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

MAR 9 1987

Docket No.: 50-530

Mr. E. E. Van Brunt, Jr.
Executive Vice President
Arizona Nuclear Power Project
Post Office Box 52034
Phoenix, Arizona 85072-2034

Dear Mr. Van Brunt:

SUBJECT: EVALUATION OF RECOVERY PROGRAM FOR DAMAGED EMERGENCY DIESEL GENERATOR ENGINE AT PALO VERDE UNIT 3

By letter dated February 9, 1987, you submitted a final report regarding the evaluation of, and corrective actions for, the damage that occurred on the "B" Diesel Engine at Palo Verde, Unit 3 during a test.

The staff has reviewed the information provided in the final report and, in conjunction with our consultant, Battelle Pacific Northwest Laboratories, we have also evaluated the information that you presented at the January 20, 1987 meeting concerning the subject matter. Based on those evaluations, the staff finds that your proposed program to demonstrate operability of the repaired engine lacks specificity regarding how it will be shown that all actual and potential damage to the engine has been corrected and that the engine is capable of reliable, long term operation. We request that you supplement your program accordingly.

In addition, we have identified a number of recommendations listed in the Enclosure, that you should consider in your program. We request that you address these recommendations.

In the TDI requalification program for its emergency diesel generator engines, an extended run at load, on the order of 500 hours, was performed for the engine types involved. This extended run, followed by an inspection, served to demonstrate conclusively the adequacy of the engine types and the components for their intended service. In light of the extensive damage to the Palo Verde engine, we feel it would be prudent to include in the testing program, following repairs to the engine, a long term run at rated load to demonstrate the adequacy of both structural and component repairs. The staff's consultants agree that a successful long term run would best demonstrate the adequacy of repairs. Therefore, we recommend that a successful long term run at rated load of the repaired Palo Verde Unit 3 engine be demonstrated prior to entering Mode 4.

We request that you provide a response to this letter in time to support the projected date for issuance of a low power license on Palo Verde, Unit 3.

If you have any questions regarding this letter, you should contact me or the Licensing Project Manager for Palo Verde.

George W. Knighton, Director
PWR Project Directorate No. 7
Division of PWR Licensing-B

Enclosure:
As stated

cc: See next page

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ENCLOSURE

STAFF RECOMMENDATIONS ON ANPP RECOVERY PROGRAM FOR DAMAGED PALO VERDE, UNIT 3 DIESEL ENGINE

Recommendations

Pre-Operational:

1. Cooper Energy Services should provide a vibration spectral analysis curve showing all the critical frequencies and their corresponding amplitudes from engine startup to engine overspeed. It would be desirable to repeat with torsiograph of shaft rotation frequency test and compare the results with the original data. A copy of the torsional vibration analysis should also be included in their report.

2. Cooper Energy Services should provide the results of their finite element analysis of the articulated and master rod joint stresses and deflections. This analysis should include the torsional vibration impact loads and stresses at the critical connecting rod areas.

3. If not already completed, Arizona Nuclear Power Project (ANPP) should inspect critical engine parts, such as the main and crankpin bearings, cam shaft bearings and surfaces, the valve mechanism bearings, and the cylinder liners, to ensure that the additional 50 minute running time on the engine did not cause additional damage.

4. ANPP should provide the results of the crankshaft evaluation, (hot and cold crankshaft deflection test) showing that the connecting rod and counter-weight damage did not bend the crankshaft.

5. Cooper Energy Services should provide a written analysis indicating that post-failure engine operation did not cause any torsional or vibration damage.

6. ANPP should inspect the crankshaft to insure that there are no cracks in the No. 9 cylinder area, including the crankpin or journal fillets and oil holes at cylinders No. 8, 9 and 10 journals. ANPP should also consider the possibility that crankshaft cracks may have developed due to the rapidity of the failure.

7. ANPP should inspect the torsional vibration damper to insure proper function prior to the failure and continued function in future operation.

Post-Operational:

8. ANPP should inspect the engine for water leaks and analyse the oil for water after the repair is completed to show that the damaged cylinders do not leak water into the oil. Also, the oil should be analysed for metal content to look for residual debris or post failure wear.

9. ANPP should inspect the master rod crankpin bearing [a] shell after operating the engine to be sure it is operating satisfactorily.

   From the photographs which were shown, it appeared that there was a section of the crankpin journal that was not cleaned up. This damaged surface should be evaluated as a potential cause of future crankpin bearing trouble.

   The No. 9 crankpin journal was reduced in diameter by about .175 inches to remove most of the damage [b]. Slight surface damage is still visible. It is not known if the crankpin bearing will operate satisfactorily on this slightly damaged journal surface. In order to show satisfactory operation, the crankpin bearing should be inspected after some period of full load operation.

General:

10. ANPP should verify that no iron plated connecting rods are used in any of the Cooper Energy Services's engines at the Palo Verde Station.

11. ANPP should verify that no nickel sprayed rods are used in the Cooper Energy Services' engines at the Palo Verde Station, except in low stress areas, until it can be shown that the physical properties of the nickel-sprayed metal are capable of transferring the stresses without developing any cracks.

12. Cooper Energy Services should identify the high stress areas in the connecting rods. This would assist in identifying the areas that need to be critically evaluated prior to being placed in an engine.

13. Any used oil from the damaged engine should be analysed to show if there were any abnormalities in the oil, such as corrosive constituents, that could have contributed to the failure.

(a) Often when an engine throws a connecting rod, the crankshaft is bent. Therefore, to determine if this crankshaft is straight, a hot and cold crankshaft deflection test showing the deflection at all the cylinders should be required. Then, during the early running of the engine, a hot "feel-over" test should be required to demonstrate that all the bearing are operating normally.

(b) The damaged crankpin journal was ground to remove the nicked and scuffed areas. This journal at No. 9 cylinder was reduced in diameter about .175 inches. This reduction in crankpin diameter appeared to leave a small damaged area on the journal surface which needs to be repaired.

15. Use of fire extinguisher chemicals on fires in turbines has been known to initiate intergranular stress corrosion cracking in certain materials. The effect of the fire extinguisher foam residue on engine materials should be carefully evaluated.

If you have any questions regarding this letter, you should contact me or the Licensing Project Manager for Palo Verde.

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George W. Knighton, Director
PWR Project Directorate No. 7
Division of PWR Licensing-B

Enclosure:
As stated

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