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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO AMENDMENT NO. 123 TO PROVISIONAL OPERATING LICENSE NO. DPR-13

SOUTHERN CALIFORNIA EDISON COMPANY

SAN DIEGO GAS AND ELECTRIC COMPANY

SAN ONOFRE NUCLEAR GENERATING STATION, UNIT NO. 1

DOCKET NO. 50-206

1.0 INTRODUCTION

The following is the staff evaluation of proposed changes to San Onofre Nuclear Generating Station, Unit 1 (SONGS-1) operating license. The changes cover (1) a maximum load limit for monthly diesel surveillance testing required by Technical Specifications, (2) a proposed set of license conditions to be applied to the diesel generators, (3) a description of the contingency plan describing actions that will be taken if cracks are found in the diesel generator crankshafts. The proposed changes were initially described in detail in the proposed Amendment Application No. 156 to the SONGS-1 Operating License transmitted by letter dated November 11, 1988. By letters dated February 14, 1989, February 22, 1989, March 11, 1989 and March 14, 1989, the licensee modified its proposed changes to reflect the staff comments and to provide additional information.

Because of the complexity of the EDG loading and the potential for cracks in the crankshaft, a meeting between the NRC staff and Southern California Edison (SCE) representatives was held in Rockville, Maryland on January 17, 1989 to discuss this amendment application.

2.0 EVALUATION

The staff evaluation is based on SCE's letter of November 11, 1988 (Reference 1), telephone discussions, and discussions with SCE's representatives during a meeting held in Rockville, Maryland on January 17, 1989, SCE letter of February 14, 1989 (Reference 2), the Supplement to Amendment Application No. 156 dated February 22, 1989 (Reference 3), Supplement No. 2 to Amendment Application No. 156 dated March 11, 1989 (Reference 4), and SCE letter dated March 14, 1989 (Reference 5).

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SONGS-1 has two emergency diesel generators (EDG) Model DSRV-20 manufactured by Delaval. The nameplate rating of these units is 6000kW. Due to certain design issues of the Transamerica DeLaval, Inc. (TDI) diesel generator, the loading limits of SONGS-1 EDG were limited to 4500kW±5%. The NRC, by letter dated July 22, 1988 (Reference 6), approved a load rating on an interim basis of 5250kW±5%. This increase was needed to allow the EDG to be loaded to new capacity of 5250kW resulting from calculational errors discovered during recent EDG load studies and calculations. However, the increase did not account for loads associated with the addition of a third Auxiliary Feedwater pump (AFW). The installation of the third AFW pump will result in additional loads on the EDG higher than the allowed 5250kW. The derating of the EDG from 6000kW to the lower value was due to the potential for failures associated with the crankshaft and piston skirts.

The licensee now believes that operation of the EDGs at 6000KW is acceptable based on the following:

1. Staff findings in NUREG-1216 (Reference 7) concerning resolution of the TDI EDG reliability issue have been addressed. This includes implementation of the Phase 1 and 2 recommendations developed by the TDI Owners Group for a comprehensive design review/quality revalidation of critical engine components, plus additional recommendations developed by the staff's consultant, Pacific Northwest Laboratory (PNL), as summarized in the licensee's letter dated February 14, 1989 (Reference 2). This also includes a comprehensive maintenance/surveillance (M/S) program as documented in the licensee's letter dated March 14, 1989 (Reference 5). As stated in this letter, the M/S program is primarily based on the TDI diesel generator owners group recommendations contained in the TDI Instruction Manual and TDI (Cooper Industries) correspondence on specific M/S issues, as applicable to San Onofre Unit 1. Supplementing these primary source documents are two additional documents: PNL-5600 (Reference 8) and NUREG-1216.

2. The modified AF piston skirts have been replaced with AE piston skirts. AE piston skirts have previously been approved by the staff in NUREG-1216 for loadings in excess of 6000kW.

3. The licensee has implemented the slow start procedure (i.e., 24 seconds from zero to 450 RPM), consistent with the findings reached by the staff and its consultants in NUREG-1216 and PNL-5600. These slow starts reduce the high transient stresses during engine startup and thus reduce the potential for initiating cracks at the most limiting crankshaft oil hole locations.

4. Inspections during the recent outage confirm the continued absence of new cracks at the limiting oil hole locations, within the limits of NDE detectability (i.e., approximately 10 mils). Assuming a 10 mil undetected crack at the beginning of a cycle, the licensee's contractor, FaAA, calculated that such cracks will not propagate beyond 18 mils depth prior to the end of the

cycle as a result of transient stresses during engine startup and coastdown. Conservative one-dimensional fracture mechanics analyses by FaAA indicate that such cracks must propagate to at least 18 mils before they would be subject to rapid propagation to failure under stresses associated with normal steady state operation of the engine.

The proposed value of loading the EDG to 6000kW is acceptable to the staff as an interim short-term proposal until the resolution of crankshaft cracking is resolved. As a result of discussions with the licensee, the staff agrees that the load verification, once every 30 days, should be limited to 6000kW (+100kW-500kW) to accommodate the EDG load variations for 60 minutes or longer. The staff acceptance of this temporary load is based on the fact that SCE, on inspection of Journal No. 8 through 12 on both diesel generators during the recent refueling, found that the crankshafts are free of cracks. This does not prove that there are no incipient "cracks" that with time and several "slow" and "fast" starts/stops may develop in the future. The 6000KW load is not likely to cause degradation to the EDGS and is acceptable, conditioned upon continuing more frequent inspections as described and for the reasons set forth below.

The staff concluded in NUREG-1216 that certain operating restrictions and elements of the M/S program should be incorporated as license conditions. In its March 14, 1989 (Reference 5) letter the licensee proposed license conditions pertaining to M/S actions to be implemented for crankshafts and the engine blocks, and a slow start restriction to minimize stresses in the crankshaft during engine startups. These proposed license conditions incorporate staff comments made in response to the licensee's initial proposals dated November 11, 1988 (Reference 1), and are acceptable.

It should be noted that the staff concluded in NUREG-1216 that the various operational restrictions recommended by the Owners Group and PNL are not considered sufficient to ensure that the transient stresses have been reduced sufficiently to preclude initiation of additional cracks and ultimately the potential failure of these crankshafts. The staff does not consider it appropriate to rely indefinitely on an accelerated inspection schedule to compensate for a deficiency in design that makes those crankshafts prone to fatigue crack initiation and propagation contrary to normal industry practice and expectation. The staff concurs with PNL that the root cause of the cracking should be corrected to ensure the long-term reliability of these engines.

The staff's concern regarding the integrity of the crankshafts is heightened by the proposed increase in EDG load to 6000kW. Although still within the bounds of what was assumed in the crack propagation analysis, this increased load (relative to the 4500kW load assumed in PNL-5600 and NUREG-1216) reduces the critical crack size beyond which the crack could rapidly propagate to failure under normal steady state operating loads. The staff, therefore, plans to perform a more detailed review of the crack propagation analysis to ensure that continued operation with the present crankshafts will not adversely impact EDG reliability. In the meantime, the staff concludes that engine operation in the 4500 to 6000kW range is acceptable for 50 start/stop cycles or one operating cycle, whichever occurs sooner. Fifty start-stop cycles corresponds to the FaAA recommended inspection interval for engine operation at 6000kW. According to the FaAA anaysis and actual operating experience, 50 cycles

of operation will not produce unacceptable flaws in the crankcase oil holes. The NRC staff agrees with this conclusion and for this reason approves the start/stop limitation.

Apart from crankshafts and engine blocks, NUREG-1216 also concluded that certain M/S items for connecting rods, cylinder heads, piston skirts, and turbochargers should be included as license conditions. These items are part of the licensees M/S program, but have not been included as part of the special license conditions. The licensee has upgraded its cylinder heads and piston skirts with improved designs which eliminate the need for license conditions for these components. Regarding the connecting rods and turbochargers, it is the staff's conclusion that leaving the M/S requirements for these components in a licensee-controlled document which is not part of the license does not significantly detract from the overall effectiveness of the M/S program and is therefore acceptable.

The amendment includes the license conditions proposed in SCE letters dated March 11, 1989 (Reference 5) and March 14, 1989 (Reference 6).

These license conditions are related to the following:

1. Approval to increase the total connected loads to 6000kW on each EDG. This approval will remain in effect up to 50 start/stops on each unit since the last inspection or until the end of Cycle 10, whichever comes first.

2. Approval of the diesel generator maintenance and surveillance program.

3. Frequency of major diesel engine overhaul.

4. Inspection of main Journal Nos. 8 through 12 at each refueling outage. If cracks are found in the inspection, the NRC will be notified within 24 hours and the affected EDG will remain inoperable until NRC has approved its return to service.

5. Periodic inspection of cylinder blocks.

The staff has concluded that based on the evaluation discussed above, the proposed amendment, with the license conditions and Technical Specification, is acceptable.

3.0 ENVIRONMENTAL CONSIDERATION

Pursuant to 10 CFR 51.21, 51.32, and 51.35, an environmental assessment and finding of no significant impact have been prepared and published in the Federal Register on January 25, 1989 (54 FR 3699). Accordingly, based upon the environmental assessment, the Commission has determined that the issuance of this amendment will not have a significant effect on the quality of the human environment.

5.0 CONCLUSION

We have concluded, based on the considerations discussed above, that: (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (2) such activities will be conducted in compliance with the Commission's regulations and (3) the issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public.

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Dated: April 14, 1989

REFERENCES

1. Letter to Document Control Desk, USNRC from Kenneth P. Baskin, Vice President, Southern California Edison Company, "Docket No. 50-206, Amendment Application No. 156, San Onofre Nuclear Generating Station, Unit 1," dated November 11, 1988.

2. Letter to Document Control Desk, USNRC from F. R. Nandy, Manager of Nuclear Licensing, Southern California Edison Company, "Docket No. 50-206, Standby Diesel Generators, San Onofre Nuclear Generating Station, Unit 1," dated February 14, 1989.

3. Letter to Document Control Desk, USNRC from Kenneth P. Baskin, Vice President, Southern California Edison Company, "Docket No. 50-206, Supplement to Amendment Application No. 156, San Onofre Nuclear Generating Station, Unit 1," dated February 22, 1989.

4. Letter to Document Control Desk, USNRC from Kenneth P. Baskin, Vice President, Southern California Edison Company, "Docket No. 50-206, Supplement No. 2 to Amendment Application No. 156, San Onofre Nuclear Generating Station, Unit 1," dated March 11, 1989.

5. Letter to Document Control Desk, USNRC, from F. R. Nandy, Manager of Nuclear Licensing, Southern California Edison Company, "Docket No. 50-206, Standby Diesel Generators, San Onofre Nuclear Generating Station, Unit 1," dated March 14, 1989.

6. Letter to Kenneth P. Baskin, Vice President, Southern California Edison Company from Charles M. Trammell, Senior Project Manager, NRC, "Issuance of Amendment No. 104 to Provisional Operating License San Onofre Nuclear Generating Station, Unit No. 1," dated July 22, 1988.

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

8. Review of Resolution of Known Problems in Engine Components for Transamerica Delaval, Inc. Emergency Diesel Generators, PNL-5600, December 1985.