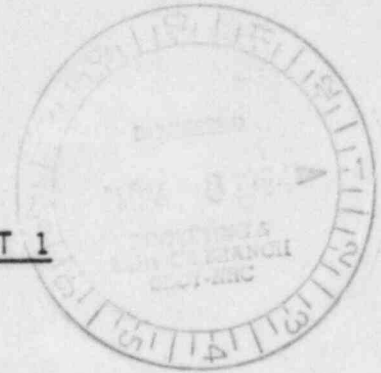


TDI OWNERS GROUP  
for  
SHOREHAM NUCLEAR POWER STATION - UNIT 1  
CYLINDER BLOCK  
COMPONENT PART NO. 03-315-A



I INTRODUCTION

The TDI Emergency Diesel Generator Owners Group Program for the Shoreham Nuclear Power Station requires Design and Quality Revalidation reviews of cylinder blocks to determine the adequacy of their design for their intended use at Shoreham. The blocks are manufactured by TDI and are supplied under their part number 03-315-03-AC. The cylinder block forms the framework of the liquid cooled engine and provides passage for coolant and support for the cylinder liners and cylinder heads.

II OBJECTIVE

The objective of this review was to evaluate the adequacy of the cylinder block for intended service at Shoreham; specifically to perform:

- o A review of Shoreham site, nuclear, and non-nuclear experience.
- o Evaluate steady state and alternating stresses resulting from firing pressures, thermal effects, and preload from assembly.
- o Evaluate critical flaw size (crack location and characteristics) for cylinder block.
- o Evaluate fatigue resistance as a function of material properties, imposed load spectrum, and operating hours.
- o A review of Quality Revalidation checklist results for acceptability.

III METHODOLOGY

The TDI Emergency Diesel Generator Component Tracking System results were reviewed for the Shoreham site, nuclear, and non-nuclear industry experiences with the cylinder block.

The structural adequacy of the cylinder block for the intended service was evaluated by strain gage testing combined with two-dimensional analytical models of the block top and liner, and cumulative damage estimates. A comparison

was made of cumulative damage incurred during testing with the predicted cumulative damage during a LOOP/LOCA event (Refs. 1 and 2).

All quality revalidation documents were analyzed for pertinent data. (Ref. 3)

#### IV RESULTS AND CONCLUSIONS

Diesel generators 101, 102, and 103 have been inspected for block cracks. Block top radial/vertical cracks located through the ligament between the cylinder liner and cylinder head stud hole and cracks in the cam galley support region were identified. During qualification testing, the original DG103 block was found to have deep cracks and the cylinder block has been replaced, with TDI's new design cylinder block.

Strain gauge testing of original DG 103 block and inspection data from before and after testing was used to predict adequate life for the cylinder blocks. The apparent rate of propagation of cracks between stud holes in the original DG 103 block at Shoreham, when compared with the Shoreham LOOP/LOCA requirements, indicates that blocks with ligament cracks (e.g., DG 101 and DG 102) are predicted to withstand with sufficient margin a LOOP/LOCA event provided that: (a) inspection shows no stud-to-stud cracks detectable between heads whenever the engines are returned to emergency stand-by service after any period of operation other than no load, and (b) the specific material of the original DG 103 block is shown to be sufficiently less resistant to fatigue than typical gray cast iron, Grade 40. In addition, it will be necessary to ensure that the microstructure of the replacement block top for DG 103 does not indicate inferior mechanical properties. Preliminary analysis of the original DG 103 block material does indicate less fatigue resistance than that of typical gray cast iron. In addition, the initial TDI analysis of the replacement block shows the proper material. Both the original block material and the replacement will be verified by metallurgical analysis.

Until operating experience is obtained for the replacement block DG103, it should be conservatively inspected for stud-to-stud cracks whenever the engine is returned to emergency standby service after any period of operation other than no load. This inspection criterion may be reduced significantly after operational time is obtained and the engine is subsequently inspected and found to be without ligament cracks. After the inspection, it could then be operated without additional inspections for combinations of load, time, and number of starts that produce less expected cumulative damage than the cumulative damage

prior to the latest inspection. The allowable engine usage without repeated inspection can be determined from cumulative damage analysis (Ref. 1).

The required inspection for DG 101, DG 102, and DG 103 was invoked by E&DCR F-46505 and the material test of original DG 103 will be performed by June 29, 1984.

Cam galley support cracks are not judged detrimental to the operation of the engine as they are predicted to grow very slowly at full load and not at all at 75 percent load.

Quality Revalidation Inspection results identified in Appendix B have been reviewed and considered in the performance of this design review and the results are consistent with the final conclusions of this report.

Pending final results of the material evaluation of the original DG 103 cylinder block and verification of the microstructure for the new block material, the DG 101, DG 102, and replacement DG 103 cylinder blocks are acceptable for intended function with implementation of routine inspections in accordance with E&DCR F-46505.

V REFERENCES

1. Design Review of TDI-R4 Series Emergency Diesel Generator Cylinder Blocks and Liners, FaAA 84-5-4.
2. FaAA Support Package SP-84-5-4.
3. FaAA Support Package Number SP-84-6-68.