October 20, 1983

DIESEL GENERATOR STATUS REPORT

I. Diesel Generator 101

The disassembly of diesel generator 101 following completion of the torsional stress tests has now been completed. Inspections conducted during and following the disassembly disclosed pitting on the lobes of the camshaft. Similar pitting was not observed on the camshafts of the other two engines. FaAA is investigating this condition. New lobes will be installed. Also, pitting was observed on the no. 1 cylinder liner. This pitting is the same as that observed and previously reported with respect to two other cylinder liners, one on each engine. This problem has been corrected by replacing the cylinder liner with a spare.

The lube oil flush of the diesel generator 101 auxiliary systems remaining in the diesel generator room is currently in progress.

During removal of the rotor from the stator on the generator for diesel generator 101, a bolt in the rigging spreader bar broke, causing the rotor to drop 7/16" onto its cradle. Subsequent inspections of the rotor and the stator, including an inspection by the manufacturer, disclosed no damage. Also, subsequent megger checks of the rotor and stator were completed with satisfactory results.

II. Diesel Generator 102

The reassembly of diesel generator 102 has been completed and the engine has been reinstalled in the diesel generator room. Final alignment of the engine is now in progress. The lube oil flushes for portions of the system left in the diesel generator room 102 have been completed. Substantial portions of the jacket water system flushes have also been completed.

Investigation of the cause or causes of indications on the diesel generator 102 baseplate is continuing and the results will be reported in FaAA's forthcoming interim report. At this time, it appears that certain damage to the baseplate was caused by the crankshaft failure.

As previously reported, the governor for diesel generator 102 has been sent to the governor manufacturer for inspection. Preliminary information from that inspection indicates that the governor was damaged as a result of the failure of the crankshaft on diesel generator 102. A report from the manufacturer is expected to be available in approximately two weeks. Inspections of the governors on diesel generators 101 and 103 did not reveal any damage.

As noted in previous status reports, electrical testing of the 102 generator rotor disclosed a low megger reading at the no. 7 pole. The rotor was returned to the manufacturer, Parsons Peebles-Electric Products, Inc., for analysis. The results of the analysis are currently being reviewed by Transamerica Delaval

(TDI) and will be available in approximately one week. Preliminary information indicates that the coil of rotor pole no. 7 grounded as a result of mechanical damage to the insulation on the pole. The mechanical damage was caused by a sharp corner located close to the winding. This corner was rounded off and the rotor pole was repaired. Also, the rotor balance and shaft runout were checked and found to be satisfactory. The rotor has been returned to Shoreham for reinstallation.

The jacket water pump for diesel generator 102 was inspected and indications of shaft wear were found. The pump impeller is press fitted to the shaft and also held in place with an appropriate lock nut and washer. The shaft wear observed indicated there may have been some slippage of the impeller on the shaft. The entire jacket water pump for diesel generator 102 will be sent to Palo Alto for evaluation by FaAA. The jacket water pumps on diesel generators 101 and 103 have also been inspected and no similar conditions were found.

Inspection of the diesel generator front end gear train disclosed fretting of the jacket water pump drive gear. This condition has been observed on all three engines to varying degrees and is presently under investigation by FaAA. Results of this investigation will be included in an FaAA report. New drive gears have been or will be installed on all three diesel generators.

As reported in previous status reports, an investigation of the conditions observed with respect to the connecting rod bearings is in progress. Suffolk County was previously provided with a copy of the attached preliminary report by FaAA concerning the bearings. New connecting rod and main bearings will be installed in all three diesel generators. Destructive testing and nondestructive examination of a representative sample of both types of bearings will be performed to provide assurance that the connecting rod and main bearings meet the appropriate material specifications. The bearing matter was reported to the NRC under 10 CFR § 50.55(e). Further information concerning the connecting rod bearings will be included in a subsequent FaAA report.

III. Diesel Generator 103

The reassembly of diesel generator 103 has been completed and the engine has been moved to its diesel generator room. Final positioning of the engine has been completed and the engine flywheel installed. The installation of the generator is currently in progress. Diesel generator 103 has been released for reconnection of piping to the diesel engine and this work is in progress. The lube oil flush and substantial portions of the jacket water system flushes have been completed for diesel generator 103.

The generator for diesel generator 103 has been inspected by representatives of the manufacturer both visually and using

electrical megger checks. These inspections yielded satisfactory results.

IV. New Crankshafts

The new crankshaft for diesel generator 101 is expected to arrive at Shoreham on October 21, 1983.

V. Schedule

The FaAA interim report setting forth FaAA's conclusions concerning the cause or causes of the diesel generator 102 crankshaft failure is now scheduled to be completed on or about November 3, 1983. At present, it is LILCO's intention to schedule a publicly noticed meeting on or about November 3 with the NRC Staff and Suffolk County to distribute and explain FaAA's interim report on the cause or causes of the crankshaft failure.

In previous status reports, reference has been made to a comprehensive FaAA report to follow the November 3 interim report. In order to provide the Board and the parties with information more expeditiously and to avoid delay in any litigation relating to the diesels, FaAA will follow the interim report with additional reports on specific subjects as the information is obtained and the conclusions reached. For example, it is anticipated that on or about November 3, 1983, FaAA will also issue a report on the adequacy of the structural integrity of the 13" x 12" crankshaft. Other aspects of FaAA's investigation will be addressed in subsequent reports to be issued as promptly as practicable.

Failure Analysis Associates

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MEMORANDUM

TO: Mike Milligan

FROM: Lee Swanger

DATE: October 13, 1983

RE: Summary of Findings: Emergency Diesel Engine Connecting Rod Bearings

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Four upper connecting rod bearings from the TDI Enterprise Diesel Engines were, upon disassembly, found to have cracks through the aluminum bearing alloy. One of the bearings was completely fractured into two pieces. Total time on these bearings was between 600 and 820 hours.

Certain observations, calculations, and tests were performed to determine the cause of bearing cracking. These are discussed individually below.

1. Mechanical properties below specification. Tests by the bearing manufacturer, TDI, revealed that the ultimate tensile strength and the tensile elongation were below the specifications published by Alcoa, the source of the castings, at the time of manufacture.

	UTS	Elongation
Specification	27,000 psi minimum	2% minimum
Test Results	15,000 psi minimum	0% minimum

This discrepancy in mechanical properties is believed to be a significant contributor to the early fracture of these bearings.

2. Unsupported bearing ends. Large ($1/4$") chamfers on the original connecting rods used with the 11" journal crankshaft left over $1/8$" of each end of the bearing back unsupported by the steel connecting rod. This resulted in a cantilever effect which probably contributed to the observed mode of cracking.

3. Edge loading of the bearing. The contact patterns in the babbitt lined bearing inner diameters show that the load on these bearings was concentrated at the ends of the bearings. This edge loading may have been due to journal "tilting" or "yawing" due to the maximum dynamic torque transmitted through the journals. Combined with the partially supported bearing backs (point 2), this effect probably contributed to the observed mode of bearing cracking.

4. Excessive Peak Oil Film Pressure (POFP). A major independent engine bearing manufacturer was engaged to compute the hydrodynamic oil film properties in the connecting rod bearings. The peak oil film pressure was calculated to be 29,745 psi. For stationary diesels in intermittent service, this bearing manufacturer (Imperial Clevite Inc.) would recommend POFP no higher than 26,000 psi for the solid aluminum bearing material used in these connecting rods.

   The high value of POFP, combined with the geometric conditions addressed in points 2 and 3 probably contributed to the observed bearing fractures.

Changes in Bearing Configuration Associated with Change of Crankshafts

Replacement of the crankshafts by new ones with 12" diameter journals has resulted in the installation of different bearings and connecting rods. The effects of the changes are discussed individually below.

1. Material properties meet specifications. TDI has reported to FaAA that they have increased their QA activities in the area of bearing materials since the manufacture of the fractured rod bearings. Current procedures should increase the probability that the material in the replacement bearing meets specifications.

2. Supported bearing ends. The new connecting rod bores have small, 1/16", chamfers and therefore completely support the bearing backs.

3. Reduced edge loading. The new 12" journal diameter crankshafts will develop lower peak torques and resist journal "tilting" and thus decrease the degree of edge loading on the bearings.

4. Reduced Peak Oil Film Pressure. The larger diameter journal results in a lower calculated POFP at full load of 26,780 psi. Combined with improved geometry, this level of POFP predicts an expected bearing life of 8,000 hours. Reducing engine output would have a significant influence on fatigue life of the bearings. Running at 80% output (2,800 KW) would almost double expected bearing life to 15,000 hours.

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cc: R. McCarthy
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