



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

April 11, 1984

Docket No. 50-416

Mr. J. P. McGaughy  
Vice President  
Nuclear Production  
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P.O. Box 1640  
Jackson, Mississippi 39205

Dear Mr. McGaughy:

Subject: Major Unresolved Issues Relating to TDI Diesel  
Generators at Grand Gulf Nuclear Station

As we discussed last week, the staff and its consultants have identified a number of unresolved issues pertaining to the TDI diesels at Grand Gulf Nuclear Station and which we would like to discuss at next Friday's meeting (4/13/84). Considerations pertinent to these issues are enclosed. The unresolved issues include the following:

- \* Cylinder Heads
- \* Engine Block
- \* Wrist Pin Bushings
- \* Connecting Rods
- \* Connecting Rod Bearings
- \* Turbocharger
- \* Testing/Maintenance Plans

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Enclosure:  
As stated

cc: See next page

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GRAND GULF

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## Unresolved Issues

The Staff and our consultants have preliminarily identified the following questions/concerns which should be addressed at our upcoming meeting scheduled for April 13, 1984.

### 1. Cylinder Heads

- o MP&L should address the potential for crack propagation in a cylinder head during operation which may potentially lead to serious damage to the engine and/or turbocharger, possibly resulting in sudden engine shutdown.
- o The MP&L report of 25% of the heads with rejectable indications is very high. The cause of the rejectable indications needs to be identified.
- o An analysis of failure rates of cylinder heads of this type operated at comparable loads may be instructive for establishing confidence in the suitability of these heads for engines in nuclear service.
- o It would be of interest to know whether the heads operating in the R-5 engine are of the same design and whether they are performing without development of rejectable indications.

### 2. Engine Block

- o Linear indications have recently been found on the cylinder liner lands at Comanche Peak. The potential for similar indications at GGNS, and their significance from an engine performance and failure standpoint need to be addressed.

### 3. Wrist Pin Bushings (a new problem area not addressed by TDI Owners Group at this time)

All eight wrist pin bushings removed from the 101 engine at Shoreham during the week of March 19 were dye checked and found to be cracked. No pattern of cracking was evident. It was also reported, but not verified, that new bushings received at Shoreham from TDI but not installed, are also cracked. This suggests that the cracking is a manufacturing problem, and if so, it may be present in the wrist pin bushings in the TDI engines at Grand Gulf.

MP&L should address the potential that:

- o Failure of wrist pin bushings may have effects leading to more serious consequences, comparable or worst than failure of the connecting rod bearings.
- o Unit loadings on wrist pin bushings are larger than on connecting rod bearings.
- o Inspections of all wrist pin bushings should be thoroughly performed (e.g., dye penetrant) and all wrist pin bushings showing positive indications be replaced.

4. Connecting Rods

- o Evidence presented suggests that a reduction in frequency of failures may have been achieved but not necessarily a solution to the problem. Please address.
- o Because of the potentially serious consequences of connecting rod failure, a conservative approach to establishing connecting rod adequacy is called for. This approach should take into consideration such factors as the root cause of connecting rod cracking, appropriate tests to verify corrective action, probable minimum time failure under worst-case conditions that may be imposed on Grand Gulf engines, and appropriate enhanced ongoing surveillance to ensure that the connecting rods remain sound in service.

5. Connecting Rod Bearings

The evidence available to the reviewers is insufficient to conclude whether the problems identified at Shoreham are applicable to Grand Gulf. Pertinent information which should be addressed by MP&L for establishing bearing suitability includes the following:

- o Radiographic inspection of all bearings to acceptance criteria established by the Owners Group in a recently issued bearing shell report.
- o Inspection and documentation of wear patterns of all bearings at Grand Gulf to verify absence of normal conditions, such as end loading.

6. Turbocharger

- o The MP&L statements on misalignment as the cause does not provide a convincing argument.
- o It is considered unlikely based on the information available that vibration generated internal to the turbocharger could be the cause since such imbalance could rapidly lead to destruction of the bearings and rotor.
- o It is considered more likely that vibration is caused by engine vibration transmitted inappropriately through turbocharger supports and/or piping.
- o MP&L should verify that appropriate consideration has been given to exhaust pipe residual loads on the turbocharger. These loads contribute to the loads on the turbocharger mounting bolts, and may contribute to excitation of turbocharger mounting vibration.

## 7. Testing/Maintenance Plans

- o The test program to demonstrate the adequacy of the TDI engines should be related to the demands that may be placed on the engines under emergency conditions as described in the Grand Gulf FSAR.
- o Plans for post-test verification inspections should be provided, including what components are to be inspected and sampling plans to be implemented. Results should be documented to the NRC. Where MPL is relying upon post-test verification inspections from other plants in lieu of such inspections at GGNS, this should be identified and justification provided.
- o The staff's preliminary thoughts are that such component verification inspections should include inspections performed after 1000 hours of component service at or above the maximum power levels which can be experienced during emergency engine service (which we understand to be 68% for GGNS).
- o The summary of testing presented in Table 11-1 suggests that the AE piston skirts at GGNS were not subjected to "Tech. Spec. Testing". It is not clear from Section 11.3 of the report which tests normally included as part of the 18 month functional testing were not included in the requalification testing following piston replacement. For example, Section 11.3.3 does not indicate whether 69 consecutive "valid" startup tests were performed. Please clarify whether an "18 month test" was performed subsequent to piston replacement, and if not, which tests were omitted.
- o The brief description provided in the MP&L submittal of the maintenance program and reliability enhancement testing is not convincing to the reviewers that there will be adequate surveillance of physical conditions and monitoring of operating parameters to assure continuous availability and operability of the engines. An appropriate maintenance and surveillance program should be defined and committed to, giving due consideration to the incomplete status of the Owners Group program. It should include appropriate maintenance and surveillance intervals for key components and justification/bases for proposed intervals.

## 8. Pistons

- o MPL should confirm with TDI that the AE piston skirts at GGNS are the same as those used in the R-5 tests.
- o Adequacy of the pistons should be verified by inspection to establish no rejectable indications following conclusion of the engine test program.

9. Push Rods

- o A push rod failure may ultimately lead to shutdown of a cylinder and may in turn require early shutdown of the engines.
- o The MP&L submittal addresses corrective action for the connector push rods but does not address the 2% failure of the main rods.
- o There is no evidence based on information available that the new design has been proven to be reliable.
- o Adequacy of the modifications should be verified through 100% inspection of the push rods to establish that no cracks have developed following conclusion of the engine test program.

10. Crankshaft

- o Incipient problems could be indicated by the finding of wear patterns on bearings.
- o Hot and cold shaft deflection readings should be taken to reveal potential alignment problems that could lead to difficulties with shaft, bearings, bearing supports and base. (Hot deflection readings should be completed within 15 minutes of engine shutdown to be valid.)
- o MPL should verify that crankshafts of this design (any service) have not failed due to design deficiencies.

11. L.P. Fuel Line

- o MPL should establish that no new vibration response problems have been introduced as a result of the corrective actions taken.

12. M.P. Fuel Line

- o MPL should verify that new lines are not defective (i.e., do not contain the draw seam).

13. Engine Base

- o MPL should verify through TDI, that historical engine base problems do not involve other than maintenance considerations in installations similar to Grand Gulf.

14. Rocker Arm Capscrew

- o A recent report issued by the Owners Group on this topic addresses: (1) design, (2) materials, and (3) retorquing.
- o MP&L should implement the Owners Group recommendations.