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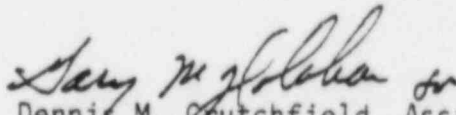
UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555
August 16, 1984

MEMORANDUM FOR: Thomas M. Novak, Assistant Director
for Licensing
Division of Licensing

FROM: Dennis M. Crutchfield, Assistant Director
for Safety Assessment
Division of Licensing

SUBJECT: SUPPLEMENTAL SAFETY EVALUATION REPORT - GRAND GULF
NUCLEAR STATION, UNIT 1; RELIABILITY OF DIESEL
GENERATORS MANUFACTURED BY TRANSAMERICA DELAVAL, INC.

The Safety Evaluation Report on the reliability of the Transamerica Delaval, Inc. diesel generators for Grand Gulf Unit 1 was transmitted to you by memorandum dated July 24, 1984. The SER concluded that the TDI diesel engines at Grand Gulf Unit 1 will provide a reliable source of on-site power subject to the license conditions given in Appendix A of that SER. Subsequently, the licensee has submitted information addressing those license conditions. This Supplemental Safety Evaluation Report (SSER) modifies the SER sent to you previously in light of the subsequent submittals by the licensee; however, the conclusions remain the same.


Dennis M. Crutchfield, Assistant Director
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8 ELECTRIC POWER SYSTEMS

8.3 Onsite Emergency Power Systems

8.3.1 Alternating Current Power System

In support of its request for a full-power license for Grand Gulf Unit 1 and in response to an NRC Order dated May 22, 1984, the licensee submitted, by letter dated July 5, 1984, a description of the June 1984 disassembly and inspection of the Division 1 diesel generator, the postinspection engine test program, and proposed enhancements to the licensee's maintenance and surveillance program. As required by the NRC Order, the licensee submittal also addresses the similarity of the "as-manufactured quality" of the Division 1 and 2 diesel generators as part of the licensee's justification for not inspecting the Division 2 engine.

Concerns regarding the reliability of large-bore, medium-speed diesel generators of the type supplied by Transamerica Delaval, Inc. (TDI) at Grand Gulf Unit 1 and at 15 other domestic nuclear plants were first prompted by a crankshaft failure at Shoreham in August 1983. However, a broad pattern of deficiencies in critical engine components have since become evident at Shoreham, Grand Gulf Unit 1, and at other nuclear and non-nuclear facilities using TDI diesel generators. These deficiencies stem from inadequacies in design, manufacture, and QA/QC by TDI.

In response to these problems, 13 U.S. nuclear utility owners, including the licensee, formed a TDI Diesel Generator Owners Group to address operational and regulatory issues relative to diesel generator sets used for standby emergency power. The Owners Group program, which was initiated in October 1983, embodies three major efforts.

- (1) Resolution of 16 known generic problem areas (Phase I program) intended by the Owners Group to serve as an interim basis for the licensing of plants.
- (2) Design review of important engine components and quality revalidation of important attributes for selected engine components (Phase II program).
- (3) Identification of any needed additional engine testing or inspections, based on findings stemming from the Phase I and II programs.

Pending completion of the Owners Group program, the licensee submitted a number of reports concerning its actions to ensure the reliability of the TDI diesels at Grand Gulf Unit 1. Based on its review of these reports and the status of the Owners Group program, the staff stated in its Safety Evaluation Report issued in support of the May 22, 1984, Order that additional information was needed regarding the present condition of critical engine components to support operation of Grand Gulf Unit 1 at power levels in excess of 5% of full power for the interim period pending completion of the Owners Group program and NRC staff review of recommendations stemming from this program as they apply to

Grand Gulf Unit 1. In addition to the engine inspections and subsequent post-inspection engine tests required by the Order, the staff's SER stated it would be necessary to review the licensee's proposed engine maintenance and surveillance program and any needed license conditions before issuance of a full-power license.

Appendix M to this supplement is a Technical Evaluation Report (TER) entitled "Review and Evaluation of Transamerica Delaval, Inc. Diesel Engine Reliability and Operability--Grand Gulf Nuclear Station, Unit 1." This TER was prepared by Pacific Northwest Laboratory (PNL), which is under contract to the NRC to perform technical evaluations of the TDI Owners Group generic program in addition to plant-specific evaluations relating to the reliability of TDI diesels. PNL has retained the services of several expert diesel consultants as part of its review staff.

In addition to the July 5, 1984, submittal, PNL and its consultants also reviewed the licensee submittals dated February 20, April 17, and May 6, 1984, and performed an onsite inspection of key engine components in June 1984 while the Division 1 engine was disassembled. PNL and its consultants also considered the status of the generic Owners Group program relative to the actions taken by the licensee to establish the reliability of the diesels.

Division 1 Engine

The June 1984 inspection of key engine components, including those identified by the Owners Group as known potential problem areas, indicates that these components are acceptable for nuclear service for the interim period extending to the first refueling of Grand Gulf Unit 1. This finding is subject to (1) an augmented maintenance and surveillance program and (2) operating restrictions as identified below.

Postinspection testing, as required by the May 22, 1984, Order, was satisfactorily completed. The licensee's letter dated July 2, 1984, provided the licensee's clarifications/interpretations of the required testing. Although the fast-start tests of the engine in accordance with the Order were performed subsequent to a manual prelubing of the turbocharger thrust bearings and thus did not simulate the worst challenge to the bearings, PNL does not recommend additional testing to simulate this challenge. The NRC staff concurs with this PNL finding and concludes that the tests performed by the licensee meet the intent of the NRC Order.

Division 2 Engine

In the Order dated May 22, 1984, the NRC staff stated that the need for Division 2 engine inspection would be contingent on

- (1) results of the inspection of the Division 1 engine
- (2) the licensee's ability to demonstrate, through a review of the manufacturer's QA records, that the two engines are of similar "as-manufactured" quality

The Division 1 engine inspection revealed only one component, the turbocharger, where failed elements, bolts and a vane, might be expected to occur in the Division 2 engine. The other components showed no rejectable indications or incipient problems that suggested adverse conditions might be present in the Division 2 engine.

Accordingly, PNL concluded that the turbochargers from the Division 2 engine should be inspected and any corrective actions taken and findings documented. No other Division 2 inspections were recommended on the basis of the Division 1 results.

In its submittal dated July 20, 1984, the licensee reported that the Division 2 turbochargers had been inspected for the type of damage found in the Division 1 turbochargers. The scope of the inspection included the stationary nozzle ring, vanes, bolts, and rotating turbine blades. The Division 2 turbochargers showed no signs of rotating disk damage, although one vane was found to be missing from each stationary nozzle ring (a similar condition was observed in the Division 1 turbochargers as discussed in Appendix M). The stationary nozzle ring bolts were found to be intact with no evidence of stress corrosion cracking. The licensee elected to replace the nozzle ring assembly and bolts although the old parts were judged to be acceptable. Turbine rotor float measurements were also performed and indicated no significant thrust bearing wear. Based on its review of the licensee's July 20, 1984, submittal, the NRC staff concludes that the licensee has satisfactorily addressed PNL's concern with respect to the Division 2 turbocharger.

On the basis of the review conducted by the licensee on the manufacturer's QA records and the upgrades accomplished for both engines, PNL concludes that the Division 1 and 2 engine components are of comparable "as-manufactured" quality. On the basis of their operating history, PNL concludes that the engines have been assembled and maintained comparably. Moreover, PNL has noted that the Division 2 engine has seen less service than the Division 1 engine. In addition, based on the status of its review of the Owners Group proposed generic resolution of the connecting rod issue, PNL has concluded that visual inspections of the connecting rods and a preload check of the connecting rod bolts should be performed on the Division 2 engine before plant operation above 5% power. In a letter dated July 26, 1984, the licensee reported that these actions have been completed. During the torque verifications, three bolts were observed to rotate from 1/16 to 1/8 inch at 95% of the required torque value. The licensee has indicated that the corresponding preload adjustment is well within the original tolerance of the torque wrench. Based on these factors and the absence of significant adverse findings from the recent inspection of Division 1 engine, the staff has concluded that no further inspections of the Division 2 engine are necessary at this time.

Augmented Maintenance and Surveillance Program

PNL concluded in the TER that modifications to the Augmented Maintenance/Surveillance Program proposed by the licensee in the July 5, 1984, submittal are needed to provide adequate assurance of engine reliability/operability. These modifications are discussed in detail in Section 6 of the TER (Appendix M).

By letter dated July 26, 1984, the licensee committed to a revised Augmented Maintenance and Surveillance Program. The NRC staff has reviewed this letter and concludes that the licensee's program incorporates all of the modifications recommended by PNL. Therefore, the staff finds the Augmented Maintenance and Surveillance Program, as identified in the licensee's July 26, 1984, letter, to be acceptable.

Operating Restrictions

PNL recommendations and conclusions regarding TDI diesel engine reliability at Grand Gulf Unit 1 are predicated on the following assumptions:

- (1) The emergency service requirements the licensee currently foresees for Grand Gulf Unit 1 will not exceed the engine load corresponding to a brake mean effective pressure (BMEP) of 185 psig. The need for this assumption is based on PNL concerns regarding the acceptability of crankshaft stresses at higher BMEP loadings.
- (2) All future engine testing (except the test to obtain preturbine exhaust temperature data as described in the next section) including surveillance testing required by the plant Technical Specifications will be limited to within $\pm 5\%$ of the nominal engine load where the upper limit of this load range corresponds to a BMEP of 185 psig.
- (3) In the absence of the Owners Group completing all elements of their program plan, PNL's conclusions are plant specific, applying only to Grand Gulf Unit 1 and are applicable only during its first reactor refueling cycle. It is understood by PNL that at the first refueling, the licensee will implement all applicable recommendations of the Owners Group.

With regard to item (1) above, the licensee reported by letter dated July 20, 1984, that 185 psig BMEP corresponds to a generator load of 5740 kW, which is about 82% of full-rated load. This exceeds the maximum engineered safety feature (ESF) loads, 68% and 56% of full-rated load for the Division 1 and 2 engines, respectively, required to shut down the plant and maintain it in a safe condition for loss of offsite power and loss-of-coolant accident (LOCA). It also exceeds the emergency service load requirements for loss of offsite power alone which are 52% and 68% for the Division 1 and 2 engines, respectively. Thus, there exists sufficient engine capacity at 185 psig BMEP to ensure that the fuel design limits and design conditions of the reactor coolant system boundary are not exceeded, and that the core is cooled and containment integrity and other vital functions are maintained in the event of postulated accidents as required by GDC 17.

The licensee also states in a letter dated August 3, 1984, that a precautionary note has been added to the Grand Gulf Off-Normal Event Procedure for Loss of Offsite Power. Specifically, the note specifies the 5740 kW (equivalent to 185 psig BMEP) limit on diesel generator loading during this off-normal event. The statement advises the operator that the Division 1 and 2 diesel generators may, if necessary, be used to carry additional plant loads. The staff found this precautionary note to be acceptable provided the "if necessary" provision would be clarified to indicate "if necessary to shut down the plant and maintain it in a safe condition." By letter dated August 5, 1984, the licensee provided acceptable clarification.

In addition, in a July 20, 1984, letter, the licensee stated that future training with respect to this procedure will explain both the basis for the note and the aspects to be taken into consideration in its application. In an August 3, 1984, letter, the licensee committed to including this training as part of the training package for Amendment 13 to the operating license which will be initiated following receipt of the amendment. The staff concurs with the need for this training and finds the licensee's proposal to be acceptable.

With regard to item (2) above, the licensee has submitted proposed Technical Specification changes incorporating this item. Specifically, the proposed changes would require that the monthly and 18-month surveillance tests be performed at a minimum of 5450 kW (78% of rated load), but not to exceed 5740 kW (82% of rated load, 185 psig BMEP). The lower limit is greater than the auto-connected loads required for the loss of offsite power and post-LOCA conditions as described above. Therefore, the staff finds these changes to be acceptable and has included them in Amendment 13 to the Technical Specifications.

With regard to item (3), the staff will include the following license condition in the full-power license amendment.

Final evaluations and recommendations from the TDI Owners Group Program applicable to Grand Gulf Unit 1, and the licensee's actions in response to this program for the Division 1 and 2 diesel generators, shall be submitted for the NRC review and approval before plant restart from the first refueling outage.

Confirmatory Issues

PNL identified a number of confirmatory issues in Section 7.2 of the enclosed TER (reproduced as Appendix M, this report) for which PNL concluded additional information was needed to ensure that no unanticipated problems exist. By letter dated July 26, 1984, the licensee provided the requested information with the exception of the preturbine exhaust temperature data. On the basis of its review of the July 26, 1984, submittal and discussions with its PNL consultants, the staff concludes that the information provided has not revealed any unanticipated problems and is consistent with and supportive of the PNL and staff conclusions regarding the reliability of the TDI engines at Grand Gulf Unit 1.

With regard to the preturbine exhaust temperature data, the licensee in a letter dated August 2, 1984, has committed to providing the requested data within 30 days of the date of the August 2 letter. The licensee maintains that the requested data are confirmatory in nature and not needed to ensure the satisfactory operation of the TDI engines. In support of that contention, the licensee has cited test data provided by TDI from an equivalent DSRV-16 engine for engine loads ranging to a BMEP of 225 psig. These data indicate that the turbocharger inlet temperatures are less than the turbocharger design temperature of 1200°F for BMEP loadings ranging to 225 psig. At the design Grand Gulf Unit 1 loss of offsite power/LOCA load of 158 psig BMEP, the TDI test data indicate a preturbine exhaust temperature of 1045°F. The staff concurs with the licensee's position that the requested preturbine exhaust temperature data from the Grand Gulf Unit 1 engines are confirmatory in nature and does not expect these data to alter the conclusions of this SER. Therefore, the licensee's commitment to provide the requested data within 30 days from August 2, 1984, is acceptable to the staff.

Fuel-Oil-Line Inspection

The Division 1 and 2 engines experienced several fuel-oil-line leaks between September and November 1983 which were directly attributable to minor damage to the lines from external causes, particularly from damage caused by maintenance operations. At the request of the NRC, the licensee has performed a walkdown of the Division 1 and 2 fuel-oil systems. The results of this

inspection are documented in the licensee's letter dated July 26, 1984. All fuel-oil piping and tubing on the Division 1 engine were found to be in acceptable condition. However, for the Division 2 engine, a number of potential future problem areas were noted. The potential problem areas involved locations where the fuel lines were observed to be in contact with other piping or components. The licensee has completed actions to correct these potential problem areas (as confirmed by the licensee in a letter dated August 3, 1984).

As also requested by the staff, the licensee has added an additional item to its augmented maintenance and surveillance program calling for a visual inspection of the fuel-oil-piping system on both engines on a monthly basis. On the basis of its review of the licensee's July 26, 1984, submittal, the staff concludes that the licensee's actions pertaining to the fuel-oil lines are acceptable.

Conclusions

The NRC staff concludes that the TDI diesel engines at Grand Gulf Unit 1 will provide a reliable standby source of onsite power in accordance with GDC 17. This finding is based on the NRC staff/PNL review of (1) the current status of the TDI Owners Group Program in resolving the TDI diesel engine issue; (2) actions taken by the licensee to enhance and verify the reliability of the Division 1 and 2 engines, including those actions taken in response to the NRC Order dated May 22, 1984; (3) the Augmented Engine Maintenance and Surveillance Program which the licensee committed to by letter dated July 26, 1984; and (4) changes to the Technical Specifications to limit future testing of the engines to 185 psig BMEP. In addition, this finding is subject to the license condition that ensures that Grand Gulf Unit 1 will continue to meet GDC 17 beyond the first refueling outage.