify as used in this context means to administratively check by examining logs or other information to determine if certain components are out-of-service for maintenance or other reasons. It does not mean to perform the surveillance requirements needed to demonstrate the operability of the component.

The total connected design load on each diesel generator is restricted to 6,000 kW or less. This requirement was the result of a crankshaft crack propagation analysis (see Reference 1). The analysis postulated that the crankshaft initially has stress-induced surface cracks. The analysis then considered the effect of four types of diesel load histories on the growth of these cracks. Each load history consisted of repeated start-stop cycles with some steady state operation at full load (6,000 kW) between each start and its stop. The analysis concluded that for a crankshaft with a detectable size crack (10 mils deep), the number of start-stop cycles required to enlarge the crack until it becomes self-propagating (18 mils deep) under the full load steady state stresses represents the effective life of the crankshaft.

During normal operations, the 480 volt system is considered OPERABLE if the four 480 volt buses and four station service transformers are OPERABLE with respective tie breakers open. This will ensure that the 480V main breakers and transformers remain OPERABLE during the worst loading condition in case of a SIS without LOP.

The primary power source for Vital Buses 1, 2, 3, 3A, and 4 is Train A DC Bus 1. The alternate power source is available from MCC-2 through MTS-7. The 1987 RPS and ESF single failure analyses credited the Train B backup power to these vital buses through MTS-7.

Correct operation of the safety injection system is assured by the operability of the load sequencers and the UPS for MOV-850C and MOV-358 (MOV-850C UPS). Correct operation of the recirculation system is assured by the operability of the MOV-850C UPS which also supplies MOV-358.

Manual Transfer Switch 8 (MTS-8) provides the means to power MOV-883 and the MOV-850C UPS from either Train A or Train B.

However, due to single failure considerations and environmental effects, MTS-8 is normally powered from MCC-4 on Train B. MOV-883 is the discharge valve from the RWST and must remain open during the safety injection phase and close with initiation of recirculation.

REFERENCE: (1) Report No FaAA-84-12-14 (Revision 1.0), Evaluation of Transient Conditions on Emergency Diesel Generator Crankshafts at San Onofre Nuclear Generating Station, Unit 1.

3.7.2 ELECTRICAL SUPPLY: SHUTDOWN

APPLICABILITY: MODES 5 and 6

OBJECTIVE: To define those conditions of available electrical power to ensure that the station can be maintained in the shutdown or refueling condition for extended periods.

SPECIFICATION:

a. One Southern California Edison Company or San Diego Gas and Electric Company high voltage transmission line to the switchyard and one transmission circuit from the switchyard, immediate or delayed access, to the onsite safety-related distribution system shall be OPERABLE.

b. One diesel generator shall be OPERABLE which is capable of automatic start, with a total connected design load not to exceed 6,000 kW and with:

   1. A day tank containing a minimum 290 gallons of fuel,

   2. A fuel storage system containing a minimum of 37,500 gallons of fuel, and

   3. A fuel transfer pump.

c. One train of AC buses shall be OPERABLE comprised of:

   1. 4,160 volt Bus 1C, and 480 volt Buses 1 and 3 with at least one associated station service transformer; OR

   2. 4,160 volt Bus 2C, and 480 volt Buses 2 and 4 with at least one associated station service transformer.

d. 120 volt Vital Buses 1, 2, and 4 energized from associated inverters connected to DC Bus 1.

e. One 125 volt DC Bus OPERABLE and energized from the associated battery with at least one full capacity charger.

ACTION: With less than the minimum required AC and DC electrical sources specified above, suspend all operations involving CORE ALTERATIONS or positive reactivity changes. Initiate corrective actions to energize the required electrical buses. Within 8 hours, depressurize and vent the RCS through at least a 1.75 square inch vent.

BASIS: In MODES 5 and 6, the requirement for one source of offsite power and one diesel generator to be OPERABLE will provide diverse and redundant electrical power sources in order that the station can be maintained in the COLD SHUTDOWN or REFUELING condition for extended time periods. Additionally, this

requirement will assure that operations involving core alterations or positive reactivity changes can be conducted safely. One SST and 480V main breaker will be capable of supplying the necessary power to the two associated 480V buses without exceeding their maximum loading ratings due to the reduced bus loading. Vital Buses 1, 2, and 4 power redundant source range nuclear instrument channels and Overpressure Mitigation System (OMS) channels and are required to support operations in MODES 5 and 6.

The total connected design load on each diesel generator is restricted to 6,000 kW or less. This requirement was the result of a crankshaft crack propagation analysis (see Reference 1). The analysis postulated that the crankshaft initially has stress-induced surface cracks. The analysis then considered the effect of four types of diesel load histories on the growth of these cracks. Each load history consisted of repeated start-stop cycles with some steady state operation at full load (6,000 kW) between each start and its stop. The analysis concluded that for a crankshaft with a detectable size crack (10 mils deep), the number of start-stop cycles required to enlarge the crack until it becomes self-propagating (18 mils deep) under the full load steady state stresses represents the effective life of the crankshaft.

Temporary cross-training between the two emergency AC trains is allowed only during the outages for maintenance purposes by use of power cables provided between 480 volt Bus 4 and Bus 1. The supply 480V bus, when cross-trained, does not become inoperable. Temporary cross-training will require two breakers in series to maintain adequate separation. In addition, the receiving bus cannot be declared OPERABLE. Loads will be added manually and limited by the operator action.

REFERENCE: (1) Report No FaAA-84-12-14 (Revision 1.0), Evaluation of Transient Conditions on Emergency Diesel Generator Crankshafts at San Onofre Nuclear Generating Station, Unit 1.

4.4 EMERGENCY POWER SYSTEM PERIODIC TESTING

APPLICABILITY: Applies to testing of the Emergency Power System.

OBJECTIVE: To verify that the Emergency Power System will respond promptly and properly when required.

SPECIFICATION:

A. The required offsite circuits shall be determined OPERABLE at least once per 7 days by verifying correct breaker alignments and power availability.

B. The required diesel generators shall be demonstrated OPERABLE:

1. At least once per 31 days on a STAGGERED TEST BASIS by:

   a. Verifying the diesel performs a DG SLOW START[1] from standby conditions,

   b. Verifying a fuel transfer pump can be started and transfers fuel from the storage system to the day tank,

   c. Verifying the diesel generator is synchronized and running at 6,000 kW (+100 kW, -500 kW) for ≧ 60 minutes,

   d. Verifying the diesel generator is aligned to provide standby power to the associated emergency buses,

   e. Verifying the day tank contains a minimum of 290 gallons of fuel, and

   f. Verifying the fuel storage tank contains a minimum of 37,500 gallons of fuel.

2. At least once per 3 months by verifying that a sample of diesel fuel from the required fuel storage tanks is within the acceptable limits as specified by the supplier when checked for viscosity, water and sediment.

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[1]All diesel starts for testing and surveillance will be slow starts (greater than 24 seconds duration) except for the fast start required by Technical Specification 4.4.G conducted once per 18 months during shutdown and any other fast start required following specific maintenance involving the fast start capability.

C. AC Distribution

1. The required buses specified in Technical Specification 3.7, Auxiliary Electrical Supply, shall be determined OPERABLE and energized from AC sources other than the diesel generators with tie breakers without automatic SIS/SISLOP tripping circuitry open between redundant buses at least once per 7 days by verifying correct breaker alignment and power availability.

D. The required DC power sources specified in Technical Specification 3.7 shall meet the following:

1. Each DC Bus train shall be determined OPERABLE and energized at least once per 7 days by verifying correct breaker alignment and power availability.

2. Each 125 volt battery bank and charger shall be demonstrated OPERABLE:

a. At least once per 7 days by verifying that:

(1) The parameters in Table 4.4-1 meet the Category A limits, and

(2) The total battery terminal voltage is greater than or equal to 129 volts on float charge.

b. At least once per 92 days and within 7 days after a battery discharge with battery terminal voltage below 110 volts, or battery overcharge with battery terminal voltage above 150 volts, by verifying that:

(1) The parameters in Table 4.4-1 meet the Category B limits,

(2) There is no visible corrosion at either terminals or connectors, or the connection resistance of these items is less than 150×10^{-6} ohms, and

(3) The average electrolyte temperature of ten connected cells is above 61°F for battery banks associated with DC Bus No. 1 and DC Bus No. 2 and above 48°F for the UPS battery bank.

c. At least once per 18 months by verifying that:

(1) The cells, cell plates and battery racks show no visual indication of physical damage or abnormal deterioration,

(2) The cell-to-cell and terminal connections are clean, tight and coated with anticorrosion material,

(3) The resistance of each cell-to-cell and terminal connection is less than or equal to 150 x 10^{-6} ohms,

(4) The battery charger for 125 volt DC Bus No. 1 will supply at least 800 amps DC at 130 volts DC for at least 8 hours,

(5) The battery charger for 125 volt DC Bus No. 2 will supply at least 45 amps DC at 130 volts DC for at least 8 hours, and

(6) The battery charger for the UPS will supply at least 10 amps AC at 480 volts AC for at least 8 hours as measured at the output of the UPS invertor.

d. At least once per 18 months, during shutdown, by verifying that the battery capacity is adequate to supply and maintain in OPERABLE status all of the actual or simulated emergency loads for the design duty cycle when the battery is subjected to a battery service test.

e. At least once per 60 months, during shutdown, by verifying that the battery capacity is at least 80%, 85% for Battery Bank No. 1, of the manufacturer's rating when subjected to a performance discharge test. Once per 60 month interval, this performance discharge test may be performed in lieu of the battery service test required by Surveillance Requirement 4.4.D.2.d.

f. Annual performance discharge tests of battery capacity shall be given to any battery that shows signs of degradation or has reached 85% of the service life expected for the application. Degradation is indicated when the battery capacity drops more than 10% of rated capacity from its average on previous performance tests, or is below 90% of the manufacturer's rating.

E. The required Safeguards Load Sequencing Systems (SLSS) shall be demonstrated OPERABLE at least once per 31 days on a STAGGERED TEST BASIS, by simulating SISLOP* conditions and verifying that the resulting interval between each load group is within ± 10% of its design interval.

F. The required diesel generators and the Safeguards Load Sequencing Systems (SLSS) shall be demonstrated OPERABLE at least once per 18 months during shutdown by:

1. Simulating SISLOP*, and:

   a. Verifying operation of circuitry which locks out non-critical equipment,

   b. Verifying the diesel performs a DG FAST START from standby condition on the auto-start signal, energizes the emergency buses with permanently connected loads and the auto connected emergency loads** through the load sequencer (with the exception of the feedwater, safety injection, charging and refueling water pumps whose respective breakers may be racked-out to the test position) and operates for ≧ 5 minutes while its generator is loaded with the emergency loads,

   c. Verifying that on the safety injection actuation signal, all diesel generator trips, except engine overspeed and generator differential, are automatically bypassed.

2. Verifying the generator capability to reject a load of 4,000 kW without tripping. The generator voltage shall not exceed 4,800 volts and the generator speed shall not exceed 500 rpm (nominal speed plus 75% of the difference between nominal speed and the overspeed trip setpoint) during and following the load rejection.

G. Manual Transfer Switches

1. Verify once every 31 days that the fuse block for breaker 8-1181 in MCC-1 for MTS-7 is removed.

2. Verify once every 31 days that MTS-8 is energized from breaker 8-1480B from MCC-4 and the cabinet door is locked, and that breaker 8-1122 from MCC-1 is locked open.

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*SISLOP is the signal generated by coincident loss of offsite power (loss of voltage on Buses 1C and 2C) and demand for safety injection.

**The sum of all loads on the engine shall not exceed 6,000 kW.

H. Periodic maintenance, surveillance, overhaul and inspection of the required diesel generator shall comply with the following:

1. A diesel engine maintenance and surveillance program as described in the Safety Evaluation related to Amendment No. 123 to this Operating License will be implemented. Changes to this program will be subject to the provisions of 10 CFR 50.59.

2. The frequency of major diesel engine overhaul that is a part of the diesel engine maintenance and surveillance program shall be at least once every ten years. For this overhaul, one engine may be inspected during the refueling outage immediately prior to the ten years and the other engine inspected during the refueling outage immediately following the ten years. Alternatively, both inspections may be performed coincident with the 10-year reactor vessel inservice inspection. The 10-year overhaul interval shall be determined on a calendar basis from the date of completion of the last overhaul.

3. Oil hole locations in journals 8 through 12 on each crankshaft shall be inspected with liquid penetrant. This inspection shall be performed at each refueling outage or at the end of fifty[2] start-stop cycles on the engine since the previous inspection, whichever comes first. Indications found shall be evaluated with eddy current testing as appropriate.

   During each major engine overhaul, the fillets of main journal Nos. 4 through 12 should be inspected together with the oil holes, using liquid penetrant. Indications found shall be evaluated with eddy current testing as appropriate. In addition, these inspections should be performed for the oil holes and fillets in at least three of the crankpin journals at each major engine overhaul.

   If during the oil hole and fillet inspections described above, cracks are found in the oil holes or in other crankshaft surfaces, these findings are to be reported to the NRC within 24 hours. The affected engine is to be considered inoperable and is not to be restored to OPERABLE status until the disposition and/or corrective actions have been approved by the NRC staff.

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[2]Start-stop cycles associated with idle (no load) engine operation at 200 rpm or less need not be counted toward the limit of fifty.

4. Cylinder blocks shall be inspected for "ligament" cracks, "stud-to-stud" cracks and "stud-to-end" cracks as defined in the report[3] by Failure Analysis Associates, Inc. (FaAA) entitled "Design Review of TDI R-4 and RV-4 Series Emergency Diesel Generator Cylinder Blocks" (FaAA Report No. FaAA-84-9-11.1) and dated December 1984. (Note that the FaAA report specifies additional inspections to be performed for blocks with "known" or "assumed" ligament cracks.) The inspection intervals (i.e., frequency) shall not exceed the intervals calculated using the cumulative damage index model in the subject FaAA report. In addition, inspection methods shall be consistent with or equivalent to those identified in the subject FaAA report.

   Blocks determined in the future to have "ligament" cracks as the result of the above inspections should be inspected at each refueling outage to determine whether or not cracks have initiated on the top surface, which was exposed because of the removal of two or more cylinder heads. This process should be repeated over several refueling outages until the entire block has been inspected. If after this process has been completed new "ligament" cracks are found, this process should again be repeated. Liquid penetrant testing or a similarly sensitive nondestructive testing technique should be used as appropriate to determine the depth of any cracks discovered.

   Whenever diesel generator No. 1 is operated in excess of 4,375 kW for one hour or more, a visual inspection of the right bank cylinder block is to be performed under intense light within 48 hours after engine shutdown to verify the absence of "stud-to-stud" and "stud-to-end" cracks.

   If "stud-to-stud" or "stud-to-end" cracks are found, these findings are to be reported to the NRC within 24 hours. The affected engine is to be considered inoperable and is not to be restored to OPERABLE status until the disposition and/or corrective actions have been approved by the NRC staff.

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[3]This report was transmitted to H.R. Denton, (NRC), from C.L. Ray, Jr., (TDI Owners Group), by letter dated December 11, 1984.

TABLE 4.4.-1

BATTERY SURVEILLANCE REQUIREMENTS

	CATEGORY A(1)	CATEGORY B(2)	
Parameter	Limits for each designated pilot cell	Limits for each connected cell	Allowable value for each connected cell (3)
Electrolyte Level	>Minimum level indication mark, and ≤1/4" above maximum level indication mark	>Minimum level indication mark, and ≤1/4" above maximum level indication mark	Above top of plates, and not overflowing
Float Voltage	≥2.13 volts	≥2.13 volts(c)	>2.07 volts
Specific Gravity (a)	≥1.200(b)	≥1.195	Not more than .020 below the average of all connected cells
		Average of all connected cells >1.205	Average of all connected cells ≥1.195(b)

(a) Corrected for electrolyte temperature and level.
(b) Or battery charging current is less than 2 amps when on charge.
(c) Corrected for average electrolyte temperature in accordance with IEEE STD 450-1980.
(1) For any Category A parameter(s) outside the limit(s) shown, the battery may be considered OPERABLE provided that within 24 hours all the Category B measurements are taken and found to be within their allowable values, and provided all Category A and B parameter(s) are restored to within limits within the next 6 days.
(2) For any Category B parameter(s) outside the limit (s) shown, the battery may be considered OPERABLE provided that the Category B parameter(s) are within their allowable values and provided the Category B parameter(s) are restored to within limits within 7 days.
(3) Any Category B parameter not within its allowable value indicates an inoperable battery.

BASIS: The normal plant Emergency Power System is normally in continuous operation, and periodically tested. (Ref. 1)

The tests specified above will be completed without any preliminary preparation or repairs which might influence the results of the test except as required to perform the DG SLOW START test set forth in T.S. 4.4.B.1.a. The tests will demonstrate that components which are not normally required will respond properly when required.

DG maintenance, surveillance, and overhaul and inspection requirements are intended to ensure the reliability and operational readiness of the diesels for emergency service. The basis for these requirements is discussed in NUREG-1216. (Ref. 2) The maintenance and surveillance program is primarily based on the TDI diesel generator owners group recommendations, as modified by NUREG-1216. The frequency of major engine overhaul conforms to the frequency specified in those recommendations.

The DG design basis load restriction of 6,000 kW and the start-stop restriction of fifty between successive crankshaft inspections were the result of assumptions and recommendations found in the owners group crack propagation analysis. (Ref. 3) The analysis postulated that the crankshaft initially has stress-induced surface cracks. The analysis then considered the effect of four types of diesel load histories on the growth of these cracks. Each load history consisted of repeated start-stop cycles with some steady state operation of full load (6,000 kW) between each start and its stop. The analysis concluded that for a crankshaft with a detectable size crack (10 mils deep), the number of start-stop cycles required to enlarge the crack until it becomes self-propagating (18 mils deep) under the full load steady state stresses represents the effective life of the crankshaft. Based on this conclusion, the analysis recommended that each crankshaft should be inspected at intervals of approximately fifty start-stop cycles.

Crankshaft stresses associated with idle (no load) DG speeds of 200 rpm or less have been found to be less than steady state stresses and so need not be counted toward the limit of fifty start-stop cycles. (Ref. 4)

DG SLOW STARTS are specified for the monthly surveillances in order to reduce the cumulative fatigue damage to the engine crankshafts to levels below the threshold of detection under a program of augmented inservice inspection. In the event that the DG SLOW START inadvertently achieves steady state voltage and frequency in less than 24 seconds, the surveillance will not be considered a failure and require restart of the diesel generator.

For the monthly surveillances, each DG is loaded to between 5,500 kW and 6,100 kW. The lower of these limits meets or exceeds the total connected design load on either diesel engine. The upper limit is to accommodate load variations above 6,000 kW.

Main journals numbered 8 through 12 of the DG crankshafts are the most highly stressed journals during engine operation and are therefore the most susceptible to fatigue-induced cracking. For this reason, the oil hole locations at these main journals are inspected for cracks at least once at every refueling outage. At each 10-year major engine overhaul, this inspection is expanded to include additional oil hole locations and selected journal fillets.

The purpose of inspecting the four cylinder blocks is to assure that these blocks, particularly the block that has degraded Widmanstaetten microstructure, remain free of cracks in the area surrounding the cylinder head stud holes.

The DG requirements and restrictions were initially imposed by the NRC as license conditions. (Ref. 5)

The surveillance requirements for demonstrating the OPERABILITY of the station batteries are based on the recommendations of Regulatory Guide 1.129, "Maintenance, Testing, and Replacement of Large Lead Storage Batteries for Nuclear Power Plants," February 1978, and IEEE Std 450-1980, "IEEE Recommended Practice for Maintenance, Testing, and Replacement of Large Lead Storage Batteries for Generating Stations and Substations."

Verifying average electrolyte temperature above the minimum for which the battery was sized, total battery terminal voltage on float charge, connection resistance values and the performance of battery service and discharge tests ensure the effectiveness of the charging system, the ability to handle high discharge rates and compares the battery capacity at that time with the rated capacity.

Table 4.4-1 specifies the normal limits for each designated pilot cell and each connected cell for electrolyte level, float voltage and specific gravity. The limits for the designated pilot cells float voltage and specific gravity, greater than 2.13 volts and .020 below normal full charge specific gravity or a battery charger current that has stabilized at a low value, is characteristic of a charged cell with adequate capacity. The normal limits for each connected cell for float voltage and specific gravity, greater than 2.13 volts and not more than .020 below normal full charge specific gravity with an average specific gravity of all the connected cells not more than .010 below normal full charge specific gravity, ensures the OPERABILITY and capability of the battery.

Operating with a battery cell's parameter outside the normal limit but within the allowable value specified in Table 4.4-1 is permitted for up to 7 days. During this 7 day period: (1) the allowable values for electrolyte level ensures no physical damage to the plates with an adequate electron transfer capability; (2) the allowable value for the average specific gravity of all the cells, not more than .020 below normal full charge specific gravity, ensures that the decrease in rating will be less than the safety margin provided in sizing; (3) the allowable value for an individual cell's specific gravity, ensures that an individual cell's specific gravity will not be more than .040 below normal full charge specific gravity and that the overall capability of the battery will be maintained within an acceptable limit; and (4) the allowable value for an individual cell's float voltage, greater than 2.07 volts, ensures the battery's capability to perform its design function.

Verifying required positions for manual transfer switches ensure single failure and environmental interaction requirements are satisfied. The normal alignments for MTS-7 and MTS-8 are MCC-2 and MCC-4, respectively.

REFERENCES:

(1) Supplement No. 1 to Final Engineering Report and Safety Analysis, Section 3, Questions 6 and 8.

(2) NUREG-1216, Safety Evaluation Report Related to the Operability and Reliability of Emergency Diesel Generators Manufactured by Transamerica Delaval, Inc. (August 1986)

(3) Report No. FaAA-84-12-14 (Revision 1.0), Evaluation of Transient Conditions on Emergency Diesel Generator Crankshafts at San Onofre Nuclear Generating Station, Unit 1.

(4) Letter dated May 2, 1990, from SCE to NRC, Emergency Diesel Generators.

(5) Amendment No. 123 to San Onofre Unit 1 Provisional Operating License, Issued on April 14, 1989.