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LILCO, June 21, 1984

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

Before the Atomic Safety and Licensing Board

In the Matter of	)	
	)	
LONG ISLAND LIGHTING COMPANY	)	Docket No. 50-322 (OL)
	)	
(Shoreham Nuclear Power Station, Unit 1)	)	
	)	

LILCO'S RESPONSE TO SUFFOLK COUNTY'S FILING CONCERNING LITIGATION OF EMERGENCY DIESEL GENERATOR CONTENTIONS

I. INTRODUCTION

LILCO objects to the County's Filing and moves the Board to strike the County's Supplemental Emergency Diesel Generator (EDG) Contentions I, II and III. LILCO reiterates that it would not object to properly supported and particularized diesel generator contentions. The Contentions the County has proposed, however, are vague and unsupported. The County's Filing totally ignores the Board's Bench Order of February 22, 1984, as extended by the Board's Orders of April 20 and May 4, 1984. It is frivolous and vexatious; it frustrates the narrowing of issues; and it is entirely evasive. Justice requires that the unnecessary delay and needless increase in the cost of this litigation cease.

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The introduction of the County's Filing incorrectly and incompletely characterizes the Board's Bench Order of February 22, 1984. The Board did initially find "that the introductory paragraph, at least Contentions 1, 2 and 3 are admissible as issues in controversy before us and that they meet the standards for reopening the record to admit a new contention." Transcript of February 22, 1984 (Tr.), at 21,611-12. But the Board specified: (1) that the parties and it were entitled to "informed litigation" (Tr. at 21,616); (2) that "a specification of the instances which the County would depend on to prove its Contentions 1, 2 and 3 would have to be provided after discovery, and prior to the time for preparation of testimony, so the parties are not surprised as to what items will be addressed in testimony" (Tr. at 21,617-18); (3) that it "would prefer . . . a listing of the instances, a statement by the County in support of why it thinks each instance has a nexus to Shoreham" (Tr. at 21,620); (4) that, in some instances, the County would have to make "a separate, more detailed, showing" of some problem that "reflects so adversely on TDI's abilities and quality and so on, that in the interest of a proper litigation we should consider that item as evidence of TDI's lack of confidence" (Tr. at 21,622); (5) that the County include in its Filing "whate [sic] elements of the DRQR should be added to the litigation, which might not already be included under Contentions 1, 2 and 3" (Tr. at 21,620); and (6)

that "the contentions as we had stated them in our June, 1983 order are superseded and subsumed within the present approach" (Tr. at 21,628).

The County's Filing fails in three major regards. First, despite massive discovery, the County has failed to set forth with any more specificity than in its January Motion to Admit Supplemental Diesel Generator Contentions (Supplemental Contentions) the bases for its EDG Contentions. NRC regulations and the case law make clear that the basis of a contention must be set forth with reasonable specificity. See 10 CFR § 2.714(b); Duke Power Co. (Catawba Nuclear Station, Units 1 and 2), LBP-82-16, 15 NRC 566 (1982). Thus, a contention must include "a reasonably specific articulation of its rationale . . . ," Catawba at 15 NRC 570. There must be "either a reasonable explanation or plausible authority for factual assertions." Cleveland Illuminating Co. (Perry Nuclear Power Plant, Units 1 and 2), LBP-81-24, 14 NRC 175, 184 (1981). The purpose of the specificity requirement is to put the Applicant on notice as to what it must defend against or oppose, Philadelphia Electric Co. (Peach Bottom Atomic Power Station, Units 1 and 2), ALAB-216, 8 AEC 13, 20 (1974), and to enable the Applicant to "make an intelligent response." Commonwealth Edison Co. (Quad Cities Station, Units 1 and 2), LBP-81-53, 14 NRC 912, 916 (1981).

Despite the time the County has had to refine its contentions, and despite the more than 50,000 pages of discovery[1/] it has amassed, the County still fails to meet the specificity requirement in its latest Filing, depriving LILCO of the notice to which it is entitled and of the ability to make a meaningful response. The County's Filing in addition flouts Judge Brenner's admonition to provide "a specification of the instances which the County would depend on to prove its Contentions 1, 2, and 3 . . . ," (Tr. at 21,617-18), so that "everybody knows what points the proof has to be addressed to." (Tr. at 21,635).

Second, the County fails to provide the necessary nexus to Shoreham for the items it lists in support of its contentions. See (Tr. at 21,620; 21,621; 21,622; 21,623.) Once again, the County focuses on diesel generators in marine and industrial use without regard to dissimilarities to Shoreham in design, construction, maintenance and operation. The County merely repeats its indiscriminate lists of occurrences or incidents involving engines different from those at Shoreham. There is no good faith effort to demonstrate whether these matters relate in any way to the Shoreham EDGs

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1/ This tabulation does not include information available to the County such as the TDI Owners Group reports and correspondence and meeting transcripts and NRC Morning and Inspection Reports.

and to the pertinent issues of this proceeding. Moreover, the County ignores instances in which LILCO has made physical changes to improve the engines and fails to show how the engines it lists have anything in common with LILCO's modified engines. The County also ignores improved QA/QC procedures that ensure the reliability of the engines. Litigation of the occurences cited by the County in its contentions would result in trying many other collateral cases within the Shoreham diesel litigation.

Third, rather than delineating specific problems with regard to the Design Review Quality Revalidation (DRQR) program that relate to Shoreham, the County inappropriately attempts to litigate generalized and vague allegations pertaining to the Owners' Group program.

One comes away from the County's Filing with the inescapable conclusion that it is yet another attempt to delay these proceedings in order to prevent Shoreham's opening rather than an attempt to litigate whether there is reasonable assurance that the Shoreham EDGs are reliable. Instead of specifics, the County offers sweeping generalizations. Instead of properly focused contentions pertaining to whether the present equipment is capable and reliable, the County raises irrelevant issues of whether the old components were improperly designed, and irrelevant matters pertaining to diesel generator performance in marine and industrial applications. This

transparent attempt to delay these proceedings should not be countenanced by the Board.

Safety and reliability issues would not, of course, go unreviewed if the Board were to strike the County's contentions. That is the Staff's role. The role of the intervenor, on the other hand, is merely to provide a check and balance to the safety review process. In so providing, the intervenor in NRC licensing proceedings has a basic obligation to "structure [its] participation so that it is meaningful, so that it alerts the agency to [its] position and contentions." Vermont Yankee Nuclear Power Corp. v. National Resources Defense Council, Inc., 435 U.S. 519, 553 (1978). See also, In the Matter of Pennsylvania Power & Light Co. and Allegheny Electric Cooperative, Inc. (Susquehanna Steam Electric Station, Units 1 and 2), ALAB-693, 16 NRC 952 (1982). The County has patently failed to meet this obligation.

The County's consultants have had the benefit of a plethora of discovery materials for months. Notwithstanding this, their consultants have been unable or unwilling to formulate opinions on much of anything. This is evidenced by testimony given in the depositions taken as recently as May. For example, in his deposition, the County's metallurgist, Robert N. Anderson formed no opinion as to whether or not the metallurgy of the AE piston skirts was correct, Anderson Deposition at 98 (Attachment 1); as to whether or not diesels

at Shoreham are capable and reliable for fuel loading and low power testing (Id. at 139); or as to any of the four categories he was to study (Id. at 104). He indicates in his deposition that other than some purely mechanical calculations he made for Lloyd's Rules, he had done almost no other calculations. (Yet, in the affidavit filed with County's Supplemental Contentions, he offered numerous opinions on the adequacy of components based on stresses they will suffer.) Dennis Eley, in his deposition, preliminarily concluded that the crankshaft was overrated but needed additional data before finalizing that opinion. Eley Deposition at 119 (Attachment 2). He indicated no final opinion on any individual components. Id. He was not prepared to state that shot peening was inadequate on replacement crankshafts. Id. at 143, 146-49. Aneesh Bakshi only broadly commented based upon what he had heard, but had no opinion in component-by-component questioning. Bakshi Deposition at 69-75 (Attachment 3).

This charade is hardly "meaningful participation." Not only does the County's pleading fail because it is unsupported, the County's challenge of the Shoreham EDGs fails because it has no basis in fact. Such dilatory tactics subvert the entire adjudicatory process. They would be subject to sanctions in federal court litigation and should not be condoned in this proceeding.

In sharp contrast, LILCO has in good faith undertaken an overwhelming program to ensure the reliability of its diesel generators. It has rebuilt its engines with components that have undergone engineering analyses and that have been certified to be suitable for operation for their intended purpose. It has run expanded pre-operational tests to ensure that the entire system and its components will perform in accordance with their intended functions. It has reviewed operating experience at other utilities and operating experience in non-utility settings to ensure that similar problems do not exist with its engines. It has conducted extensive analyses and inspections in addition to the preoperational testing to ensure the reliability of any seemingly questionable components. The County has had the results of LILCO's efforts, yet has failed, not only to provide its own results, but even to criticize specifically what LILCO has done.

Under Part II of its Filing, the County claims to consolidate and restate the admitted portions of EDG Contentions I, II and III. Also, the County represents that it will list the items or instances relied on. LILCO will demonstrate that none of this results in "informed litigation," tells anyone what items "will be addressed in testimony," or shows a "nexus to Shoreham."

For the foregoing reasons, LILCO asks that the County's proposed contentions be stricken. If, however, the Board finds such relief to be inappropriate, the Board might adopt a procedure used previously for Contention SC-FOC 7B. Because of the vagueness of that proposed contention, the Board required the County to file its testimony and undergo cross-examination prior to the filing of testimony by LILCO and the Staff. This procedure was designed to provide notice to LILCO and the Staff of the precise issues to be litigated, an element sorely lacking to date in this proceeding.

II. SPECIFIC RESPONSE

EDG Contention. The County continues to assert that the EDGs are unreliable. LILCO has recognized problems with the EDGs and has addressed them. Extensive evidence of engineering evaluation, engine testing and inspections, however, demonstrates that those problems have been addressed. The County has been furnished with this evidence.[2/] Nevertheless, the County ignored the evidence in the items listed in support of its Contention. LILCO believes that adequate and reasonable assurance exists that the Shoreham EDGs

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2/ In addition to depositions, Owners Group documents, and the NRC reports mentioned above that have been furnished to the County, LILCO also provided to the County in discovery the preoperational test results, repair/rework requests and deficiency reports which show specific results of testing and evaluation.

will perform satisfactorily, but objects to litigating the issue based on the unparticularized, and in many cases erroneous, items listed by the County. The injection by the County at this late date of such unspecific issues is solely for the purpose of harassment, unnecessary delay and needless increase in the cost of litigation.

1. Crankshafts

A. Shoreham. LILCO objects to any litigation by the County of the original 11" x 13" crankshafts in the EDGs. Their design, rating or size is relevant only as they relate to an evaluation of the adequacy of the replacement 12" x 13" crankshafts. This alleged specification should be stricken.

B. (1) Shoreham. Based on the specification in the Filing, LILCO objects to litigation by the County of the replacement crankshafts in the EDGs. This attempted specification should be stricken.

Despite ample opportunity and repeated direction by the Board, the County totally fails to specify the particulars for its claim of inadequate design for operation at overload or full load. LILCO has had numerous analyses performed that show the replacement crankshaft meets the stress standards of the Diesel Engines Manufacturers Association (DEMA) as required in the crankshaft specification.[3/] In addition, the American

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3/ Failure Analysis Associates (FaAA) and Dr. Simon K. Chen concluded that the crankshafts meet DEMA. See Evaluation of

Bureau of Shipping (ABS) has certified the crankshaft. See Attachment 4. The County has not furnished LILCO or the Board with any calculations to show the crankshafts are unacceptable. Instead, the County continues to make aimless and unsubstantiated allegations regarding the crankshafts in the same manner as it did in its January Supplemental Contentions.

The County also fails to support its conclusory allegation that the replacement crankshafts "will adversely affect and be affected by other engine systems, such as bearings and piston pressures." (Emphasis added.) A broad, vague statement of the issue followed only by an exemplary "such as" is inadequate. Board Order Relating to Stipulation by the NRC Staff and Shoreham Coalition, June 24, 1980, at 2 (regarding words "such as").

Moreover, there is no basis for the County's claims. The analysis performed by FaAA takes into consideration the affect of other relevant engine characteristics, such as piston pressures, on the crankshaft. Specifically, FaAA considered the stresses due to gas pressure loading. Owners Group Report On Shoreham Replacement Crankshaft at 3-7. LILCO also showed

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(footnote continued)

Emergency Diesel Generator Crankshafts at Shoreham and Grand Gulf Nuclear Power Stations prepared by Failure Analysis Associates for the TDI Diesel Generator Owners Group (April 19, 1984) (Owners Group Report On Shoreham Replacement Crankshaft) and Chen Deposition at 89-107, respectively.

in its Response to the County's Supplemental Contentions that the replacement crankshaft will not affect the main bearings. As pointed out, the new crankshaft weighs only slightly more than the original crankshaft which had not indicated any excessive bearing wear. Furthermore, the weight of the crankshaft is insignificant in comparison to the weight exerted by the piston pressures, which were considered by FaAA.

The County's speculation regarding the replacement crankshaft is emphasized by its suggestion that "shot-peening of the replacement crankshafts may be detrimental." Shot peening is a commonly accepted industry method to accomplish the beneficial result of relieving tensile stresses.

B. (2) Common. LILCO objects to any litigation by the County of the incident involving Rafha Electricity Corp. in Saudi Arabia. This item recites an occurrence relating to the "crankshaft oil passage plugs on a replacement design crankshaft." Contrary to the February 22, 1984 Bench Order, the County has not offered any nexus between this occurence and Shoreham. In fact, there is none. The Rafha instance involved oil passage plugs of a different design from Shoreham. LILCO has not experienced any "inadequate crankshaft oil passage plugs" or "damaged pistons" from its replacement crankshafts.

The County failed to note the true, relevant common occurrences. The County was furnished with a document listing 30 TDI engine experiences with the 12" x 13" crankshaft.

Twenty-nine of those engines with the 12" x 13" crankshafts and similar ratings have operated since their production in 1975 with no crankshaft failures. Of these 29 engines, five have experienced more the 20,000 hours and 17 have experienced more that 10,000 hours. One of the crankshafts (at Rafha) was replaced, because of damage from an overspeed accident and not because of a design or manufacturing deficiency.

In conclusion, the structural integrity of the replacement 12" by 13" diameter crankshafts installed in the EDGs at Shoreham has been extensively evaluated by testing and analyses. As stated, the crankshaft meets the DEMA requirements and has been certified by ABS. The crankshafts have a factor of safety of 1.48 without taking into account any benefit of shot peening the crank pin fillets. The unrefuted fact at the present time is that the replacement crankshafts are suitable for unlimited operation in the EDGs at Shoreham. See Owners Group Report On Shoreham Replacement Crankshaft.

2. Cylinder Blocks

A. Shoreham. LILCO objects to litigation by the County of the cylinder blocks in the EDGs as the issue is framed in this Filing. The County states that "cracks have occurred in the cylinder liner landing area of all EDGs"[4/] and

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4/ Despite a recent inspection of the original EDG 103 block, the County incorrectly characterizes where these cracks

(footnote continued)

"in the camshaft galley area of the blocks." Despite ample opportunity and repeated direction by the Board, the County totally fails to specify the significance, if any, of these cracks.

The reference to a large crack propagating through the front of EDG 103 is irrelevant and immaterial since this cylinder block has concededly been replaced. The County alleges that the new design is "unproven" and "has been inadequately tested." This reference is abstract, hypothetical and lacks the specificity to allow LILCO to avoid surprise as to the items to be addressed in litigation. The new block is, in fact, a proven design and has undergone extensive testing, including tensile and chemical analysis of block test specimens, metallography and eddy current inspection. Furthermore, a block with heavier upper sections similar to the new EDG 103 block first appeared in the R-5 prototype engine at TDI in 1979.5/ The R-5 engine has accumulated 5,622 hours, with most operation far above the 611 horsepower per cylinder rating of the Shoreham EDGs. In fact, the R-5 is rated at 850

(footnote continued)

occurred. In all three engines, initiation of cracks occurred between stud hole and liner counterbore. On the EDG 103 the cracks also extended from between the stud holes.

5/ The new block on Shoreham EDG 103 are basically the same as the R-5 engine.

horsepower per cylinder. It has accumulated more than 1,070 hours at or above 935 horsepower per cylinder and more than 4,980 hours above the Shoreham rating. The heavy upper section blocks have also been in the field since 1981 and have had no reported problems in more than 12,000 hours of operation.

The County fails to give any explanation as to how the block crack on EDGs 101 and 102 will affect their reliability. The cracks were tested by liquid dye penetrant and eddy current before and after being run at full load for 100 hours. The EDG 102 was also cycled through 100 starts and reinspected. The cracks showed no evidence of propagation. Furthermore, the indications of minor cracks in the camshaft galley area of the blocks were present prior to the original crankshaft failure and have also not propagated. Ralph Caruso, the NRC Shoreham Project Manager, also testified that the Staff's consultants do not consider those cracks to be significant. Caruso Deposition at 49. (Attachment 6).

The presence of cracks does not preclude an engine from performing reliably. As Clinton S. Mathews, Vice President and General Manager of the Engine and Compressor Division of TDI, testified, experience shows that engines can operate safely with cracks or indications. Mathews Deposition at 95-97 (Attachment 7).

B. Common. LILCO objects to any litigation by the County of alleged cylinder block cracking in the 15

cylinder blocks located on other TDI engines. The County's Filing is totally devoid of any required specification of these alleged cylinder block cracking incidents and their comparability to the Shoreham EDG components. More importantly, none of the R-4 and RV-4 blocks manufactured since 1968 have had cracks that have caused block failures or have necessitated replacement.6/

3. Cylinder Heads

A. Shoreham. LILCO objects to any litigation by the County of the original cylinder heads. Their design or manufacture is irrelevant and immaterial.

LILCO can defend the adequacy of the design and manufacture of the replacement cylinder heads based on sufficiently particularized issues. LILCO objects however, to going forward based on the broad claims made by the County. Once again, despite ample opportunity and repeated direction by the Board, the County totally fails to specify its claim about the "inadequate design and manufacturing quality" of the replacement cylinder heads to withstand "satisfactorily thermal and mechanical loads during EDG operation." This specification should be stricken.

6/ The M.V. Pride of Texas required replacement of one of its two blocks for reasons unrelated to block top cracking.

Furthermore, the evidence clearly shows that the current cylinder heads at Shoreham have been properly designed and manufactured and will perform satisfactorily in service. The cylinder heads at Shoreham were produced after 1980. Due to improved casting process and QA/QC procedures implemented by TDI after 1978, these replacement heads at Shoreham, as well as elsewhere, have demonstrated very high quality. Moreover, Shoreham also has in place a rigid QA/QC procedure to protect against the receipt of any inadequate heads. LILCO's program includes hydrostatic and liquid dye penetrant inspection of the heads before they are installed. In addition, the field performance of TDI heads produced since 1978 has been excellent. See Evaluation of Cylinder Heads of Transamerica Delaval Inc. Series R-4 Diesel Engines prepared by Failure Analysis Associates for TDI Diesel Generator Owners Group (May 1984)(Owners Group Report On Cylinder Heads).

B. Common. LILCO objects to any litigation by the County of alleged "rejection rates" in the factory prior to shipment. Such an issue is irrelevant and immaterial to showing the cylinder heads are unreliable. In fact, the claim shows that TDI has an improved QA/QC procedure in place to prevent inadequate cylinder heads from being shipped to its customers.

C. Common. LILCO objects to any litigation by the County of cylinder heads it lists as "similar" to Shoreham.

By its own admission, the County states that it has been unable to ascertain whether those cylinder heads were manufactured after 1980 and, therefore, whether they are similar to the cylinder heads at Shoreham. On its face, this issue fails to comply with the Board's requirement that a nexus be shown to Shoreham. Furthermore, the additional QA/QC procedures LILCO employed to ensure installation of acceptable heads makes LILCO's situation dissimilar from others.

In summary, all of the cylinder heads at Shoreham have been replaced with heads manufactured after 1980. The fire decks of a number of these heads have been inspected for casting defects, welding defects and thickness after approximately 300 hours of operation, including 100 hours at full load. No relevant indications or deviations were reported, and these heads are suitable for unlimited operation. (Owners Group Report On Cylinder Heads). Furthermore, LILCO has initiated a barring over procedure recommended by the NRC to detect leaks in the unlikely event a head were to leak. The County has presented no specification to refute that the extraordinary and conservative measures to assure the reliability and safety of the heads have been unsuccessful.

4. Pistons

A. Shoreham. LILCO objects to any litigation by the County of AF or AN piston skirts. Their design, rating, size or manufacture is irrelevant and immaterial because the Shoreham EDGs have type AE piston skirts. This specification should be stricken.

B. Shoreham. Based on this vague specification, LILCO objects to any litigation by the County of the AE piston skirts. Despite ample opportunity and repeated direction by the Board, the County totally fails to specify the particulars of its claims as to the "inadequate design and manufacturing quality" of the AE piston skirts "to satisfactorily withstand operating conditions"; the alleged alteration prior to installation; and the alleged inadequate testing or unproven nature of the AE pistons. This alleged specification should be stricken.

The type AE piston skirt is an improved skirt design. The AE skirt provides additional material for support of the loads in the stud boss area and improved stiffness and strength over the AF design originally on the EDGs at Shoreham.7/ See Owners Group Piston Report.

7/ The AF type piston skirt evidenced linear indications in the crown-to-skirt stud attachment bosses. The Investigation of Types AF and AE Piston Skirts prepared by Failure Analysis Associates for TDI Diesel Generator Owners Group (May 23, 1984 wners Group Piston Report), however, concluded that those indications would not have propogated.

The AE skirts have already demonstrated satisfactory operating experience. They have operated over 300 hours in one of the Shoreham EDGs, including 100 hours at full power operation. The skirts were disassembled and reinspected using eddy current and no defects were found. The replacement AE pistons have also proven to be adequate in laboratory operation and other field experience. Strain gage testing of the AE pistons demonstrated the stresses to be within acceptable limits. The R-5 prototype engine at TDI operated 622 hours at 935 horsepower per cylinder, or 2,000 psi firing pressures, using two AE pistons.8/ A 16-cylinder engine in Kodiak, Alaska, has been operating with a full complement of AE pistons since mid-1982, and has accumulated more that 11,400 hours to date with no AE piston problems.9/ Two marine 16-cylinder engines equipped with AE pistons have accumulated approximately 1,500 hours with these pistons and have reported no problems.

Lastly, the assertion by the County that the type AE piston skirts were altered prior to installation at Shoreham contrary to the requirements of 10 CFR Part 50, Appendix B is incorrect. Prior to shipment from the factory,

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8/ The piston skirts at Shoreham are not subjected to stress levels this high. The firing pressures of the Shoreham EDGs are 1,650 psi.

9/ The Shoreham EDGs will see far less service than these skirts which are operating satisfactorily.

fins or excess material from the casting process were identified around the inner rim of the piston skirts. Fins are a normal product of the casting process and are no indication of a design or manufacturing deficiency. The fins were ground out prior to shipment from the factory according to normal practice in order to avoid the possibility that this extra material could act as a stress riser. This process, however, was not an unauthorized alteration of the piston skirts contrary to Appendix B. It was performed by qualified personnel. The piston skirt was inspected prior to shipment and accepted by LILCO in accordance with authorized Appendix B procedure. Furthermore, Mr. Caruso testified that the Staff's consultants thought the process was "an acceptable" and "right thing to do." Caruso Deposition at 41. (Attachment 6).

In conclusion, the County has given no adequate basis for showing that the type AE piston skirt in the Shoreham EDGs should be litigated. Moreover, the Owners Group Report On Piston Skirts concluded, based upon the results of inspections of engine-operated AE skirts and upon the results of stress analysis that the AE skirts are adequate for unlimited life. The County has not set forth any specific showing that contradicts this conclusion.

C. Common. LILCO objects to any litigation by the County of Apex Marine or U.S. Steel incidents. They involve piston crowns, not piston skirts, which are the subject of the County's specification.

5. Other Components

LILCO objects to any litigation by the County of theoretical and hypothetical "other components." Despite ample opportunity and repeated directions by the Board, the County totally fails to specify any "other component." Their injection into this proceeding is solely for the purpose of harassment and unnecessary delay. No one could reasonably be expected to reply to the references to "components" disclosed in "Board Notifications, the TDI Owners Group program reports and documents and the NRC Morning Reports and Inspection Reports." This universe more than likely includes every EDG component. The Board and LILCO clearly are not "informed" by this sort of open-ended issue. This issue lacks "specification of the instance," and demonstrates that the County is not engaging in a good faith effort to litigate the reliability of the Shoreham EDGs. Accordingly, the specification should be stricken.

The County should be allowed to litigate only claims regarding specific problems with specific components. The County lists components that it "will also refer to" in support of its contention. The County must, at the very least, be limited to such a specific list. The Board has previously indicated that a broad statement followed by such indications of "not limited to" and "etc." are not acceptable. Prehearing Conference Transcript of October 11, 1977, at 63-64.

A. Connecting Rod Bearing Shells

(1) Shoreham. LILCO objects to any litigation by the County of incidents involving the prior connecting rod bearing shells or rejections of some new 12" diameter bearings and limitation of use of others. The original bearings have been replaced with a different design, and the rejections evidence a procedure in place to guarantee acceptable bearings. This alleged specification should be stricken.

The old bearing shells experienced stress fractures caused by the relationship of the bearing size to the 11" journal, bearing overhang and casting discontinuities above an acceptable criteria. A change in the diameter of the replacement crankshaft from 11" to 12" changed the relationship between the bearing and the journal, creating a larger surface area to support the bearing and modified the edges of the bearing shell to correct the overhang condition. Both changes reduced the pressure on the bearing. Based on fracture mechanics analysis, an acceptance criteria for discontinuities was developed and radiographics testing was and is performed on all new bearings[10/] to assure complicance with the acceptance criteria. See Design Review of Connecting Rod Bearing Shells

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10/ The Owners Group report recommended radiographic inspection on a sampling plan. LILCO, however, is inspecting 100% of the bearings. The County states that 14 of the new 12" bearings were rejected or limited, but fails to note it was the result of this detailed, extensive inspection procedure.

For Transamerica Delaval Enterprise Engines prepared by Failure Analysis Associates for TDI Diesel Generator Owners Group (March 12, 1984)(Owners Group Report On Connecting Rod Bearing Shells). All bearings were replaced under this acceptance criteria. This procedure precludes the possibility of unacceptable bearings being installed at Shoreham. The County provides no basis for contradicting the fact that this particular problem has been remedied.

(2) Common

The County cannot establish a relationship between any other occurrence and Shoreham. LILCO's radiographic inspection is unparalleled in nonnuclear applications of the TDI engine and, as described, precludes any similar bearing problems.

In conclusion, the design review shows that the new 12" diameter connecting rod bearing shells recently installed in the DSR-48 diesel generators are predicted to have a fatigue life of 38,000 hours at full load. This far exceeds the hours that are required during the 40-year service life of a nuclear power station. Thus, it has been concluded that the connecting rod bearing shells will function reliably in nuclear standby applications. Owners Group Report On Connecting Rod Bearing Shells. The County has specified no issue to contradict this conclusion.

B. Engine Bases

The County lists no occurrence at Shoreham to support this specification. LILCO objects to any litigation by the County of incidents elsewhere. This purported specification should be stricken.

The County has evidently abandoned its Supplemental Contention that indications and cracks found in the base plates of EDGs 102 and 103 were a design deficiency. Therefore, the County should not be allowed to continue litigating this issue merely based on three instances unrelated to Shoreham. The County evidently agrees with the conclusions of the Owners Group report that the cracking of the engine bases at Shoreham resulted from maintenance problems and the EDG 102 crankshaft failure (not design or operation) and that the identified cracks have not propagated. See Design Review of Engine Base and Bearing Caps For Transamerica Delaval Diesel Engines prepared by Failure Analysis Associates for TDI Diesel Generator Owners Group (April 1984)(Owners Group Report On Engine Base).

Again, the County's Filing fails to specify the causes of the problems cited on other TDI engines and their applicability or nexus to Shoreham. All three of the occurrences listed by the County have no relationship to the contentions of overrating or undersizing, design deficiency or manufacturing deficiency at Shoreham. Approximately five years

ago, the engine base of U.S. Coast Guard DSR-4 S/N 77020/27 (incorrectly reported as 72033), cracked as a result of inadequate torquing of main bearing caps. Repairs were made and adequate torque was applied. The repaired parts are still in service. The cause and type of base failure at Anamex is unrelated to the base cracking at Shoreham. Furthermore, the design and loadings of the two bases are not similar. The cracking of the Rafha base occurred as the result of an overspeed accident mentioned above. A new crankshaft was installed in the existing base, and it is still in operation after more than 10,000 additional hours.

In summary, structural analysis has been carried out on the base assemblies of DSR-48 EDGs at Shoreham. Adequate margins of safety for ultimate and fatigue loading were found in all cases. Owners Group Report On Engine Base.

C. Cylinder Liners

(1) Shoreham. LILCO objects to any litigation by the County of cylinder liners based on the present specification, which is lacking in sufficient detail to permit informed litigation. It should be stricken.

The County merely reiterates from its Supplemental Contentions that cracks and pitting have been found in the cylinder liners at Shoreham. Without further evidence in the instant Filing, however, the County is claiming

that this evidences not just a design deficiency, as it earlier alleged, but also overrating and undersizing and a manufacturing deficiency.

LILCO continues to object to this issue because the County still provides inadequate bases to support its contention. First, only one crack has been found in the cylinder liners at Shoreham and that was determined to be the result of an isolated manufacturing defect. Second, pitting has occurred on the cylinder liners of all three EDGs, but there is no basis to support the contention that it is a result of overrating and undersizing, a design deficiency or a manufacturing deficiency. Furthermore, pitting in the cylinder liners has not adversely impacted the operation of the EDGs throughout the factory test runs or site preoperational test program. Finally, LILCO elected to replace the affected cylinder liners which is a normal maintenance procedure. See Affidavit of John C. Kammeyer attached to LILCO's Response to County's Supplemental Contentions filed January 27, 1984.

(2) Common. Two of the "common" cylinder liner occurrences listed by the County involve marine applications. As stated, the nuclear and marine applications of the TDI engines are significantly different. Therefore, a special showing of nexus is required. One of the most noteworthy differences is the number of service hours expected in nuclear applications versus the service actually experienced in marine

applications. For instance, almost all M. V. Gott cylinder liners remained in service after five complete seasons totalling more than 20,000 operating hours. Nuclear EDGs will never experience that type of operation. As to the other occurrences, they appear to be isolated. Out of more than 3,500 cylinders of R-4 and RV-4 engines, cylinder liner cracking is almost unheard of and detrimental scuffing is rare.

D. Connecting Rods

(1) Common. LILCO objects to any litigation by the County of the Copper Valley Electrical Association incident. The County makes no effort to show a nexus to Shoreham. Also, Shoreham has never experienced any problems with connecting rods. This contention should be stricken.

The Copper Valley instance represents one known rod failure out of the more than seven hundred in-line R-4 connecting rods manufactured with identical or near identical upper end design since 1968. It should be noted that the RV-4s have the same upper end and have never suffered a similar failure. This means that the failure is one out of more than three thousand five hundred upper ends. Further, the design remains virtually unchanged since 1954. Since that time, five hundred engines (six thousand upper rod ends) have been manufactured with the Copper Valley failure as one of a kind. It insults LILCO and the Board to list such a "common" instance.

Moreover, FaAA evaluated eight of the replacement connecting rods at Shoreham and found no discontinuities. They concluded that there is no substantial risk of fatigue failure on the in-line connecting rods in place at Shoreham. See Design Review of Connecting Rods of Transamerica Delaval Inline DSR-48 Emergency Diesel Generators prepared by Failure Analysis Associates for TDI Diesel Genrator Owners Group (April 1984).

E. Cylinder Head Studs

(1) Shoreham. LILCO objects to any litigation by the County of cracked studs. Contrary to the County's specification, no studs cracked at Shoreham. This spe-ification should be stricken.

(2) Common. The County cites as a common instance broken studs in two DSR V-20-4 engines at the City of Homestead. Once again, the County has failed to show a nexus between this occurrence and Shoreham. Furthermore, no cylinder head stud failures are known to have occurred in any nuclear EDGs, including Shoreham. Also, when LILCO replaced the heads, a new, improved stud design was incorporated. The Owners Group concluded that both the new and old stud designs were adequate for given service conditions and that the failures associated with the old head stud design in nonnuclear service were most likely attributable to insufficient preload application, not design or manufacturing. See Emergency Diesel Generator

Cylinder Head Stud Stress Analysis prepared by Stone & Webster Engineering Corp. for TDI Owners Group (March 1984). LILCO has in place adequate preload procedures using calibrated torque wrenches to insure proper preload.11/ These procedures distinguish Shoreham from any non-nuclear experience where no assurance necessarily exists that the studs are properly preloaded.

F. Turbochargers

(1) Shoreham. LILCO objects to any litigation by the County of the old prelubrication system on the Shoreham EDG turbochargers. The design of the original lubricating oil system is irrelevant and immaterial. LILCO stated in its Response to the County's Supplemental Contentions, shortly after the thrust bearing failure, that it did not object to litigating the prelubrication system for the turbocharger thrust bearings. At that time, however, LILCO had not had an opportunity to investigate this matter. Over the last several months, LILCO has identified the problem with the prelubrication oil system and has taken steps to resolve it. As LILCO pointed out in its earlier Response, the purpose of preoperational testing is to identify and correct such

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11/ The procedures and documentation to ensure proper torquing are found in the LILCO repair rework requests, which were furnished to the County during discovery.

problems. LILCO is currently using free flow prelubrication of the bearings during testing in order to avoid excessive wear. LILCO objects, at this time, to litigation of an issue that has been adequately remedied. This alleged specification should be stricken.

(2) Common. The County cites as a common instance the failure of three turbochargers at Kuosheng. The County fails to show, however, whether these failures were due to a lubricating oil system problem similar to Shoreham. The County has failed to provide the appropriate nexus, and LILCO continues to object to the use of such "common" instances.

In summary, FaAA concluded that the Elliott Model 90G thrust bearings are adequate for nuclear standby service, including preoperational testing and up to 40 automatic fast starts without the benefit of any prelubrication. To assure adequate service, FaAA made certain recommendations that have been adopted by LILCO. See Design Review of Elliott Model 90G Turbocharger Used On Transamerica Delaval DSR-48 and DSRV-16 Emergency Diesel Generator Sets prepared by Failure Analysis Associates for TDI Diesel Generator Owners Group (May 1984). The County provides no evidence and offers no explanation contradicting the adequacy of the new procedures to avoid turbocharger thrust bearing failure.

6. Overrating and Undersizing of EDGs

The County claims that it will trace the development of the engines to show that they are overrated and undersized and not sufficiently tested. LILCO objects to this contention because it is overly broad and irrelevant to the reliability and adequacy of the EDGs currently installed at Shoreham. The County appears merely to be reiterating its general contention without further specific proof. Furthermore, as the Board indicated in its February 22, 1984 Bench Order, litigation of such broad issues will be sufficiently included in the litigation of specific contentions and would not likely change the result to be reached under those contentions. Tr. at 21,613-614. The County has given no bases as to why that rationale does not apply here.

The County goes on to claim that the Shoreham EDGs "are effectively new prototypes which have been inadequately tested and inspected." The County does not specify what tests or inspections it considers inadequate and gives no basis for this sweeping generalization. The Shoreham EDGs have undergone 1000 hours of extensive and expanded preoperational testing and post-operational disassembly inspections to verify that nothing had been missed during preoperational testing.[12/] In addition, the EDGs have

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12/ The expanded preoperational testing program is outlined in the Diesel Recovery Program, Section VI, which has been made available to the County. See SNRC-1003, January 6, 1984.

undergone analyses and inspection by the DRQR. The actual tests and inspections performed are too numerous to reiterate here, but are listed and described in each Owners Group report made available to the County. The testing, analyses and inspection performed on the Shoreham EDGs far exceed any NRC requirement.

The County has had access to preoperational test results and Owners Group documents but has not even attempted to particularize anywhere the bases for its contentions that the engines are not adequately tested and inspected. The actual testing and inspection performed on the Shoreham EDGs have been too extensive to expect LILCO to divine what particular aspects the County is allegedly criticizing. Allowing the County to continue with such broad allegations is truly litigation by surprise and is totally unnecessary. If the County ever intended to go forward in good faith with this litigation, it has had ample discovery and ample time to formulate more specific issues of concern. This alleged specification should be stricken.

III. TDI DIESEL GENERATOR OWNERS GROUP PROGRAM PLAN

LILCO objects to Part III of the County's Filing and moves that it be stricken. Rather than presenting evidence of specific problems about the review of any particular component, the County suggests that the overall scope and implementation

of the TDI Diesel Generator Owners Group Program Plan (Owners Group Program) be added as an issue to this litigation. The County's contentions concerning the Owners Group Program are vague, excessively broad and unrelated to the question of engine reliability. The County does not even attempt to link any of its contentions regarding the Owners Group Program to problems with the diesels. Rather, the County seeks broad, unfocused litigation of the entire Owners Group Program. These contentions should not be admitted.

The issue in this proceeding is the reliability of the Shoreham EDGs to perform their intended functions. The Owners Group program provides a framework for analyzing the reliability of the engines. The Owners Group Program itself, however, should not be an issue in this litigation.

The entire focus of the County's contentions about the Owners Group program is misplaced. The County should set forth specific concerns it has about those components and specifically identify the relationship between alleged deficiencies in the Owners Group Program and the problem with the components. LILCO strongly opposes unfocused litigation about the overall scope of the Owners Group Program, because such litigation will not resolve questions about the reliability of the EDGs. Such litigation will merely delay these proceedings.

In addition, to the extent the County seeks to raise questions about the procedures followed by the Owners Group Program, the County has not raised these issues in a timely manner. LILCO first informed the County of its intention to conduct a design review of the diesels on November 3, 1983. Over the next several months LILCO gave the County information on review procedures and test programs that would be followed. In early January 1984, the County was provided copies of the DRQR program description, copies of DRQR procedures and a list of the components to be reviewed. If the County wanted to raise broad questions about the procedures to be followed by the Owners Group program, it should have raised them in its Motion to Admit Supplemental Diesel Generator Contentions, filed January 27, 1984, rather than waiting until now. The County's Filing is untimely and should be stricken for that reason alone.

In any event, LILCO does not believe it is appropriate to litigate the Owners Group Program procedures in the abstract. The County's contentions are excessively vague and do not give LILCO notice of what facts the County intends to prove to support its contentions. If the County has any specific evidence that a problem exists with any components reviewed by the Owners Group Program, the County should present that evidence to the Board. In the absence, however, of some nexus between alleged deficiencies in the Owners Group Program

and established problems with components of the diesels, an unfocused litigation concerning the adequacy of the Program itself will serve only to delay and confuse these proceedings.

A. Alleged Deficiencies in Scope and Implementation of Owners Group Program

No response is required to those areas of Part III describing the Shoreham Diesel Generator Recovery Program, the DRQR and the Owners Group Program. Suffice it to say that all of these efforts, when coupled with the pre-operational testing program and post-testing inspections, have confirmed that the Shoreham EDGs are capable and reliable to adequately perform their required functions.

1. The County alleges the Owners Group Program addresses the design of individual components only and not the interaction of components and systems in the engine as a whole. There is no basis for this claim. Component interaction is an integral part of the Owners Group Program analysis. The Owners Group Program does not analyze each component in a vacuum. Rather, the Owners Group Program analyzes how each component functions in the engine and how other portions of the engine interact with the component. In addition, overall engine reliability is guaranteed by the pre-operational testing program. The test program guarantees that the engine as a whole will operate properly.

This issue was specifically addressed at the February 10, 1984 meeting between the NRC Staff and the Owners Group. The Owners Group representatives explained at that meeting that the analysis of the engine was designed to consider system interactions. See Transcript of February 10, 1984, Meeting Between NRC Staff and TDI Owners Group, at 32-36. (Attachment 8). A representative of the County attended this meeting

The County also alleges that no systematic methodology for the classification of safety significance of engine components was employed by the Owners Group. There is no basis for this claim. The entire engine is a QA Category I item. In addition, each component was classified in one of the following categories:

Class	Significance of Component Failure
A	Failure can result in immediate shutdown of engine or prevent startup under emergency conditions.
B	Failure can result in reduced capacity of engine or result in eventual failure of a Class A component if not detected.
C	Failure does not significantly impact the ability of the engine to meet its load requirements.

The classification system is explicitly stated in the Owners Group Program Plan, which was provided to the County months ago. See TDI Diesel Generators Owners Group Program Plan DG-2 at 4 (Attachment 9). Therefore, contrary to the

County's assertion, a systematic methodology for classification of components was used by the Owners Group. Furthermore, the County was aware of what components were being analyzed in January, 1984. If the County objected to the component selection, that objection should have been raised in the County's Supplemental Contentions.

2(a). The County alleges the Phase I design reviews are incomplete in that the task descriptions address only the particular form of past failures. LILCO objects to this contention on the grounds that it is irrelevant. Phase I reports were not designed to consider all functional attributes of the engine. Phase I reports were designed to address known problems with the engines. The Owners Group Program Plan specifically states:

> the first major program element of the TDI Diesel Generator Owners Group is the resolution of generic known problems.

See TDI Diesel Generators Owners Group Program Plan Section III.A. at 1. Furthermore, the County has failed to specify any potential forms of failure that should have been considered. In the absence of any specificity, there is no substance to the County's contention.

2(b). The County alleges that the task descriptions do not address the evolution of component designs, thereby inadequately assessing design changes. LILCO objects to this contention on the grounds that it is irrelevant to any issue in

this proceeding. The issue in this proceeding is whether the TDI emergency diesel generators, as designed and currently installed, are capable of performing their jobs. The issue to be determined is whether the present design of a component is adequate, not the evolution of the component design.

Furthermore, there is no basis for the County's claim. Many of the reports address design evolution in great detail. For example, the piston skirt report discusses the evolution of the design of the current AE piston skirt from the original AF piston skirt design. See Owners Group Report On Piston Skirts.

2(c). The County alleges that some functional attributes and evaluations in the task descriptions are not discussed in the Phase I reports. LILCO objects to this contention because it is excessively vague. The task descriptions listed in the Owners Group Program Plan were preliminary descriptions that were developed prior to full-scale review of the engine. The analysis of the engine was not limited to the attributes listed in the task descriptions. As representatives of the Owners Group explained in the February 10, 1984 meeting with the NRC Staff, the attributes listed in the task descriptions were merely preliminary and were expected to change as actual analysis of the engine progressed. All necessary attributes associated with known generic problems were reviewed and discussed in the Phase I reports. See Transcript of February 10, 1984 Meeting

Between NRC Staff and TDI Owners Group, at 25-32. (Attachment 8). In addition, the County has not specified a single instance in which the analysis of a Phase I component is inadequate.

3. The County alleges that deficiencies in engine components experienced at non-nuclear facilities were not systematically obtained and assessed during the Owners Group Program reviews. LILCO objects to this contention. The County does not even attempt to show how this contention impacts on the adequacy of the review of LILCO's diesels. In addition, there is no basis for the County's allegations. The Owners Group Program obtained all nuclear and non-nuclear experience that was available and reviewed this experience. This information was systematically analyzed as part of the Owners Group Program. A computerized component tracking list (which is not attached as an exhibit because it is approximately 500 pages long, but which has been provided to the County) documents all available component experience, whether nuclear or non-nuclear.

Further, as Dr. Carl Berlinger noted in his deposition, and as the County pointed out in its Filing, the records kept about engines in non-nuclear service are frequently inadequate to make information about those engines meaningful. Without proper documentation, information about diesels in non-nuclear service is of extremely limited value. Berlinger Deposition at 64-71. (Attachment 10).

4(a). The County alleges that inspection commitments in the Owners Group Program were poorly defined and acceptance criteria were often lacking. LILCO objects to the excessive vagueness of this contention. Inspection and acceptance criteria are addressed in individual Owners Group Program reports. The Owners Group Program Plan did not, nor could it, detail specific inspection and acceptance criteria for each component. These criteria are discussed in individual component task descriptions. Acceptance criteria did not previously exist for certain components and had to be developed by the Owners Group Program. Details concerning inspection and acceptance criteria for individual components are provided in individual Owners Group reports. For example, conservative acceptance criteria for porosity, or voids, in cast aluminum bearing shells were developed by the Owners Group Program in the course of the review of the connecting red bearing shells. See Owners Group Report on Connecting Rod Bearing Shells, Section 5.3 (Attachment 11). In addition, the County has cited no instance where alleged poorly defined inspection or acceptance criteria has caused a problem with a component.

4(b). The County alleges the Owners Group Program commitments do not adequately define precise inspection scope and inspection techniques. This contention has no merit. The Owners Group Program Plan is a general document describing the scope of work to be performed. Details concerning inspections

are contained in the Owners Group reports and in the component task descriptions. The reports contain details of how the component was inspected and the criteria applied to determine whether the component was acceptable.

4(c). The County alleges the Owners Group has not taken into account manufacturing deficiencies of TDI in the formulation of inspection procedures. LILCO objects to this contention because it is excessively vague. There is also no basis for the County's contention. Inspection procedures developed by the Owners Group specifically take into account TDI's maufacturing deficiencies. For example, cracks have been discovered in the valve seats of many cylinder heads manufactured by TDI prior to 1980. This cracking has been attributed to problems with TDI's manufacturing process. See Owners Group Report on Cylinder Heads. The cylinder head report specifically provides inspection procedures that are designed to detect any defective cylinder heads. Specifically, the report recommends that all heads manufactured prior to 1980 should be inspected by liquid penetrant and/or magnetic particle testing, and fire deck thickness should be ultrasonically measured. In addition, the heads should be regularly checked for leaks. For heads manufactured after 1980, sample inspections of all heads by the methods described above is recommended. See Owners Group Report on Cylinder Heads, Section 4. (Attachment 12).

4(d). The County alleges that the inspections specified are not adequate to disclose latent defects. LILCO objects to this contention. The County has not specified how or why LILCO's inspection procedures are inadequate, nor has the County suggested any component that has a latent defect LILCO has failed to discover. LILCO has employed a wide range of state of the art inspections designed to discover all possible defects. The pre-operational test program is designed to identify defects that may have been missed by original inspections. Post-testing inspections provide further assurance that all defects have been discovered. The cylinder head inspection procedures discussed in Paragraph 4(c) above, are but one example of LILCO's efforts in this regard. The County's allegation is excessively vague and not linked to any identifiable problem at Shoreham.

4(e). The County alleges that document reviews based on suspect and incomplete TDI records have been relied upon to substitute for actual physical inspection of components. LILCO objects to this contention on the grounds that it is excessively vague. The County points to no specific instances to supports its contention. This contention is also refuted by the Owners Group Program Plan itself. In Section IV, page 1, the Plan describes the extent of the reliance on TDI information.

> It is significant to note, that, while TDI drawings and certain TDI information is being used as input to the DR/QR Program, the actual technical evaluations are being performed independent of TDI thereby providing an independent verificaton. TDI will be kept in the review and comment cycle in order to take into account their engine and component specific expertise.

The County provides no evidence to support its contention.

4(f). The County contends that the inspections conducted at Shoreham after engine testing have been inadequately specified in the Program Plan. LILCO objects to this contention on the grounds that it is excessively vague and repetitive of earlier, unsupported contentions. In addition, there is no basis for this contention. As previously noted, the Owners Group Program Plan is a summary of the program to review the adequacy of the diesels. It was never contemplated that the Program Plan itself would contain every detail concerning inspection procedures. As stated in response to Paragraph 4(b) above, details of inspection techniques are contained in component task descriptions.

4(g). The County alleges LILCO failed to utilize appropriate non-destructive examination techniques, but instead relied heavily on simple visual inspection. LILCO objects to this contention on the grounds that it is excessively vague and is not related to any particular component of the engine. In addition, there is no basis for this contention. LILCO did not rely solely on visual inspections. LILCO relied heavily on

appropriate non-destructive examination techniques, including ultrasonic testing, liquid dye penetrant testing, eddy current testing and other forms of non-destructive examination. For example, cylinder heads are inspected by ultrasonic measurement of fire deck thickness, liquid penetrant and/or magnetic particle inspection, and hydrostatic testing. Details of inspections are provided in the report on each component. See, e.g., Owners Group Report on Cylinder Heads, Section 4 (Attachment 12); Owners Group Report on Connecting Rod Bearing Shells, Section 2 (Attachment 11).

4(h). The County alleges inspection commitments are not assured for spares and maintenance parts, thereby providing the potential for quality degradation in the future. There is no basis for this allegation. LILCO is committed to the continued inspection of replacement parts. Spare parts for all critical engine components that have experienced problems in the past will continue to undergo inspections specififed by the Owners Group to ensure continued quality. See, e.g., Owners Group Report on Connecting Rod Bearing Shells, at 6-2 (March 12, 1984) (Attachment 11).

5(a). The County alleges the Owners Group Program does not require demonstration that the engine and components will meet the FSAR or procurement load specification. There is no basis for this contention. The expanded pre-operational testing program for the Shoreham diesels demonstrates the

engines are capable of meeting the load conditions described in the FSAR. All components have been tested to meet operational conditions and the engines have been subjected to, and passed, integrated electrical tests, mechanical tests and qualification tests. The expanded pre-operational test procedures were submitted to the NRC before testing began. The county has been furnished the results, including the specific test details, of the pre-operational test program. Despite this fact, the County does not specify a single instance in which a test was allegedly deficient.

5(b). The County alleges the Owners Group Program does not consider lifetime performance requirements at full engine rating. There is no basis for this allegation. The Owners Group reports specifically address the question of component life. All components are assessed for their ability to meet their lifetime performance requirements. The actual service life of the Shoreham diesels is anticipated to be approximately 4,600 hours. See Affidavit of John C. Kammeyer (Attachment 13). Component reliability for expected service is specifically discussed in each report. For example, the report on connecting rod bearing shells estimates that the bearing shells have an expected service life of 38,000 hours, which is well in excess of the expected hours of operation of the diesels. See Owners Group Report on Connecting Rod Bearing Shells, Report at iv (Attachment 11). In addition, the County

has provided absolutely no basis for concluding that any component will not operate reliably for the expected life of the engines.

5(c). The County alleges the Owners Group Program does not document the possible use of maintenance and inspection requirements as a substitute for acceptance standards. LILCO objects to this contention. The contention is so vague that LILCO is unable to formulate a response.

5(d). The County alleges that the safety significance of TDI design and manufacturing product improvements which were deferred were not included in the assessment of engine reliability. LILCO objects to this contention on the grounds that it is excessively vague and does not inform LILCO of the facts the County intends to prove. All TDI product improvements were assessed by LILCO, and LILCO implemented all product improvements that were necessary to ensure engine operability and reliability. The issue in this proceeding is the condition of the engines as they now exist. The County does not specify a single deferred improvement about which it has particular concern, nor does the County provide a basis to conclude that any deferred improvement will affect engine operability.

6. The County alleges that sample inspections relied upon in the Owners Group Program were not appropriate because the pattern of QA/QC deficiencies indicates there may be

significant differences in the as-manufactured quality of EDG components. LILCO objects to this contention because the County does not even attempt to specify the components to which it refers. In addition there is no basis for this contention. LILCO conducted 100% inspections of critical components where necessary. One hundred percent inspections were performed on all connecting rod bearing shells, cylinder heads (hydrostatic tests), push rods, fuel oil injection tubing, cylinder head stud torques, rocker arm capscrew torques, airstart valve capscrew torques, crankshafts, wiring and terminations and cylinder blocks. In the absence of any specific details by the County, LILCO is unable to respond in more detail to this contention.

7(a). The County contends testing was inadequate to establish the quality of the engine because the program does not satisfy the start-up qualification requirement of IEEE-387. LILCO is unable to respond to this contention because it is so vague that LILCO has no idea what the County means nor what facts the County would prove to support the contention.

7(b). The County alleges the duration and duty cycle of the testing program is inadequate to establish engine reliability. LILCO objects to the excessive vagueness of this contention. The testing program specifies exactly what loads and cycles the engines are subjected to during operation. The tests conducted establish that the engines are capable of

meeting these conditions. In addition, the testing program meets the requirements of IEEE-383 and NRC Reg. Guide 1.108. The details of the pre-operational electrical and mechanical test have been provided to the County previously. To the extent the County has specific objections about the tests, those objections should have been raised. Vague objections such as those raised here provide no notice to anyone of what the County wants to litigate.

7(c). The County contends the effects of ambient temperature and humidity variations were not adequately addressed by the Owners Group testing program. There is no basis for this contention. Pre-operational test criteria specifically address ambient temperature and humidity. The results of these tests are contained in the pre-operational test reports that have been provided to the County.

7(d). The County alleges the Owners Group Program failed to demonstrate environmental and seismic qualifications of the engines as required by GDC-4, IEEE-323 and IEEE-344. LILCO objects to this contention on the grounds that it is irrelevant. There has been no contention that the engines failed to meet environmental or seismic qualifications. This issue was not addressed in the Owners Group Program because these issues do not relate to engine reliability. The County has not alleged, nor is it able to allege, that the engines do not meet the environmental and seismic qualifications required by GDC-4, IEEE-323 and IEEE-344.

8. The County alleges that the Owners Group Program reviews have not taken into account the inspection deficiencies identified by the NRC's vendor inspection program. LILCO objects to this contention on the grounds that it is excessively vague. In addition, there is no basis for the County's contention. The inspection deficiencies noted by the NRC have been placed on the Owners Group Program component tracking list and evaluated by the Owners Group.

Summary. The County has launched a broad based, entirely non-specific, attack on the Owners Group program. The County has made no attempt to link any of its vague allegations to specific problems with the Shoreham diesels. Rather, the County has simply attacked wholesale the Owners Group Program. LILCO respectfully requests that no portion of Part III, Section A be admitted as an issue in this litigation. The County's allegations are so vague that meaningful litigation is impossible. They should be stricken.

B. Alleged Lack of Independence

The County argues that the results of the Owners Group Program cannot be relied upon because LILCO and FaAA personnel were involved in the Program, and much of the analysis and testing was performed on LILCO's EDGs at Shoreham. This argument is totally frivolous and is typical of the County's attempt to bog down this proceeding with false issues. The

County suggests, by implication, that a review like that conducted by the Owners Group Program must be "independent" from the utility whose engines are being reviewed. There is, however, no regulatory requirement that such a review be conducted by a party not affiliated with the utility. The procedures followed here were completely appropriate.

The involvement of LILCO and FaAA personnel in the Owners Group Program has been a matter of public record from the beginning of the Owners Group program. To suggest that the utilities owning TDI diesels should not be involved in the program to review the design and quality of the diesels is absurd. LILCO has the ultimate responsibility for ensuring the safe operation of Shoreham. Indeed, utility companies routinely build their own nuclear power plants and assume responsibility for their safe operation. There is nothing unusual about LILCO's involvement in a program to review the adequacy of a component of its plant. As the County itself notes, the NRC Staff requirement of independent review means only that the DRQR must be "separate from any previous TDI quality assurance program." The County has made no attempt to show that the Owners Group Program is not separate from TDI's quality assurance program. Indeed, it cannot.

Furthermore, there is nothing to litigate concerning the alleged lack of independence of the Owners Group program. There is no dispute about who was involved in the Program and

what engines were tested. This Board can take those facts into consideration in evaluating the evidence presented at the hearings. It would be absurd, however, to waste everyone's time litigating the obvious. LILCO and FaAA personnel were involved in the Owners Group Program, and their involvement was entirely appropriate. The County's assertion that LILCO should not be involved in the evaluation of its own diesels, particularly when a large portion of the evaluation depends on the successful completion of engine testing, is simply not credible. The "independence" of the Owners Group Program is not an appropriate issue for litigation in this case.

C. Key Elements of Program Are Complete

The County contends in Section C of Part III that key elements of the Owners Group Program are incomplete and that this proceeding should be delayed until these matters have been completed and the County has had an opportunity to review and evaluate them. There is no foundation for the County's request for additional delay of these proceedings. LILCO's response to each of the County's specific contentions is listed below.

1. Not all Phase I activities have been completed in that:

(a) Cylinder block and liner report is not issued.

Response: The cylinder block and liner report will be issued in the near future. In addition, the County already has received extensive information on the cylinder blocks. A preliminary cylinder block report was issued on April 30, 1984. The County has inspected the engines on two separate occasions within the last two months. The County also deposed three of LILCO's consultants who have done work on the cylinder block, Messrs. Chen, Wells and Taylor.

(b) Existing reports do not fully address all issues in Task Descriptions.

Response: See response to Part III Section A, Paragraph 2(c).

(c) NRC review, and that of its consultants, is ongoing and is incomplete. Indeed, at the May 24, 1984 Owners Group meeting, the NRC Program Manager promised that a draft would not be furnished until mid-June documenting the NRC consultants' comments on the adequacy of the scope (not the results) of the Phase I program.

Response: This comment has no bearing on the completeness of the Owners Group program.

(d) As of May 31, 1984, the Staff had no preliminary or other views regarding the adequacy of the DRQR or of TDI EDGs based upon the Owners Group program.

Response: This comment has no bearing on the completeness of the Owners Group program.

2. The Owners Group program has not issued reports for Phase II regarding the DRQR and is not scheduled to do so until the first of July. Thus, documentation of the design and quality of important EDG components is not yet available for evaluation.

Response: LILCO objects to this contention on the grounds that it is not relevant. Completion of Phase II is not a prerequisite to licensing. Completion of Phase I, together with testing and inspections, provide the assurance necessary for licensing. Phase II is merely confirmatory. All components with known generic problems were reviewed in Phase I.

The NRC also agrees that completion of Phase II is not a prerequisite for licensing. On April 25, 1984, Darrell G. Eisenhut of the Division of Licensing wrote Mississippi Power & Light Company indicating that completion of Phase I activities was sufficient for licensing. That letter, with enclosures is Attachment 14.

3. Shoreham engine testing and inspection have not yet been completed in that:

(a) Post-operational inspections are incomplete.

Response: Testing and inspection of EDG 101 and EDG 102 are complete. Testing and inspection of EDG 103 is not complete because the block in that engine has been replaced. However, this proceeding does not have to be delayed until

testing of EDG 103 is complete. Testing of EDG 103 will not change the extensive design and quality analyses that have already been performed on the engines. The County has had more than enough time to amass the information it needs to start this litigation. LILCO does not dispute that EDG 103 must successfully complete the pre-operational test program and post-testing inspections before an operating license may be issued. There is, however, no reason to delay the start of these proceedings.

(b) New cylinder block testing program is not defined.

Response: The cylinder block in EDG 103 has been replaced. EDG 103 will repeat the entire start-up test program. After the start-up program has been completed, the engine will be disassembled and inspected.

4. Procedures for increased engine maintenance, inspection, and surveillance activities, including crack indications monitoring relied upon by the Owners Group, have not yet been issued.

Response: See the response to Part III Section A, Paragraph 4(a) - (h).

The County has known for months what components were being evaluated by the Owners Group Program. The task descriptions, test procedures, component tracking list, and other information have been available for months. The County

should not be heard now to request additional delay or additional discovery.

The County had every opportunity during the discovery period to depose the key LILCO and Stone and Webster personnel involved in the Owners Group Program. Rather than focus on these people, the County chose to depose primarily FaAA and TDI employees. The County also chose to focus on the sixteen Phase I generic components in discovery. The County should not be permitted to reopen discovery to seek additional information about the remaining components covered by Phase II. The County has known for months what components were reviewed by the Owners Group Program. No additional delay or discovery is warranted.

IV. ADDITIONAL INFORMATION

LILCO objects to Part IV of the County's filing in its entirety. In Part IV, the County attempts to lay the foundation for prolonging this litigation by indicating that it may seek authority to obtain documents and take depositions from owners of TDI engines in marine and non-nuclear stationary applications. This Board should not allow such discovery, which is both cumulative and of questionable relevance.

The County states that it needs additional information from TDI owners in three areas -- block cracking, cylinder head cracking and piston crown cracking. The County argues it has

been prevented from acquiring this information because the Board, in its February 22, 1984 Bench Order, prohibited formal discovery from TDI customers, and that it therefore needs subpoenas to obtain the information as well as a period of time for taking depositions of these TDI owners.[13/]

For the County to be entitled to obtain discovery of TDI customers under the Board's ruling of February 22, 1984, it must make a special showing that there is some information particularly in the possession of TDI owners that warrants further discovery and depositions. Tr. at 21,624. The Board indicated that it would require a special showing because the information from TDI customers would, on the whole, probably be cumulative to that already obtained by the County or the NRC Staff.

The information sought by the County is clearly cumulative. The County obtained all the customer service

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13/ The County makes much of the fact that TDI apparently sent a letter to its customers informing them of the fact that they might be contacted by Suffolk County. The County alleges that this "might" have had a chilling effect on these customers so that it "may" be difficult, if not impossible, for the County to obtain the information it desires. The County further states that it and the State of New York are in the process of contacting TDI owners to obtain certain information but that the results have been inconclusive. LILCO contends that the fact TDI sent a letter to its customers with regard to potential contacts by Suffolk County has absolutely no relevance to this proceeding, nor does the general nebulous indication from the County that most of the TDI owners contacted did not want to get involved in this litigation.

records and operating histories from TDI at least two months ago. Yet, conspicuously absent from the County's request is a showing of any special circumstances or particular information in the possession of the TDI owners which would, under the Board's Bench Order, permit the County to obtain additional discovery from the TDI owners. The County simply recites that it needs more information in three areas and lists the owners involved for each area without any sort of specification or particularization as to how this information will add anything to the information already available.

What the Filing does show is that the majority of instances involved relate to marine applications of TDI diesels. But the County's own experts, Aneesh Bakshi, Dennis Eley and Stanley Christensen, have all stated in their depositions that the operating conditions and the stresses operating upon marine diesels are much different from those operating in nuclear standby application. See Bakshi Deposition at 89 and 100 (Attachment 3); Christensen Deposition at 78-79 (Attachment 15).

Furthermore, the County's assertion that piston crown cracking is an area that should be added to its contentions and in which discovery should be conducted ignores the Board's Shoreham specific requirement. There is no evidence in this proceeding that any piston crowns in the Shoreham EDGs have cracked. The information the County "may" be seeking in these

three areas is precisely what this Board sought to guard against when it earlier determined not to allow discovery of cumulative information of questionable relevance.

The County also indicates that it "probably" needs to obtain operating history data from Rafha Electricity Corp. in Saudi Arabia on the replacement crankshafts and cylinder heads, from Suralco in Surinam, on cylinder blocks, and from Sceco Gizon in Saudi Arabia on cylinder heads and blocks. Again, the County does not specify why it is important to obtain additional information on crankshafts, cylinder heads, and blocks. As with the instances discussed above, the County has made absolutely no attempt to show that there are any special circumstances that exist with regard to these TDI owners which would entitle the County to obtain information or take depositions. This information is nothing more than cumulative information with no particular relevance to Shoreham.

Finally, in a desperate attempt to buttress its alleged need for TDI owner information, the County criticizes the Staff and its consultants for not attempting to obtain all the operating history and data from TDI diesel owners, and asks the Board to encourage the Staff to do so. It is clear from the evidence in this proceeding and in particular from the deposition of Dr. Carl Berlinger, the NRC project leader for the ..RC Owners Group, that the Staff believes: (1) there is abundant operating data and history already available in this

proceeding; and (2) most of the non-nuclear TDI data will not be informative because the records kept by marine owners and non-nuclear owners are not nearly as detailed as the records required to be kept in the nuclear context. Berlinger Deposition at 67-71 (Attachment 10). Thus, as Dr. Berlinger confirmed in his deposition, the relevance of particular component failures or problems is questionable without knowing the operating conditions to which they were subjected. Id. In addition, most, if not all, of the marine and non-nuclear applications subject the engines to such different conditions that their relevancy is suspect. As the County's experts have admitted, engines are subjected to different stresses in marine applications than in nuclear standby operations. Similarly, engines operate continuously at municipal water or sewage plants and when used primarily for the generation of electricity. Operation of the Shoreham EDGs will not be continuous because they are standby units.

LILCO objects to the County's request that the Board encourage the NRC Staff to obtain the information requested by the County. The information is cumulative and is sought for no purpose other than delay.

V. CONCLUSION

In its February 22, 1984 Bench Order, the Board directed the County make the following showings in its June 11, 1984 Filing:

> (1) a listing of specific instances it would depend on to support its three general Contentions, and
>
> (2) a statement as to the elements of the DRQR that should be added to the litigation.

The County has complied with neither directive.

The Board directed the County to file, after discovery, a specification of issues "so the parties are not surprised as to what items will be addressed in testimony." Tr. at 21, 617-18. The Board also required the County to establish a "nexus" between the instances cited and the three specific contentions regarding the Shoreham EDGs, i.e., overrating and undersizing, design deficiency and manufacturing deficiency. The Board required a showing of nexus for occurrences both at Shoreham and other TDI diesel engines. The Board stated that this showing of nexus for occurrences at Shoreham could be brief, but nevertheless indicated that a mere occurrence without some showing that it had a relationship to the three contentions was inadequate. The Board stated that a nexus would have to be shown in regard to occurrences involving other TDI diesels by a showing that the particular concern arising from the particular occurrence would be relevant to the Shoreham EDGs. For any other occurrence, the Board required the County to show there was a basis for believing that the occurrence was so significant and so adverse that it should be considered in litigation.

In Part II of its Filing, the County has chosen to provide nothing more than it provided in its January Supplemental Contentions.[14/] The County has listed some occurrences at Shoreham, but has failed to provide even a brief explanation as to how they prove their broad contentions. The County has listed additional "common" occurrences at other TDI diesel engines with no explanation, much less with any supporting affidavits, as the Board suggested, showing how the particular occurrence is relevant to Shoreham or how the occurrence is so significant and so adverse as to be the subject of proper litigation. It is incredulous for the County to characterize Part II of its Filing as "the particularization of matters." It should be rejected.

With similar lack of specificity, the County included in Part III of its Filing a general discussion of the Owners Group Program. As an update of the Owners Group Program, LILCO appends as Attachment 16 a list of the reports issued to date. All but one of the Phase I reports have been issued.[15/] The County has been furnished with copies of these reports as well as all related correspondence and transcripts of Owners Group

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14/ In fact, the County has abandoned some of the bases cited in its supplemental contentions. To the extent they are not reiterated, LILCO considers that they will not be an issue in this litigation.

15/ As indicated above, the last Phase I report, will be issued shortly.

meetings. In addition, representatives of the County attended most of the Owners Group meetings. With this information and the assistance of consultants that have been in their employ for some time, the County had every reasonable opportunity to designate "the elements of the DRQR [that] should be added to the litigation" pursuant to the February 22, 1984 Bench Order. Ignoring the Bench Order dictates the rejection of Part III of the County's Filing.

LILCO also points out that the State did not file any separate specifications on June 11. In its Bench Order, the Board invited the State to provide its own specifications that might vary from the County's. Tr. at 21,628. LILCO considers the State's failure to file separate specifications as a joinder in the County's Filing.

The County's request to "defer the filing of testimony and commencement of EDG litigation" and its request "to obtain additional information, and encourage the Staff to obtain additional information" is completely without basis. The County has received two extensions of the discovery deadlines established on February 22, 1984. The County has had every opportunity to avail itself of Board assistance and procedures prior to June 11, 1984. LILCO must be protected from this unreasonable annoyance, oppression, harassment and frivolous conduct. A schedule for filing testimony and the evidentiary hearing should be scheduled on July 5, 1984 as ordered by the Board.

LILCO requests the Board: (1) to strike the County's supplemental Emergency Diesel Generator Contentions I, II and III or, in the alternative, to enter an Order establishing a procedure similar to that used for Contention SC-FOC 7B; (2) to refuse to admit to litigation the matters concerning the TDI Owners Group Program in Part III of the County's Filing; (3) to deny any delay in the filing of testimony and commencement of litigation based on the matters specified in Section C of Part III of the County's Filing; and (4) to deny the County's request in Part IX to obtain additional information or to encourage the Staff to seek additional information.

Respectfully submitted,

LONG ISLAND LIGHTING COMPANY

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DATED: June 21, 1984

ATTACHMENT 1

OFFICIAL TRANSCRIPT

PROCEEDINGS BEFORE

UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of:	)	
	)	
LONG ISLAND LIGHTING COMPANY	)	Docket No. 50-322-OL
	)	
(Shoreham Nuclear Power Station	)	
	)	
Unit 1)	)	

DEPOSITION OF ROBERT N. ANDERSON

Washington, D. C.

Wednesday, May 16, 1984

ALDERSON REPORTING

(202) 628-9300
440 FIRST STREET N.W

A The sprue -- you'd be pouring the metal into the sprue, so it's essentially going down to the side of the mold, through a runner, into a gate, and into my mold.

Q Do you have any opinion today, preliminarily or otherwise, as to whether or not the metalurgy involved in the AE piston skirts was correct and there is nothing wrong with it?

A No, I have no opinion.

Q Can you determine whether or not the metalurgy of the AE piston skirts is correct and there's nothing wrong with it from an analysis independent of knowing any heat treatment information?

A Well, if we are just talking metalurgy, then I have to think of chemistry and structure and heat treatment as going to address many features. The heat treating operation would be important to determine whether it's metalurgically sound.

Q Do you know whether or not the analysis conducted by FAA of the AE piston skirts was done independent of knowing any heat treatment information?

A I don't recall.

be a DRQR procedure.

Q It is your understanding that you expect to give expert testimony on behalf of Suffolk County in connection with the licensing proceedings for these diesel generators?

A Yes. I'm looking forward to it.

Q And the subject matter on which you are expected to testify will be the four matters you enumerated to me this morning?

A That's been given to me with the date. Something may be added to that or taken away from that, but that is what I expect right now to testify to.

Q And the substance of your testimony on any of those four items or categories, you are not prepared to give me any preliminary or other views or conclusions or opinions today, is that right?

A No, I haven't formed opinions. I'm going to work that up as soon as I return to California.

Q And you do not have in existence today any analyses, computations, or any other -- or tests or anything in connection with these four categories?

A No. I have materials back in my office in

California which I will look at when I return. I have nothing else. You have seen everything I have with me.

Q This is the material you will use to make an analysis and computations, if any, and to perform any tests that you consider necessary?

A Yes.

Q Are you a member of the American Foundry Society?

A No, I'm not.

Q Have you ever attempted to join?

A No.

Q Are you a member of the Steel Foundry Society of America?

A No, I'm not.

Q Have you ever attempted to join that?

A No, I haven't.

Q Describe for me, if you will, the process at TDI for making a pattern of a cast part.

A Oh, I would want to refer to my notes. As I recall, the pattern shop was more or less in the center of the building, not protected by any walls or that. They had the various items there, either out of wood or

indication. It would depend a lot on his age, his experience, and the light. And I could certainly express that opinion.

Q Do you have an opinion today, based on a reasonable degree of engineering certainty, as to whether or not the diesel generators at Shoreham are capable and reliable for fuel load and low power testing?

A No, sir, I do not.

MR. FARLEY: That's all.

(Whereupon, at 2:50 p.m., the taking of the instant deposition was concluded.)

* * *

_____

Signature of the Witness

SIGNED AND SWORN TO before me this _____ day of _____, 19 ___.

_____

Notary Public

My commission expires _____.

IANNO * ROUGH SHOREHAM 5/3

UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

----------x

In the Matter of : Docket No.

LONG ISLAND LIGHTING COMPANY : 50-322 O.L.

(SHOREHAM NUCLEAR POWER STATION, UNIT 1) :

----------x

Deposition of DENNIS ELEY, held at the Shoreham Nuclear Power Plant, Wading River, New York, on the 3rd day of May, 1984, at 9:50 o'clock a.m., before Thomas R. Nichols and John Ianno, Jr., Notaries Public of the State of New York.

LILCO, June 21, 1984

CERTIFICATE OF SERVICE

In the Matter of
LONG ISLAND LIGHTING COMPANY
(Shoreham Nuclear Power Station, Unit 1)
Docket No. 50-322 (OL)

I hereby certify that copies of LILCO's Response to Suffolk County's Filing Concerning Litigation of Emergency Diesel Generator Contentions were served this date upon the following by first-class mail, postage prepaid, or by hand, as indicated by as asterisk:

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DATED: June 21, 1984

will render an opinion on everything except the cylinder heads, that we have gone over?

When I say you, I'm referring to you individually, and not ocean fleet.

A. I believe in the time constraints that we are in at present, my ability to do so will be impaired.

Q. Do you have any plans to ask others at Ocean Fleets to assist you in rendering opinions on these components?

A. Yes.

Q. Are those firm in your mind at this point in time?

A. No.

Q. Have you reached conclusions or opinions on any of these components?

A. Not final conclusions, no.

Q. Have you reached preliminary conclusions on any of these components. My preliminary conclusions on the crankshaft is that it is overrated. It is undersized with regards to Lloyd's Rules and Regulations, but I still have additional data to get before I can finalize that conclusion.

A. I don't recollect the name.

Q. Did that person occupy any particular position at ABS?

A. Yes, I was he was in the design department.

Q. Do you have any opinion, sir, satisfactory to yourself, regardless of what ABS's position is, whether or not shot peening of the fill either has any effect on the strength of the crankshaft?

A. I think it can be problematic. I do believe that the depth of the shot peening is inadequate to create any positive effects and I do believe, also, that it can have deleterious effects if not done correctly.

Q. Let's take each one of those things at a time, if we may.

What do you know the depth of the shot peen to be?

A. I can't recollect offhand. It is a matter of thousandths.

Q. Thousandths of an inch, is that what you are referring to?

A. Yes.

Q. Did you say it was your opinion that the shotpeening was inadequate, before I told you --

A. Little Company had the shotpeening done twice. If it was adequate the first time, why have it done twice? If

If it wasn't inadequate the first time, why --

Q. Are you prepared to tell me today that the shotpeening on the replacement crankshafts is inadequate?

MR. MILLER: That was just asked and answered. You just asked him the same question.

MR. STROUPE: I want the answered again.

MR. MILLER: I object.

Q. You may answer the question.

A. In my view, I don't believe the shotpeening would give any credit with regard to a classification society's requirement.

Q. That's not what I asked you.

A. Would you repeat the question?

Q. Yes, I'd be happy to. Is it your opinion, today, based on what you know, that the shotpeening, as it presently exists, on the replacement crankshaft, is inadequate?

A. I can't make a judgment on that issue at the moment.

Q. You don't have an opinion at this time?

A. I don't have an opinion at this time.

6** Q. The second thing I wanted to discuss with you that you mentioned a moment ago, was that shotpeening can be -- how did you phrase it, deleterious?

A. Yes.

Q. What did you mean by that?

A. If it isn't -- I have again read a report which says that it must be done under strict, very strict conditions, and if these conditions are not met, it may produce some surface disparity which would be deleterious.

Q. Do you know what the conditions were under which the replacement crankshafts were shotpeened?

A. No.

Q. So, you are certainly not prepared to offer any opinion today, are you, sir, that any shotpeening that was done on the crankshafts could be deleterious?

A. I have not cited the crankshafts, nor

have I information?

A. I have not sighted the crankshafts, nor have I information on the shotpeening process that was performed.

Q. So to say again, you are not in a position to render an opinion on that?

A. Not today, no.

Q. Did you consider or do you consider in your calculations, Mr. Eley, the effect of the change in the design of the filets on the crankshaft?

A. The dimensional changes that the filets do change some of the formula.

Q. What about the curvature?

A. With the drawing, that I have had made available to me, in -- by TDI, I have used that data in the formulae. I am unaware as to whether those filet radii have changed from that drawing.

Q. Do you have any information, Mr. Eley, as to why the filet radius has been changed on the replacement crankshafts?

A. Not that I'm aware.

Q. Would that impact upon or affect any opinions or conclusions you might have as to the

adequacy of the crankshaft?

A. Are you talking now about the changing filet radii between the new shaft and old shaft?

Q. Yes.

A. I am aware that there is a change there. I thought you were talking about a change in the filet radii from the drawing on the new shaft to the actual manufacture of that shaft, if you understand what I mean. Has there been any change on the filet radii?

(Discussion off the record.)

Q. I was referring to the change in the filet radii, between the 13x12 crankshaft and 13x11. Does that eliminate the confusion now?

A. Yes. I recollect there has been some change to that filet radii.

Q. Did you, in any way, consider that, or did that, in any way, impact upon your conclusions with regard to the adequacy of this crankshaft?

A. Not that I can recollect.

Q. So, as far as you can recollect --

A. I haven't made any changes to my formula as of yet.

Q. Do you intend to make any changes to

ATTACHMENT 3

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION
BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of : Docket No.
LONG ISLAND LIGHTING COMPANY : 50-322 O.C.
(SHOREHAM NUCLEAR POWER STATION, UNIT 1) :

Deposition of ANEESHI BAKSHI, held at the Shoreham Nuclear Power Plant, Shoreham, New York, on the 2nd day of May, 1984, at 10:05 o'clock a.m., before Thomas R. Nichols, a Notary Public of the State of New York.

who?

A. I don't recall who did that or who. Maybe TDI. But these engines were rated for a different rating. I remember having read that. And the rating was increased, sort of test bed procedures were carried out, as far as I can remember, when all the components were fitted together again. They were put at random off and on. Maybe part of it, what I have said, is what I heard. But a part of what I said I have read.

Q. Have you had occasion, Mr. Bakshi, to review or to have access to the various preoperational test reports for the emergency diesel generators that have been conducted subsequent to the time the cylinder heads were replaced?

A. Not at this stage, no.

Q. Are those reports that you would be interested in?

A. Probably would be.

Q. Those reports could have some data, I take it, that would be very valuable in assessing cylinder heads, because it would give you operating experience, would it not?

A. I would probably like to go into the design aspects of the cylinder head.

Q. But you're not interested in operating experience?

A. Oh, yes, that's very crucial also, sure.

Q. At this point in time you have not had access to that operating experience.

A. Operating experience data I think I have not had a look at that, yes.

Q. Other than the report that you site in this memorandum, have you had access to any design data with regard to the cylinder heads?

A. No. I would like to get ahold of that, if possible.

Q. Would it be fair to say, Mr. Bakshi, that the data that you're operating on right now with regard to the cylinder head is either data that Mr. Eley has furnished you or data that you extracted from this report referred to in your memoranda?

A. I have been through a lot of documents, like the component tracking system, you know, a lot of other documents, trying to sift material off this thing, which he may have just given, said

"Go through this." There are so many documents. He said, "Just go through them, see if you can find anything on cylinder heads. I would like you to focus on the cylinder heads," so that's what I was doing.

Q. What I am asking you is with regard to assessing the present cylinder heads that are on the diesel generators at Shoreham, the only data that you have is the data that you have been furnished by Mr. Eley or the data you extracted from this report, is it not?

A. I may have read more on cylinder heads from the data which I took from the experience.

Q. You can't recall at this point in time or tell me what those reports were.

A. No, just a glance going through the documents, trying to get them to one side and at a later date to review them. I haven't had a chance to do that yet.

MR. MILLER: Maybe this will help in clarifying your questions. During the last week or so Mr. Bakshi along with other consultants for the county has reviewed a lot of documents. A lot of those documents have been supplied by TDI,

LILCO. A lot of documents have been reviewed.

The documents number, I guess, in the tens of thousands. It's not a few hundred. It is a lot. That being the case -- I can make these points later if you want, but I think it would help for you to understand that Mr. Bakshi has seen a lot of documents.

I think what he is saying is that he can't recall where he has seen certain things, which is understandable in the light of the number of documents being reviewed, but he has seen a number of documents prepared by a number of different people, primarily TDI, but also LILCO.

Q. Let me move on for a moment to other areas.

Let me ask you this. Other than the calculations that you did for Mr. Eley on the crankshaft and other than the cylinder head work that you did, have you had occasion to form any opinions or conclusions or render any opinions or conclusions with regard to any of the other components of the Shoreham emergency diesel generators?

A. Since I have not had an opportunity to

review the other components, you know, but from what I have heard and where I have glanced at various documents, I have made some kind of a preliminary opinion about the generators as a whole.

Q. Just as a whole?

A. Generally, yes.

Q. Let me backtrack for just a second.

In doing that did you form any preliminary opinions or conclusions about any of the components of the diesel generators?

A. Nothing in particular, because I haven't really gone into depth with any of the particular components.

Q. How about the cylinder heads?

A. I still have to do a lot of study on the cylinder heads before I can say definite this is X, this is Y, this is my results, and I still have to do that kind of thing.

Q. So you haven't formed even a preliminary opinion on cylinder heads?

A. No, not as such. Not on cylinder heads as such.

Q. If I might take a moment, let me run

through a few of the components and ask you the same questions.

Have you looked at pistons?

A. No.

Q. Have you looked at the jacket water pump?

A. No.

Q. Have you looked at cylinder head studs?

A. No.

Q. Connecting rod bearings?

A. No.

Q. Rocker arm cap screws?

A. No.

Q. Air start valve cap screws?

A. No.

Q. Fuel lines?

A. No.

Q. Turbocharger?

A. You're asking me if I formed any opinion on that?

Q. Yes.

A. I did read a document while going through the component tracking system regarding that there were a lot of failures on the

turbocharger. They had problems with their lubricating system. So they put such kind of a component, even if it was of an outside vendor, without having really done any test bed procedures prior to putting it on. This is the opinion I have formed on that particular component, but nothing else.

Q. Well, do you know for a fact that there were no test bed procedures with regard to the turbocharger?

A. I haven't had access to them yet. There may have been some definitely.

Q. So when you say you could not believe they had done this without test bed --

A. Correct test procedures.

Q. You don't know what the tests were, if in fact there were --

A. I feel if they had been done correctly this kind of a problem would not have existed.

Q. What do you know about Elliott turbochargers? Have you ever heard of them before?

A. Yes, I have.

Q. Would it be fair to say that they are a major turbocharger manufacturer?

A. A number of things -- the pins, crank pins, if have crankshaft fractures. The crankshaft has twisted, on the webs. There have been complete crankshaft failures that have broken to a couple of pieces.

So there's a range of failures which have occurred.

Q. Are most, if not all, marine application diesels, at least as far as propulsion systems go, Mr. Bakshi, variable speed engines?

A. No. Fixed speed.

Q. They are all fixed speed?

A. The generators are all fixed speed.

Q. I am talking about the main propulsion system, not the auxiliaries.

A. Not all of them. 75 to 80 percent of them are variable speed, and the remaining are fixed speed.

Q. Would you agree with me that marine application diesels are subjected to heavy service requirements, heavy loading requirements?

A. Yes and no, both, yes. Depends on what kind of load and what size of the vessel it is, things like that.

same thing.

A. Yes.

Q. You don't mean to imply, do you, that marine application diesels and stationary diesels are subjected to the same sort of stresses?

A. I am not talking about stresses or anything. Just talking as a diesel engine, principle of diesel engine. And the components which are on a diesel engine on a ship or on a nuclear plant basically are the same. These may require in certain aspects more stringent regulations. Diesel may require more in certain other aspects.

Q. The fact that a diesel engine is moving with a ship brings certain other problems into play, does it not?

A. May bring. Not necessarily.

(Luncheon recess: 12:30 p.m.)

ATTACHMENT 4

American Bureau of Shipping

Sixty-four Broadway
New York, N.Y. 10006

Refer to RTW:ml
File Ref T8-3

3 May 1984

Transamerica Delaval DSR-48 Diesel Engine/Generator
for Long Island Lighting Company Shoreham Plant
Report on Crankshaft Torsional Stresses.

Transamerica Delaval Inc.
Engine & Compressor Division
550 85th Avenue
P. O. Box 2161
Oakland, CA 94621

Attention: Mr. Roland T. M. Yang
Manager Applied Mechanics.

Gentlemen:

We have your letter of 3 April 1984 submitting copies of the above subject report for our review, and with regard thereto have to advise as follows:

We note from the submitted report that the torsional vibration stress in the crankshaft for the first mode 5½ order critical speed (422 RPM) was expected to approach or exceed that permitted by the Rules for the submitted crankshaft material.

We further note from the submitted report that tests were conducted to determine the actual stresses in the crankshaft, and that these tests indicated a substantial margin of safety against fatigue failure due to torsional vibration.

Based on the submitted test data, and on submitted service experience with similar engines having similar torsional critical speed arrangements, we advise that we would have no objection to the submitted torsional critical speed arrangement for use on diesel generator sets on an ocean going vessel, insofar as our classification requirements for marine service are concerned.

Three (3) copyies of the subject report, stamped to indicate our review, are being returned.

Very truly yours,

AMERICAN BUREAU OF SHIPPING

W. M. HANNAN
Vice President

by: Robert A. Giuffra
Robert A. Giuffra
Principal Surveyor - Machinery

G.E.T. S.O. A.R.F. R.T.Y. M.H.L. C.R.C.
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cc: LILCO. (E. Montgomery)
Accounting Dept. w/enclosure
Legal Dept. (M. Adams)
Subject File 460

ATTACHMENT 3

UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of : Docket No.

LONG ISLAND LIGHTING COMPANY : 50-322 O.C.

(SHOREHAM NUCLEAR POWER STATION, UNIT 1) :

Deposition of ANEESHI BAKSHI, held at the Shoreham Nuclear Power Plant, Shoreham, New York, on the 2nd day of May, 1984, at 10:05 o'clock a.m., before Thomas R. Nichols, a Notary Public of the State of New York.

who?

A. I don't recall who did that or who. Maybe TDI. But these engines were rated for a different rating. I remember having read that. And the rating was increased, sort of test bed procedures were carried out, as far as I can remember, when all the components were fitted together again. They were put at random off and on. Maybe part of it, what I have said, is what I heard. But a part of what I said I have read.

Q. Have you had occasion, Mr. Bakshi, to review or to have access to the various preoperational test reports for the emergency diesel generators that have been conducted subsequent to the time the cylinder heads were replaced?

A. Not at this stage, no.

Q. Are those reports that you would be interested in?

A. Probably would be.

Q. Those reports could have some data, I take it, that would be very valuable in assessing cylinder heads, because it would give you operating experience, would it not?

A. I would probably like to go into the design aspects of the cylinder head.

Q. But you're not interested in operating experience?

A. Oh, yes, that's very crucial also, sure.

Q. At this point in time you have not had access to that operating experience.

A. Operating experience data I think I have not had a look at that, yes.

Q. Other than the report that you site in this memorandum, have you had access to any design data with regard to the cylinder heads?

A. No. I would like to get ahold of that, if possible.

Q. Would it be fair to say, Mr. Bakshi, that the data that you're operating on right now with regard to the cylinder head is either data that Mr. Eley has furnished you or data that you extracted from this report referred to in your memoranda?

A. I have been through a lot of documents, like the component tracking system, you know, a lot of other documents, tryirg to sift material off this thing, which he may have just given, said

"Go through this." There are so many documents. He said, "Just go through them, see if you can find anything on cylinder heads. I would like you to focus on the cylinder heads," so that's what I was doing.

Q. What I am asking you is with regard to assessing the present cylinder heads that are on the diesel generators at Shoreham, the only data that you have is the data that you have been furnished by Mr. Eley or the data you extracted from this report, is it not?

A. I may have read more on cylinder heads from the data which I took from the experience.

Q. You can't recall at this point in time or tell me what those reports were.

A. No, just a glance going through the documents, trying to get them to one side and at a later date to review them. I haven't had a chance to do that yet.

MR. MILLER: Maybe this will help in clarifying your questions. During the last week or so Mr. Bakshi along with other consultants for the county has reviewed a lot of documents. A lot of those documents have been supplied by TDI,

OFFICIAL TRANSCRIPT

PROCEEDINGS BEFORE

UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of:	)	
	)	
LONG ISLAND LIGHTING COMPANY	)	Docket No. 50-322-OL
	)	
(Shoreham Nuclear Power Station	)	
	)	
Unit 1)	)	

DEPOSITION OF SIMON K. CHEN

[redacted], D. C.

Tuesday, [redacted] 15, 1984

crank for the Shoreham unit. At that time I believe the 11-inch crank had already shown cracks and things like that.

So they said well, please come to the side and tell me whether LILCO has done the right thing in replacing the crank and so forth. That was October of last year.

Q There were three?

A That was the first part of it.

Q There were three replacement crankshafts, correct?

A I believe yes. They are all replaced. All have been replaced. All three crankshafts have been replaced.

Q And the design of the replacement crankshafts encompassed a crank pin of approximately 12 inches in diameter; is that correct?

A The nominal size of the replacement crank pin is 12-inch.

Q And you say you did some calculations about the replacement crankshafts, right?

A Yes, sir.

Q What were those calculations?

A Those were primarily dealing with the torsional calculations, whether they would survive under the load conditions given and as well as whether they were -- satisfied DEMA-suggested or recommended stress levels.

Q What were the load conditions given to you to measure these calculations against?

A The horsepower was given to me, was rated at 3,500 KW and there are 225, plus or minus a few -- it's 225 BMEP per cylinder at 450 rpm.

Q And these calculations to see whether the torsional vibration at that load level would be a problem?

A Well, the calculation is a fairly common industrial accepted procedure in predicting or analyzing the suitability of crankshaft for that particular application.

Q Against what standard? Was there some kind of standard?

A Oh, the standards basically -- there are all kinds of standards involved, but as far as to talk about

stress output it's a stress limit. Last November or October I used the DEMA standard because that is the only applicable standard for this application.

Q Why do you say the DEMA is the only applicable standard?

A It is.

Q Where did you get that information?

A It's in the contract. It's cited in the contract.

Q Is there a DEMA standard for torsional vibration?

A Yes, sir.

Q How is that expressed?

A It is expressed to be, oh, I hate to say this. I cannot recall the exact term, but -- although I was the technical chairman of the committee who prepared the doggone thing some years ago. It says that for single order, the torsional stress, nominal torsional stress should not exceed 5,000 pounds, and for some order should not exceed 7,000 psi at the rating, intended rating.

And it says something like -- that's for the

stationary. I think we're talking about stationary.

Q Now before you performed this calculation with respect to the DEMA standard, how did you fix the basic stresses on the crankshaft?

MR. STROUPE: Objection to the form of the question.

THE WITNESS: How do you fix?

BY MR. DYNNER: (Resuming)

Q How did you determine the basic stresses on the crankshaft if you did?

A Please define "basic stres.". We're talking about calculating torsional stress.

Q I'm talking about stresses other than the torsional. Did you calculate bending stress, for example?

A I did estimate bending stress. I think if you will go back, sir, to the formulations of those limits, why DEMA used 5,000 pounds, why ABS used 5,000 pounds, if you go to the history of the calculations you will find out that these nominal stresses are very low compared to what the crankshaft can really do. They were designed very conservatively to take into

account -- pardon?

Q Go ahead.

A To take into account other stress when the crankshaft is designed by a qualified designer.

Q Did you do the calculation for the 11-inch crankshaft?

A Yes, I did.

Q And what were the results of that calculation?

A It should fail on the fourth order torsional stress, including the bending to stress.

Q Did you take into consideration the type of material of the 11-inch crankshaft when you made that calculation?

A At that time I would just use the material strength of the 11-inch given to me by LILCO engineers. I have forgotten who I was given the material strengths of those shaft, which were called 11-inch shaft. Eleven-inch is really talking about the pin. The main journal is 13-inch. The crankpin is 11-inch.

Q Did you later learn whether or not the material specifications given to you by the LILCO

engineers were correct or not?

A I believe they are correct. Actually, these figures are in line with the -- in line with the industrial practice of a forged shaft, and they are inferior to some of the other forged shafts that I have worked with, and I am sure that information was either in the drawing or in some specification of the shaft.

And I looked at those data and considered them to be very, very reasonable figures. They are not very high.

Q Now when you did the calculations regarding the DEMA standards for the replacement crankshaft did you have a pressure/time diagram to fix various values required in the torsional calculations?

A I used a pressure/time diagram or used the T_N. I used the A tangential effort, figures, tabulation that is what I culled from reliable information.

Q What was the source of this reliable information?

A Okay. Let me go back to the 11-inch shaft. The T_N used by -- in a TDI report that I have looked

at has a T_N corresponding to what I call maybe 165, 175 BMEP engine. Then, if I used a commonly acceptable T_N from a reliable source then the T_N of those 11-inch shaft should have been much higher.

A reliable source I am talking about happened to be from the Lloyd Register -- Lloyd table shown in the Lloyd Register. I did have to extrapolate linearly about ten, 20 BMEP or so of that data because Lloyd is not an up-to-date code, so they only go up to 200 BMEP. They don't go over 200 BMEP. So I have to extrapolate from 200 BMEP to 225 BMEP linearly, which I consider very conservative.

In other words, Lloyd came out and said if you don't have any good time/pressure diagram you use this T_N, which is the case. I did not have good time/pressure diagram. I have requested good time/pressure diagram. I did not have it at that time.

Q Do you have one now?

A I do not have one, no. I used the T_N from Lloyd and compared that with some other T_N figures for other engines. I find that Lloyd figures are reasonable.

Q Have you seen what you consider to be a good pressure/time diagram?

A I do it all the time when I work on engines.

Q No, no -- for this engine.

MR. STROUPE: You mean for this engine?

BY MR. DYNNES: (Resuming)

Q You said you don't have one. Now I ask if you have seen one or if you know whether anyone else has one.

A I did not see a good, reliable pressure/time diagram from the TDI engine.

Q Do you know whether any exists?

A Well, it's referred to in some of their reports, yes.

Q Some of the FAA reports?

A Yes, sir. I might add that those T_N are used for the 12-inch shaft and compares very close within a few percent with those T_N figures shown in the FAA report, as well as those T_N figures shown by the torsional calculation report made by TDI for the 12-inch shaft.

Q What was the date of the Lloyd's code you

used?

A I don't remember the dates. I can go back and find the copies and give you a copy of it.

Q Do you think it was the most recent Lloyd's code?

A I don't know the dates. It's a Lloyd's register that happens to be in my possession, and I believe it is fairly decent, a fairly recent book.

Q Now in making your calculations concerning the replacement of crankshafts how did you consider the condition when resonance would occur, if you did?

A The commonly-acceptable methods, which is the Hoser calculations, so in my possessions I have computerized Hoser calculations. So you put the thing in. You get the natural frequencies in very short term -- first mole, second mole, third mole.

Q Did you calculate your own T_N, suff N for the purposes of these calculations?

A I believe I have answered the T_N I used, which I relied on, was the Lloyd figures. And I compared those figures with the TDI figures I believe by Mr. Rollingen and the figures by Paul Johnston and Dave

Check within ten, fifteen percent, which is about as accurate as you can get for these kinds of figures.

Q Dr. Chen, do you know what T suff N means?

A I don't know what --

Q That is T, s-u-f-f, N -- T, suffix, N.

A I don't know.

Q What were the results of your calculations on the replacement crankshafts with respect to the DEMA standard?

A I believe I stated that it satisfied the DEMA standards. I did more than that. I also believed that the crank is good for its intended service.

Q What standards did you use for establishing its intended service?

A I have calculated the torsional stress. I have checked the overall design and I even go beyond that and check against my own software about how a crankshaft should be designed.

Q What are the standards for its intended service?

A It goes beyond its intended service. For instance, I checked against ABS standards.

Q What is its intended service?

A For the ABS?

Q For the replacement crankshafts?

A For the stationary diesel engine, based on the DEMA standard, which is an engine, if its rating is 3,500 KW it should run, should be capable of running two hours out of 24 hours at overload, 110 percent BMEP condition.

Q What were the sum of the orders you calculated for the replacement crankshaft?

A Sum of orders you have to define. Sum of orders, again you have to go back to history. What do you mean by "sum of orders"?

Q Well, you just told me that the DEMA standard was that the sum of orders must not exceed 7,000 psi, didn't you?

A Yes, sir.

Q What were the sum of orders you calculated?

A Sum of orders specified in DEMA. You have go to back to history. That DEMA handbook was written in the 1960s, I believe. It's revised. The latest revision is 1972 or '73, somewhere around there, and the

sum of orders at that time is the sum of orders, the term used by the industry at that time. If you ask me what I think of sum of orders at that time, I would say that based on the instrumentation and the calculation at that time, using force vibration type of calculation and using, considering first load, considering six or eight orders of vibration and you add those orders up vectorally and that is a very conservative sum of orders calculation.

But the industry at that time would use other calculations to get the sum of orders, so it is not something that you can -- so any time when you talk about those figures you have to talk about the methods used, sir.

Q Dr. Chen, my question is a simple one. You have testified that under DEMA standards the sum of orders are not to exceed 7,000 psi. I'm asking you under your calculations you did what were the sum of orders? Did it exceed 7,000 psi?

A No, it did not.

MR. STROUPE: Objection. He already answered that question.

THE WITNESS: It's under the DEMA standards, accerding to my very --

MR. STROUPE: Simon, give me a chance to object. Go ahead, sir.

BY MR. DYNNER: (Resuming)

Q Dr. Chen, do you recall if the number for the sum of orders that you calculated did not exceed 7,000 psi? Do you recall what the psi number was?

A Okay. My best recollection is I made several calculations. I made sum of orders for four significant orders. I made calculations for six significant orders. I made calculations for 12 significant orders. The reason I go to 12 is because Failure Analysis used -- I think they used 21.

So I have to use more orders to see whether my figures get closer to what they have, and it was the 12 orders, which takes quite a bit more computer time. It, I believe, is 65, 6600 psi.

Q What was the number using six orders?

A 63, 64, somewhere around there.

Q And with four orders?

A 61. This is based on my memory, but I

remember that I have gone beyond the routine calculations to get to the 12 orders, because the industry does not use that many orders.

Q Did you say FAA used 21 orders?

A Much bigger figures. They have a much bigger computer. They are much more conservative, so they used many orders.

Q Did you take half orders?

A What do you mean "half orders"?

Q Half orders.

A .5 order?

Q Yes.

A Yes, I considered .5.

Q Did you take all the half orders in making your calculations of 12?

A Okay. Let me tell you, okay? Maybe if I tell you that I used -- usually the TORVAP calculations use six orders. I run them twice to get the 12 orders. TORVAP stands for torsional vibration program, which is a --

Q Go ahead. Go ahead.

A You asked me a question. I would like to talk

to you so you cannot do two things at one time. The TORVAP I make more than one calculation, but the calculations on TORVAP is based on the Lloyd -- based on the Bassara calculations which also incalculates the Lloyd requirements and is a common domain torsional vibration calculations published by CAD Company, United Kingdom and it's used under license by -- today by the SDRC group and also the COMSHARE group, the COMSHARE computer company.

COMSHARE means -- it's a name. C-O-M-S-H-A-R-E company, which is a software firm which supplies the common domain crankshaft calculations.

The reason I did not go back to my filing use and change calculation is because it's proprietary calculation. So I used the commonly-acceptable calculations, developed, frankly, by a very good organization that I have some respect of, which is accepted by Lloyd's, so far as I know. They use Lloyd figures.

Q Did you make any calculations concerning the replacement crankshafts under Lloyd's code?

A I did not use the Lloyd code. I used the

methois they recommended. Let's put it this way.

Q Why didn't ycu use the Llcyd code?

A Why would you want to use the Lloyd code?

Q My question is why didn't you use the Llcyd code?

A The Lloyd code has no relevancy on this application. The Lloyd --

Q Go ahead.

MR. STROUPE: Go ahead and explain your answer.

THE WITNESS: In my life I don't use the Lloyd code because I'm a USA company, number one. If I want to apply that engine tc a ship, I use American code, the most up-to-date code, the ABS code. In my life I have never been asked to use the Llcyd code because all the owners are very happy with the ABS code. I use cther codes, but not the Lloyd code.

BY MR. DYNNES: (Resuming)

Q What is the basis for your statement that the ABS codes are more up-tc-date than Lloyd's?

A The latest code is published this year. You have revisions in there.

Q What are the revisions concerning crankshaft dimension?

A Crankshaft calculations? There's a few pages of it. I don't remember the detail, but it goes through that and you find out that they will take care of the latest design of the crankshaft.

Q Did you do calculations on the replacement crankshafts to see if they complied with the ABS code?

A I did.

Q And what were your results?

A My results would say that this engine has no problem for stationary applications. It's unqualified approval under the ABS rules for stationary pumping -- if it's for stationary pumping, let's put it that way, for generator sets, for example, on shipboard.

Q Did your calculations take into consideration operation of the crankshaft in engines operating at 3,900 KW?

A I did calculations. I think my calculations shows that all that's required to do for the ABS and ABS requests you to do only ratings at the continuous rating, so I do it for continuous rating, but they do

require you to check against other speeds, because it's basically for a marine engine, so they ask you to check overspeed conditions and underspeed conditions. I did check that, sir.

Q What was the maximum pressure, firing pressure, in the cylinder that you used in your calculations?

A I believe I answered that. I used the Lloyd figures, the T_N listed in the Lloyd register calculations, the chapter that deals with the crankshaft calculations.

Q Do you know what the maximum firing pressure in the cylinder that you used in psis to do your calculation?

A If you go back to Lloyd, Lloyd does not specify maximum firing pressure because they are conservative. They used a BMEP figures. I believe I mentioned that. If you have firing pressures, then use the firing pressure indicated diagram. If you don't have an indicated diagram, then one will go to use the Lloyd figures. It is a common acceptable practice by the Lloyd group.

Q Are there ABS figures comparable to the Lloyd figures that you used?

A No. I used the Lloyd figures for ABS calculations.

Q I understand, but my question is are there ABS figures comparable to the Lloyd figures that you used?

A There is no tabulation as such in the ABS and the ABS will say that the company should generate its own pressure/time diagram.

Q Did you have any discussions with any personnel from ABS concerning your findings?

A No, I have no discussion with them, but I attended one of the meetings together with Mr. Yen and Mr. Montgomery. I have attended one ABS meeting together with Mr. Roland Yen of TDI and Gene Montgomery of LILCO, as well as Paul Johnston of Failure Analysis, and the date I don't remember. It was sometime in March, I believe.

Q What was the purpose of that meeting?

A LILCO management wants to be sure that I know what I'm talking about. I don't know. They say, well, you really know the new rules? I said, well, I think I

ATTACHMENT 6

OFFICIAL TRANSCRIPT
PROCEEDINGS BEFORE

UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of:	)	
	)	
LONG ISLAND LIGHTING COMPANY	)	Docket No. 50-322-OL
	)	
(Shoreham Nuclear Power Station	)	
	)	
Unit 1)	)	

Deposition of RALPH CARUSO

Washington, D. C.

Thursday, May 31, 1984

ALDERSON REPORTING

(202) 628-9300
440 FIRST STREET, N.W.

submitted to us, which you have a copy of, and which the staff is currently evaluating.

Q Now, with regard to the AE pistons, is it your understanding that that is a new design different from the AF piston?

A In the sense that it is the same diameter, it fits the same cylinder, it fits the same connecting rods, the crowns are the same, the compression is the same, the stroke is the same, it is not radically different, but it is different in the sense of a bolting of the crown to the piston in the area -- excuse me -- it is different in the area where the bolting attaches the crown to the piston. The metal distribution has been changed.

Q I think you said it is not radically different. Would you consider the differences between the AE and the AF piston design to be significant?

A I think it would depend upon the application.

Q Well, the application being to run those pistons and piston skirts in the Shoreham engines.

A I'm not an expert on piston design, but I would say it is not radical.

Q Is it significant? Is the difference significant?

A I couldn't say.

Q Are you aware of matters concerning the stress concentration in the crown of the AE piston?

A No.

Q You have never expressed any concern about the stress concentrations on the crown?

A No, not that I know of.

Q Are you aware of alterations that were performed on the AE pistons prior to the time they were installed in the Shoreham engines?

MS. TARLETZ: Objection to the form of the question, if that is a hypothetical. I don't think the record has established that there were any alterations before the piston was installed.

THE WITNESS: The only alteration that I know of involved the fact that in the area where the bolt holes were machined, a small lip of metal had been left on some pistons right in that area, and there was some concern that might act as a stress riser, and those small lips of metal have been ground off. That is the

only change that I am aware of.

BY MR. DYNNER: (Resuming)

Q Do you know whether those lips of metal appear in the design drawings for the AE piston?

A I'm not certain whether they do or not.

Q If they did appear in the design drawings and had been ground off, as you stated, would that procedure have complied with Appendix B requirements?

A You're asking me a complete hypothetical. I mean I don't know whether those lips are required, and it is entirely possible that removing them could be done in a manner which was consistent with Appendix B.

Q Do you know whether it was done in a manner consistent with Appendix B?

A No, I am not familiar with the details of that removal.

Q Do you have any opinion as to whether that alteration might affect the operability or reliability of those pistons?

A No, I do not have any opinion on that.

Q Is that matter being reviewed or investigated by the NRC staff or its consultants?

A The staff is cognizant of it, and I understand that some of our consultants thought that that was what should be done; that that was an acceptable -- indeed, they thought it was the right thing to do, because I understood that the lip was just there because in the process of machining just a thin -- this is my understanding, and I don't know this from firsthand knowledge -- but when you cast a part, the casting surfaces are not always exact.

There is always some tolerance on how much metal you have in a certain area. When you machine it, you machine it to certain specifications, and it is possible that if you have more metal in a certain area, when you machine it you might leave a little fin, for example, a fin of metal in a certain area, because the machining process is much more precise than the casting process.

And in some applications it might be critical to remove that fin. In other applications you might want to remove it for personnel safety point of view because somebody has to stick their hand in there, and they may get cut on the fin. In other cases, you might

not care at all whether it was there.

And in this case I understood that our consultants thought that it would be a good idea to remove that fin because it might act as a stress riser.

Q Do I understand your answer to mean that no further review or investigation is being conducted of that alteration?

A The staff is reviewing the piston report which was submitted by the Owners Group.

Q And the piston report doesn't say anything about grinding off this fin, does it?

A I do not know whether it does or not.

Q Have you read the piston report?

A Not entirely, no.

Q Has the staff reached any preliminary views concerning this AE piston report?

A Not that I know of.

Q You haven't discussed it with anyone?

A The staff had a number of questions about a preliminary piston report which was issued during the winter, and they were discussed at meetings which were held on Long Island, which I think you attended.

Q I'm talking about the May piston report, the latest one.

A We just received it last Thursday, and as far as I know, no one has any comments.

MR. GODDARD: Off the record.

(Discussion off the record.)

MR. DYNNER: Let's take a five-minute break.

(Recess.)

BY MR. DYNNER: (Resuming)

Q Mr. Caruso, has the NRC staff had any communication with the American Bureau of Shipping concerning the replacement crankshafts in the Shoreham engines?

A Not that I know of.

Q Have you reached any preliminary opinions concerning the reliability of the Shoreham diesels?

A I think the staff expressed its position back on February 22nd at the Licensing Board hearing on this matter, and I don't think that position has changed since then, because the staff has not yet completed its review of all 16 of the significant problem reports by the Owners Group and has not yet received the DRQR

(Discussion off the record.)

MR. DYNNER: I have no further questions.

EXAMINATION BY COUNSEL FOR LILCO

BY MS. TARLETZ:

Q Mr. Caruso, my name is Darla Tarletz from Long Island Lighting Company.

Mr. Dynner asked you a few questions about indications in the area of the cam galley. How long have you been aware of those, the existence of those indications?

MR. DYNNER: Objection. I never used the word "indications." I used the word "cracks."

MR. GODDARD: Staff joins in the objection to the question as asked.

THE WITNESS: Cracks, indications -- since the fall of last year.

BY MS. TARLETZ: (Resuming)

Q And has the NRC staff been working with LILCO in a program of monitoring those indications?

A Not that I know of specifically. Not that I know of firsthand. I understand, though, that our consultants don't think that those cracks or indications

are significant. I'm not familiar with any monitoring program that might have been instituted, that might have been started by the resident inspector. But I'm not familiar with any specific program that he is involved with.

Q And Mr. Dynner also asked you several questions about the cracks in the block and the standards that you may have developed to review the cracks in the block. Would you agree with me that any criteria is developed on a case-by-case analysis as the information is made available for your review?

A I don't know that I would necessarily put it quite that way. I think my statements to Mr. Dynner are pretty clear; that the staff has not yet received its -- a copy of a report evaluating those cracks. And the staff will review any explanations that are put forward by LILCO or the Owners Group regarding the cause of these cracks, and will review any suggested corrective action if any is needed, and will review any justification for not taking any action, if that is proposed.

And the staff has hired some eminent

consultants, and we will rely to a great extent on their expertise in helping us to determine whether the arguments put forth by the Owners Group and LILCO satisfy us.

Q And in order for you to formulate an opinion as to whether that information satisfies you, is it necessary for you at this time to have a pre-established or set criteria or standard by which you review that information?

A No, I don't think so. Sort of by definition when you're exploring the unknown, you don't know what you expect to find.

Q And is it possible, either in the hypothetical or with your experience in the industry that a component or a machine can be licensed, even with the presence of a crack in a certain component?

MR. GODDARD: Objection. I think that is too vague to answer. If you would like to relate that to the specific cracks we're talking about, do so.

THE WITNESS: Could you repeat the question again?

BY MS. TARLETZ: (Resuming)

Q Yes. Either in the hypothetical or based on your experience in the industry, is it possible after a review of, for instance, in this case the cause of a crack, that an engine or a particular component could be determined to be reliable, and an engine licensed even with the presence of a crack?

MR. GODDARD: Same objection. What cracks are we talking about?

THE WITNESS: I think I can answer the question. You are asking me generally cracks. I mean certainly if we had a crack in the nameplate, I don't think we would necessarily object to licensing the plant. It would depend upon an evaluation of the situation, although there might be some areas where we might categorically reject a component. I'm thinking about a crack in a crankshaft, and it is very possible that we might categorically reject a crack in a crankshaft, no matter where it was or how deep it was or what it was.

MS. TARLETZ: I have no further questions.

MR. GODDARD: I have just a few questions.

EXAMINATION BY COUNSEL FOR NRC STAFF

COPY

ATTACHMENT 7

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

--oOo--

In the matter of LONG ISLAND LIGHTING COMPANY	)	
(Shoreham Nuclear Power Station, Unit 1)	)	Docket No. 50-332-OL

DEPOSITION OF CLINTON S. MATHEWS

MAY 8, 1984

VOLUME II - Afternoon Session

Reported by:

KEMBLE ANTZ, CSR 669

A. If he finds something specific that he is troubled with or pleased with, he may report. But he doesn't report on a daily basis.

Q. Now, Mr. Matthews, in your prior testimony, you indicated that the types of indications you observed on the cylinder block of the Shoreham engine you examined were common, was the word you used. In what way do you believe those indications are common?

A. In a general sense, a fairly common occurrence to diesel engine, diesel engines of our manufacture and others. And most of that or all of that experience on other engines is what I have heard from others.

I do know that it is not unusual to find that kind of crack in engines that we have manufactured that may have thousands and thousands of hours of operation and even decades of service behind them.

Q. Have you ascertained approximately how many Delaval R-4 series engines in the field have indications in the cylinder block similar to those you observed on the Shoreham engine?

A. No.

Q. What is the basis for your testimony that there are many such engines with similar indications?

A. I know of a number of them that have such indications.

Q. Please identify those.

A. The motor vessel EDWIN GOTT owned by United States Steel Corporation has two RV-16 engines. The best of my knowledge, both engines have that kind of indication in each

of the blocks.

There are two oilfield work boats known as the Motor Vessel TRADER and Motor Vessel TRAVELER, each having two engines, and to the best of my knowledge, there are indications in each of the blocks.

The Motor Vessel COLUMBIA owned by the Alaska Marine Highway Department has two RV-16 engines and each of the engines had indications in each of the blocks.

I am reasonably sure there are more, but those are the ones that come to mind.

Q. What type of engines are on the MV TRADER and the MV TRAVELER?

A. Those are R-46 engines.

Q. Is the cylinder block in the RV-16 engine the same as the cylinder block in the DSR-48 engine?

A. No, it isn't. The upper entablature of the cylinder block of the V engine is very much like the equivalent upper entablature of the in-line engine in design philosophy, materials of construction and dimensionally. It is not identical.

Q. Is the cylinder block in the R-46 engine identical to the cylinder block in the DSR-48 engine?

A. Speaking of an R-46 engine or the TRADER-TRAVELER?

Q. We can be speaking then about the TRADER and TRAVELER as compared to the cylinder block at Shoreham.

A. They certainly are not identical. The six-cylinder engine has a length suitable for six-cylinder engine and six liner boards. And the eight has eight cylinders with

eight liner boards. But they use the same cores and therefore are very similar.

Q. What is the relevance of the indications in the engines on the GOTT, the TRAVELER, the TRADER, and the COLUMBIA to the indications experienced in the cylinder block of the Shoreham engine?

A. They appear to be similar indications and I guess the relevance is that those other vessels or the other engines other than Shoreham operate either full-time or most of the time of their operating season and have accumulated thousands and thousands of operating hours.

Q. Is it your testimony that none of the indications or cracks on the vessels, the cylinder heads on the vessels you have identified have propagated or grown?

A. You said cylinder heads. Did you mean blocks?

Q. I'm sorry. I meant cylinder blocks. Thank you.

A. If these are fatigue cracks, a special form of indication, then they start life, start their existence as microscopic crack initiation sites. Then certainly to get long enough to be visible or to progress to a point where they are a half-inch long or 5/8ths of an inch long, they did in fact propagate.

The significance of citing the experience with those blocks is that the cracks didn't progress to cause any other failure or to require the blocks to be replaced.

Q. Are the operating conditions with respect to these marine application engines the same as the operating conditions to which the Shoreham engines will be subjected?

A. The rated power level is similar. The other engines don't have the rapid start load requirement of the emergency standby for nuclear power use.

Q. Is the MV COLUMBIA operated at full load, full rated load?

A. Some of the time, but not all of the time.

Q. How much of the time is it operated at full rated load?

A. I recall the number 75 percent of its operating time as maneuvering time and out of the locks, into loading and unloading docks and things like that, shallow water where it has to operate at less than full power.

Q. And during what period of time, starting now and going backwards, has the MV COLUMBIA operated at full load for approximately 75 percent of the time?

A. Its operating season is typically as I recall about 5,000 hours a year. It has completed between five and seven years of operation, I'm not sure, seasons of operation. I couldn't accurately tell you how many operating hours or how many of them were at full power.

Q. Do you know whether the owners or operators of the MV COLUMBIA have ever derated the engines on board?

A. They have either derated them or given us a contract to perform work of rerating them. And I don't really recall what the contract language said, whether it said to derate or to rerate. But the outcome of it is an engine that runs at considerably less power than the original nameplate states.

Q. Do you know how much less power?

ATTACHMENT 8

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

February 27, 1984

RECEIVED 3/7/84

BRM NOSD
JPM SNPS
LFB IO
JTM, S&W
PB, GE

NRC 545 EJ4 JMK SC33

DIST. LIST # 1/1
FILE #
LE / APE
T.R. FORM D.P. CARD

Docket Nos: See Enclosure

APPLICANT: See Enclosure

FACILITY: See Enclosure

SUBJECT: REPORT OF FEBRUARY 10, 1984 MEETING WITH REPRESENTATIVES OF THE TRANSAMERICA DELAVAL, INC. (TDI) EMERGENCY DIESEL GENERATOR OWNERS GROUP

On February 10, 1984, members of the NRC Staff met with representatives of the TDI Owners Group to discuss problems related to Emergency Diesel Generators manufactured by TDI. Enclosure 2 contains a transcript of the meeting which includes attendees. Enclosure 3 contains TDI Owners Group handouts at the meeting. Enclosure 4 contains staff comments on the TDI Owners Group Program Plan which was discussed at the meeting.

Ralph Caruso

Ralph Caruso, Project Manager
Licensing Branch No. 2
Division of Licensing

Enclosures:
As stated

cc w/enclosures:
See next page

Received MAR 5 1984
M. S. F[illegible], VICE PRESIDENT
By

SHOREHAM PROJECT

MAR 07 1984

excluded.

MR. CARUSO: Others of them might not be obvious. I think an example Bill brought out during his presentation in January was, for example, a platform. He said the platform was not included in the question. But suppose the thing falls over? What will it fall on top of? We are not asking you to do an analysis of that but we are asking you to just explain why you don't think you need to do an analysis. I was wondering if you were going to do that for things like that.

MR. MUSELER: I think what we would probably request -- we certainly could do that. What we would like, since the Staff is now going to start reviewing things in detail, is when you review the first listing of items that are excluded from the design review or quality revalidation, that if based upon your reivew of that, you determine that there is a need for us to document specifically for each item excluded why it was excluded, we would do that; but we would ask you to take a look at the first list first and see whether it needs to be done, and if you determine that you think it does need to be done, we will do it.

MR. BERLINGER: Okay.

MR. MUSELER: The second question. Gary, can you paraphase that question also?

MR. ROGERS: Question 2 relates to the attributes

and how it is that the attributes for the various components are determined. I would like to explain that process, if I might. As John Kammeyer identified, the initial component selection committee meeting goes through and identifies particular components based upon the combined knowledge of the functions of those components, and then there are some basic attributes identified.

From that point, then, there are individual specialists assigned to each component to conduct an engineering investigation of those components, and he takes that information which has been provided by the Selection Committee into consideration and begins the process of going through and establishing to the best of his ability at that point what needs to be examined: how should an engineering investigation be conducted on these particular components?

Once his review is done and there is an initial outline or scope of work with regard to that investigation -- and the task descriptions are basically that, a scope of work -- that scope of work then goes into the design review organization. It is then reviewed by me, it is reviewed by other individuals within the design review organization, it is reviewed by the diesel engine specialists that we have brought in to assist us; and at that point we would approve this scope of work.

However, even at that point that does not limit

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the extent of the analysis. The analyst would then begin his review of the component, and as part of his analysis, if he finds additional things he needs, as one would expect, as part of a detailed engineering analysis, that likewise would be incorporated into the investigation. So these task descriptions should be considered a scope of work, and the attributes that are included in here are those attributes established by several reviews of people, up to recognized specialists in the world for these individual components.

That is the process by which the design review and the attributes are established. The quality attributes, on the other hand, are intended to be a verification of those properties for the components that are necessary to guarantee the engineering organization that in fact the component as we have analyzed it is out there.

Therefore, during the initial component selection meeting we would identify some preliminary sets of quality attributes that should be verified. However, as part of the design review process, if there are additional things, if we do an analysis and we find there becomes one dimension that is critical, we then would incorporate into the program an investigation to determine whether or not that particular dimension has been achieved. Depending upon the safety associated with the investigation, that may be done on a sample basis or on a complete engine inspection, so the quality

attributes are those things that we believe are necessary to assure ourselves that the components out there being analyzed by the specialists in the engineering organization have the appropriate qualities.

MR. CARUSO: Let me just make a comment. Any Staff member who wants to join in, sing out.

MR. EMMIT MURPHY: I think the question really relates to how you go about considering the completeness of your review. Do you go in and look at a component and ask yourselves, we have a problem; where is the problem most likely to occur; where are you coming from in a different direction? You have a litany of various items to be checked for all components, and you go through item by item to determine that you have met each of the pressure limits, that you don't have a vibration problem, that you don't have smaller clearances than you assumed in the design analysis; that essentially you have addressed all the attributes that should be addressed, not just the obvious ones but ones perhaps you would not have thought of in your initial assessment of which are the most important attributes. How do you go about assuring the completeness?

MR. ROGERS: I would have to say that because of the encompassing scope of the investigation, in which we are analyzing components ranging from piping to electrical wiring, it's rather difficult to go in and establish a list of

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attributes for all components that should be examined. I believe that the completeness of attributes is a combination of the engineering experience of all of the individuals involved in the review process, coupled with field inspection service histories. All of the information, both nuclear and non-nuclear, that we have been able to assemble is the way in which we assess the complete nature of looking at the component.

I think that as part of the engineering understanding of the component and the service-induced parameters, that it must withstand vibration temperature, pressure, structural types of loadings. That is the purpose of going in and establishing the functions of the component. Then it is the analyst's responsibility and the responsibility of all of the reviewers in the process to guarantee that all of the attributes that the engineering community that encompasses those individuals that are being used in this investigation from their experience and from an engineering mechanics and mechanical engineering understanding of these components dictates what those attributes need to be.

MR. MUSELER: Let me perhaps mention a couple of examples Gary can collaborate on. If you consider the bearing situation for a moment, the task leader for the bearings is a gentleman from FAA who used to be in charge of R&D for Imperial Cleavite, a major bearing manufacturer. So his

input into what needed to be looked at came from a lot of experience in designing and trouble shooting bearing problems. FAA, on the other hand, the other gentlemen in FAA had added a slightly different dimension to it in that they identified a need to look at what potential flaw initiation points or failure initiation points and got into a more detailed finite element analysis and fracture mechanics analysis of the bearing, which is beyond what a bearing manufacturer would normally do.

I think what we are trying to convey is that the assurance, or at least we believe with a high degree of confidence that all of the attributes that need to be looked at on these components do get looked at because the people who were choosing those attributes are people who are specialists in those particular areas, and the FTV -- these are the German diesel specialists -- review all of them to ensure that, based upon their experience in designing and building engines, that that experience is factored in to looking at the right attributes.

So we cannot, frankly, show you a check sheet that shows you for each component here is a list of all of the attributes that were considered because we think, based upon the variety of components, that would probably be an endless list. But again, we think -- when you see the task descriptions, I am sure you will have questions on them -- but we think

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that that will give you confidence that the right attributes are being looked at and that the attribute selection is pretty comprehensive.

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MR. ROGERS: I guess if you were to attempt to put together a list of attributes, those lists would be put together by the same people who are responsible for conducting the investigations, and the attributes, as we have shown here from a task description and scope of work point of view, are not the only thing that would be analyzed.

As I mentioned earlier, as part of this investigation, as we get into an investigation, there certainly may be additional things that we find from that analysis need to be examined, and that, again, is an additional means of expanding the scope and assuring ourselves, to the best of our ability, that we have considered all of those things. We could then go beyond that into an aggressive testing program and an aggressive inspection program for things that -- for a combination of engineering analysis, engineering testing and inspection is the way in which we are assuring ourselves that all of the attributes of these components are being considered.

MR. CARUSO: All right.

MR. MUSELER: The third question is Craig's.

MR. SEAMAN: The third questions deals with a concern about considering individual components instead of considering a systems type review.

In response to that, then, there are several

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examples cited. I guess what I would like to say is, we are considering a systems review. It may not be apparent, because we have been talking about components all of the time, but, in fact, if you look at the design attributes culled out on the task descriptions for individual components, you will see that we are taking a systems type approach to the components, and maybe the best thing to do would be, use two examples cited in tha question here -- pneumatic control system, for one.

We have specified a systems and systems logic type review by an I&C engineer for the pneumatic control system on the engine. So that is one of the attributes that has to be verified for the pneumatic system.

Another example that I guess I would like to use is this cranking system, i.e. pistons, connecting rods, bearings, crankshaft. If you were to look at the task descriptions for these individual components -- pistons, con rods, bearings -- you will see that there are references to each of these components in this mechanical system, this mechanical interaction system, that requires input for the piston review, for example, from con rods and vice-versa. So that type of approach is being utilized.

I don't know if, Gary would have anything to add. He has certainly elaborated on the task description system in some detail.

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MR. ROGERS: I think another example, if I use that example it will lay the groundwork for several other questions put forth here, in our examination of the jacket water pump failures at particularly the Shoreham plant, not only do we understand the function of the jacket water pump and the steady-state requirements for load and temperature and lubrication and those kinds of things, but by understanding that the jacket water pump is in a complete mechanical system that initially gets its power from coming out of the pistons and goes through the crankshaft and is driven off a gear assembly in the front of the engine, we, as part of our review of the jacket water pump, are interested not only in the main service torgques going into the jacket water pumps, but also the fatigue critical aspects of the jacket water pump. And by knowing this is being driven off a gear set, we have to consider not only torque requirements for the jacket water pump, but any torsional oscillations and fluctuations that may be put into the system as it is drive off the front end of the crankshaft.

So in the examination of the jacket water pump, we not only look at the jacket water pump, but the gearing in front of the jacket water pump and the torsional response that is exciting that gearing as part of an overall systems approach to looking at the jacket water pump.

That also goes into the intermediate assembly,

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let's say the gear assembly itself as part of the investigation of the gear assembly.

We also must have information with regard to the requirements of the jacket water pump and the oscillations that may be coming off the drive gear on the front of the crankshaft. And included in the evaluation portion of the scopes of work and the information required, portions of the scopes of work, we attempt to identify not only those dimensional and materials requirements we need, but also the results of analyses that may be conducted by other specialists that require the input again from an engineering analysis point of view for the investigation of this particular component. But absolutely, we are considering the interaction of all of these pieces, and they set the stage for that information required for the analysis of individual components.

MR. BERLINGER: How do you interact with your operating experience data base in making these judgments?

MR. SEAMAN: In answer to that question, again there is almost two phases that are important to design review, explained in some detail how we define a primary function or component, and that is one aspect of the review. But also associated with the review is a review of each individual site experience piece of data and industry data by the design review task leader to determine

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whether that is pertinent to our engine, and if so, what impact that has on design considerations. So everyone of those things will be reviewed. Every piece of operating data we have in our data base gets reviewed as part of the design review process.

MP. ROGERS: But those are not to be considered the only focus of our investigation. Those are the minimum of the investigations.

MR. SEAMAN: Right. So it is a two-phase approach.

MR. MUSELER: Three and four were really the same general question, I think.

MR. DYNNER: I have a question.

MR. MUSELER: Excuse me. In terms of -- is that okay with you? They both deal with component interaction and the like.

MR. ROGERS: I would like to make one comment with regard to 4. That is, with regard to input we may be getting from Delaval and TDI.

To the extent that we require those engine operating parameters to conduct our investigation, our first attempt to get those parameters is by contact with the manufacturer and trying to obtain information he may have in the form of engineering testing that they may have done, let's say mounting thermocouplers on cylinder

ATTACHMENT 9

DIESEL GENERATOR COMPONENT

SELECTION PROCEDURE

DG - 2

Component Selection Chairperson _____ Date_____

Quality Group Chairperson _____ Date_____

Design Group Chairperson _____ Date_____

Program Manager _____ Date_____

purpose

This procedure provides the methodology for the classification of diesel generator components and the selection process for the components which will be subjected to design review and quality revalidation.

2.0 Scope

The scope of this procedure is to identify the procedural requirements for each of the five steps involved in selecting and documenting the components to be included in the design review and quality revalidation:

- o Generation of Component Data Base (CDB)
- o Classification of components
- o Determination of components operating experience (Site Specific and Industry wide).
- o Selection of components
- o Completion of input to the CDB using the computer data sheet

3.0 Instructions

The methodology and guidelines for selecting diesel generator components for design review and quality revalidation are provided below.

It is important to note that steps may be performed simultaneously on the various components. For example, the classification and experience data gathering may proceed simultaneously.

3.1 Component Data Base Generation

3.1.1 The Component Data Base (CDB) is a computer summary listing of the selected diesel generator components. This listing is generated by using the "TDI Parts Manual", which is the base document for the Diesel Generator Design Review and Quality Revalidation Program.

3.1.2 A separate CDB is developed for each utility in the Owners' Group, using the Shoreham CDB and the plant-specific "TDI Parts Manual" as the basis. The CDB for each plant is updated to reflect site specific differences including the substitution of specific site experiences for Shoreham's site experience, and to include the input of site attribute sheets.

3.2 Component Classification

3.2.1 Components are classified either type A, B or C. These classifications are based on the effect of the component's failure on the diesel generator performance. The definitions of these classifications are as follows:

Type A Component - A component, based on the judgement and experience of the Component Selection Group, whose failure would result in immediate diesel generator shutdown or prevent startup under emergency conditions.

Type B Component - A component, based on the judgement and experience of the Component Selection Group, whose failure would result in reduced capacity of the diesel generator or the eventual failure of a Type A component if not detected.

Type C Component - A component, based on the judgement and experience of the Component Selection Group, whose failure has little bearing on the effective use or operation of the diesel generator.

3.2.2 In most instances, the classification for each plants' components shall be based on corresponding Shoreham parts if applicable to other engine types. If no corresponding Shoreham part exists, a classification shall be assigned based on the definitions in 3.2.1.

3.2.3 Record classification type on Selection Committee Component Input Data Sheet (see Appendix 5.1 of this procedure).

3.3 Component Experience

The experience of the specific components or similar type components is gathered and reviewed by the Component Selection Group. This review will be divided into four

sections: Shoreham specific experience, Nuclear Industry experience, Non-Nuclear Industry experience and other utility site specific experience. This data will be used to aid in the decision making process to determine if a design review or quality revalidation is required.

3.3.1 Shoreham Specific Experience

Shoreham specific experience for components shall be gathered and input into the Component Data Base to assist the Component Selection Group in its review. Sources of information include but are not limited to:

Engineering & Design Change Request (E&DCRs)
Repair/Rework Requests (RRRs)
LILCO Deficiency Reports (LDRs)
Diesel Generator Disassembly Inspection Results (DGDIRs)
Non-Conformance & Disposition Reports (N&Ds)

A summary of each "experience" is provided and appropriate references are recorded on the Shoreham-Based Component Event Data Sheet (see Appendix 5.2 of this procedure).

Nuclear Industry Experience

The industry experience of each component (grouped by TDI and other manufacturers) shall be gathered and entered into the Component Data Base to assist the Component Selection Group in its review . Sources of information include but are not limited to:

Licensee Events Reports (LERs)
Significant Event Reports (SERs)
INPO Significant Operating Event Reports (SOERs)
10CFR50.55(e) reports
10CFR21 reports
Nuclear Plant Reliability Data System (NPRDS)
EPRI reports
I&E bulletins, notices, circulars
TDI Service Information Memos (SIMs)

A summary of each experience is provided and appropriate references are recorded on the Industry-Based Component Event Data sheet (see Appendix 3.3 of this procedure).

3.3.3 Non-Nuclear Industry Experience

The non-nuclear industry experience (eg., marine and/or stationary experience) of the component is gathered and entered into the Component Data Base to assist the

Component Selection Group in its review. This information shall be limited to engines manufactured by TDI. Sources of information shall include, but are not limited to:

TDI Stationary/Marine Engine Experience
Correspondence between TDI and purchasers
Ships Logs
Engine Inspection Reports

A summary of each experience and the appropriate references is provided on the Non-Nuclear Based Component Event Input Data Sheet (see Appendix 5.5 attached).

3.3.4 Other Utility Site Specific Experience

Each utility in the Owners' Group shall gather site specific experience for components. This is entered into the Component Data Base to assist the Component Selection Group in its review.

Sources of information include, but are not limited to:

Design Change Documents
Repair/Rework Documentation
Deficiency Reports
Inspection Reports
Maintenance Logs

A summary of each experience is provided and appropriate references are recorded on the site specific component event data sheet, which is similar to Appendix 5.2.

3.4 Component Selection

The Component Selection Group shall select the components to be subjected to a design review and/or quality revalidation. Selection shall be based on component criticality and past Shoreham, industry, or other site experience as inputted into the Component Data Base, and the engineering judgement and experience of the Component Selection Group. Absense of adverse experience does not necessarily exclude a component from review. The following shall be used as a guideline for selection:

Type A Components - Design Review and/or Quality Revalidation normally required

Type B Components - Component Selection Group determines if Design Review and/or Quality Revalidation is required.

Type C Components - Design Review and Quality Revalidation not required

The results of this review and any comments are recorded on the Selection Committee Component Input Data Sheet (see Appendix 5.1 of this procedure).

3.5 Components Selected for Design Review

Once a component is selected for design review, the Component Selection Group provides minimum review requirements. These requirements shall then be used by the Component Design Review Group to generate a task description.

The task description shall detail the methodology to be used for the design review. It shall be approved by the Design Review Group Chairperson and the Program Manager. Any unique problems encountered by the Design Review Group during the implementation of the design review shall be documented with recommendations (including recommendations to perform a quality revalidation) on a Component Task Evaluation Report (see Appendix 5.4 of this procedure) and returned to the Program Manager through the Design Review Group Chairperson for disposition.

3.6 Components Selected for Quality Revalidation

Once a component is selected for quality revalidation, the Component Selection Group shall provide minimum revalidation requirements (ref. Appendix 5.1). These requirements are used by the Component Quality Revalidation Group to generate a task description.

The task description shall detail the methodology to be used for the quality revalidation. It shall be approved by the Quality Review Group Chairperson and the Program Manager. Any unique problems encountered by the Quality Revalidation Group shall be documented with recommendations on a Component Task Evaluation Report (see Appendix 5.4 of this procedure) and returned to the Program Manager through the Quality Revalidation Group Chairperson for disposition.

4.0 References

4.1 Diesel Generator Design and Quality Revalidation Program

4.2 Transamerica Delaval Parts Manual

5.0 Appendices

5.1 Selection Committee Component Input Data Sheet

5.2 Shoreham-based Component Event Data Sheet

5.3 Industry-based Component Event Data Sheet

5.4 Component Task Evaluation Report (TER)

5.5 Non-Nuclear Based Component Event Data Input Sheet

ATTACHMENT 10

OFFICIAL TRANSCRIPT
PROCEEDINGS BEFORE

UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of:	)	
	)	
LONG ISLAND LIGHTING COMPANY	)	Docket No. 50-322-OL-3
	)	
(Shoreham Nuclear Power Station	)	
	)	
Unit 1)	)	

DEPOSITION OF WILLIAM E. FOSTER, P.E.,

and

CARL H. BERLINGER

Hauppauge, New York

Tuesday, May 22, 1984

ALDERSON REPORTING

maybe I ought to get on the next plane and come out and go through the records, because you were finding out a lot of very interesting information.

When I asked what that specific information might be that would be of great interest to me, you really couldn't identify anything over the phone. But I have been -- I have been a very busy man since I've been assigned this task, and I really have not had the time to go out to TDI to go through their entire record.

Q Dr. Berlinger, have you, other than your communication with Mr. Molina, have you requested any information concerning the operating history of Delaval Engines from any other owners of Delaval Engines in non-nuclear service?

WITNESS BERLINGER: We have received some information from the state of Alaska, but specifically, I have not and I do not intend to request information in the marine area of application, primarily on the basis of the recommendation by the diesel consultants who I have retained.

They feel that many of the problems

associated with marine application were these diesels, or any other diesels, are very closely related to the type of service that is seen in marine application, which is different from nuclear service and also is different on the basis of the type of fuel that's used.

And primarily based on their recommendation, I am not going out and soliciting operating experience data of any -- to any great extent with regard to marine applications.

Q How about nuclear stationary applications?

WITNESS BERLINGER: Some of that information has been obtained, but a limited amount of information. I have not specifically gone out and requested it.

Q Do you know how many Delaval Engines there are in non-nuclear stationary applications?

WITNESS BERLINGER: In simple terms, many. I have requested the information, or information pertaining to non-nuclear station installations of TDI Engines from TDI. That information has still not been received.

One of the explanations I got for it

taking so long in identifying the particular engines and their specific locations is the fact that some of these engines were shipped overseas.

One example cited was to Saudi Arabia. I think there might have been several hundred that were sold to Saudi Arabia. I'm not sure of the exact numbers.

But after they are received, TDI doesn't know where they are installed, so they really can't give me a lot of information about them. They're having difficulty trying to put this information together. But I would have expected to have received it by now.

Q Why are you relying so heavily on Delaval to obtain this information?

WITNESS BERLINGER: The type of information I requested was the class of engine in what is called the 4 series, the series 4 line, and their specific location.

In other words, the rating and the location.

Q I have a document which I will give you later on which contains information --

WITNESS BERLINGER: Can I look at that?

Q Sure.

WITNESS BERLINGER: I know I'm not allowed to ask questions, but where did you get it?

Q As you know, Dr. Berlinger, I told you we received many thousands of documents in the course of discovery from Delaval. We're in the process of going through those documents. This is one that we obtained. We will make a copy available to you after the deposition.

WITNESS BERLINGER: Very good.

One of the -- one of the points I think should be brought out with regard to -- call it non-nuclear TDI applications -- is the fact that much of the information pertinent to the operation of those engines just is not available, especially with regard to -- or if you compare it to the type of information that's required to be kept for nuclear service applications.

For instance, if I found out that there was an engine located in Oshkosh, if it was a non-nuclear installation, the chances are that much of the operating experience information -- there are no

records kept. And the conditions for which that engine are operated are not closely controlled.

So, it's difficulty, if not pointless in most cases, to look into failures for which there is an inadequate data base describing the circumstances under which those failures occurred, because it really does not give you enough information to evaluate the cause of some of those problems. And it does give you more information and more paper to look at, but the value of that information is questionable.

Q Dr. Berlinger, I'm confused. How can you, on what basis can you say that the data would be inadequate when you haven't even attempted to obtain that data?

WITNESS BERLINGER: What I said was that the information or the records that I would be interested in finding out or learning of are not routinely kept by any industry other than the nuclear industry.

Q Let me take an example. If a crank shaft were to break at a stationary non-nuclear power plant, are you suggesting that there would not be useful data

concerning the conditions under which that crank shaft broke?

WITNESS BERLINGER: Most likely, that is true. But I --

Q Most likely, what is true? I'm sorry --

WITNESS BERLINGER: It is true that the data would not be sufficient for me to determine what caused the failure.

Q What data would you need to determine what caused the failure?

MR. STROUP: Objection to the form of the question.

WITNESS BERLINGER: Not being an expert in crank shaft analysis, I can't tell you specifically what data would be necessary. But I can characterize the fact that if an engine is installed somewhere in the desert in Saudi Arabia, I don't really know whether or not it is covered or in a building or susceptible to environmental conditions or using heavy oil or diesel oil.

This is the type of information which you might be able to get to give you a partial indication

in some cases as to what may have led to a failure. But let's say the measurements taken at some of these installations are not the type of measurements that would be taken at a nuclear plant.

For example, many of these installations, they turn on the engine and they leave and there is no one on-site specifically monitoring the operation of that engine unless it shuts down for some reason.

It's the type of operation that I'm looking -- that I'm trying to characterize for you which is not specifically identifiable by me.

I can't tell you exactly what information is or is not readily available, but I can characterize it from -- not from my personal experience but from what I have gathered from discussions with people who have been all over the world looking into diesel problems -- that it's very difficult sometimes to determine the root cause of problems because of insufficient information.

Q So you don't know, for example, what kind of records on Delaval Engine failures or defects are kept by the Rafha Electricity Corporation in Saudi Arabia, do you?

WITNESS BERLINGER: No.

Q Dr. Berlinger, who told you that useful data is generally unavailable from stationary non-nuclear plants?

WITNESS BERLINGER: I can't give you a specific name of an individual. It just came up during discussions with people at NRC and at our contractor shop and their consultants. I can't give you a specific name.

Q What contractor do you mean? Pacific Northwest?

WITNESS BERLINGER: Yes. Pacific Northwest.

To give you a clearer indication -- and I think you'll have an opportunity tomorrow, in discussions with our consultants -- I think you will find from their comments that they do not feel that marine application is necessarily applicable in the assessment of nuclear application problems. There is not necessarily a one-to-one relationship as far as those operating experiences are concerned.

But I'll let them address it.

Failure
Analysis
Associates

ENGINEERING AND METALLURGICAL CONSULTANTS
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ATTACHMENT 11

FaAA-84-3-1
PAO 7396/LAS-M&T-3A

DESIGN REVIEW OF CONNECTING ROD BEARING SHELLS FOR TRANSAMERICA DELAVAL ENTERPRISE ENGINES

****

THIS REPORT IS FINAL PENDING CONFIRMATORY REVIEWS REQUIRED BY FaAA's QUALITY ASSURANCE PROCEDURES

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Prepared by

Failure Analysis Associates
Palo Alto, California

Prepared for

TDI Diesel Generator Owners Group

March 12, 1984

Shoreham DSR-48 engines revealed voids about 0.025 inch in diameter that appeared to be the initiation sites for the fatigue crack. Such voids are not uncommon for aluminum castings of the type used in connecting rod bearing shells.

The replacement 12-inch bearing shells and connecting rods installed with the new crankshafts in the SNPS standby diesel generators are of a different design than the original components. The design modification addresses each of the conditions identified as contributing causes of the cracking. First, the geometry of the connecting rods and the bearing shells was changed to provide complete support to the bearing shell ends. Second, the increase in diameter to 12 inches reduced the peak oil film pressure. Third, although the edge loading was not affected, the two previous changes reduce the stress caused by the edge loading to an allowable level for the bearing shell material. The effect of this improvement was quantified by finite element stress analysis of the 11- and 12-inch bearing shells, using the results of journal orbit analysis to determine the detailed loading of the bearing shells. The maximum tensile stress found in the 11-inch bearing was reduced by about 50% in the 12-inch configuration.

Two analyses were performed to determine the effect of the stress reduction on the fatigue resistance of the new 12-inch bearing shells. A stress vs. number of cycles equation predicted that, based on the observed life of the 11-inch diameter bearing shells, the 12- and 13-inch shell fatigue life should be approximately 38,000 hours at full load, which is over ten times the usage expected over the 40-year service life of the nuclear standby diesel generators. An alternative analysis demonstrated that the decrease in the stress range is sufficient to prevent fatigue cracks, which indicates an infinite fatigue life for the bearing shells. Based on fracture mechanics analysis, an acceptance criterion for discontinuities in the aluminum was established. Voids up to 0.050 inch in diameter will not compromise the fatigue performance of the 12-inch and 13-inch connecting rod bearing shells in DSR-48 or DSRV-16-4 standby diesel generators. In addition to the standard manufacturer's recommended periodic bearing shell inspections [1], a radiographic NDE of the bearing shells, on a sampling plan, will be recommended to assure compliance with the acceptance criterion.

2.0 EXAMINATION OF BEARING SHELLS

Visual examination of connecting rod bearing shells from the original 11-inch diameter configuration of the SNPS DSR-48 TDI diesel engines showed that, except for the four bearing shells containing fatigue cracks, the remaining bearings were generally in serviceable condition. The contact patterns in the babbitt overlay revealed significant edge loading of some of the bearing shells. Contact patterns on the back of the bearing shells revealed that the ends were not supported by the bores of the connecting rods.

Replacement SNPS 12-inch bearing shells installed with the 12-inch crankpin crankshaft, showed similar edge loading in the babbitt contact patterns. In addition, the No. 2 upper connecting rod bearing from DG102 showed a babbitt removal pattern which was found to be due to reduced adhesion of the babbitt to the aluminum substrate. Analysis, presented in later sections, demonstrates neither condition is expected to adversely impact the expected life of the bearing.

Visual inspection of 13-inch connecting rod bearing shells from the Grand Gulf Nuclear Station DSRV-16-4 engines showed some edge loading effects on the bearings and some areas of overlay cavitation, neither of which is a significant factor in the predicted bearing life.

Scanning electron microscopy of the fracture surface of one of the cracked SNPS 11-inch connecting rod bearing shells showed that the fracture probably originated at surface pores approximately 0.020 inch to 0.030 inch in diameter. An acceptance criteria is presented in Section 5.0 to detect unacceptably large voids in any new bearing shells.

The tensile properties of specimens taken from the cracked SNPS 11-inch bearings shells showed that the ultimate tensile strength of the material met current TDI [2-1] specifications. However, since only subsized tensile specimens could be obtained from the actual bearing shells, it is difficult to determine whether or not ductility specifications were met with the material from the cracked bearings.

2.1 Nondestructive Examination

Connecting rod bearing shells from three different sources were examined visually. The first group of shells were the original connecting rod bearing shells from the SNPS DSR-4A diesels with 11-inch crankpin crankshafts. The second group were bearing shells from SNPS DSR-48 diesels with the replacement 12-inch crankpin crankshafts. The last source of bearing shells was Grand Gulf Nuclear Station operated by Mississippi Power & Light; four pairs of connecting rod bearing shells from the DSRV-16-4 engine with a 13-inch crankpin crankshaft were examined.

The original 11-inch SNPS bearings, with the exception of the cracked shells, appeared to be in serviceable condition, showing the expected polishing of the babbitt overlay. The polishing had occurred in the most highly loaded areas of the bearing. The amount of scoring of the bearing surface resulting from circulating solid particles in the lubricant was minimal, indicating that the engines were internally clean.

There was no evidence of any chemical attack of the babbitt overlay, indicating that the lubricating oil had remained nonacidic and was uncontaminated by acidic combustion products or by coolant leaks into the oil system. The majority of these bearings showed a polishing pattern in the babbitt that was wider at the ends of the bearings, covering almost 90° of arc, than it was in the middle where it covered less than 45° of arc. Also the intensity of the wear was higher at the edges of the bearing than in the center of the bearing. This pattern is indicative of edge loading which results when the journal axis is not perfectly parallel with the bearing surface. This causes the journal to approach the bearing more closely at the bearing ends, increasing the proportion of the firing pressure carried on the bearing ends. This asymmetry is considered and assumed in the life prediction of the new 12-inch bearings, and acceptable bearing life is found even in its presence.

Visual examination of the backs of the original 11-inch SNPS bearings showed that the ends of the bearing were not supported by the bores of the connecting rods. This was a consequence of the large 1/4-inch chamfers on the

connecting rod bores. Figure 3a shows a cross-sectional representation of the contact between the connecting rod and the connecting rod bearing and indicates the unsupported ends of the bearings with the original 11-inch crankpin crankshaft. This large chamfer has been reduced to 1/16 inch in the new 12-inch connecting rod design.

The three cracked 11-inch bearings which had not completely fractured had cracks approximately four inches in length near one end of the bearing. A crack was apparent on both the I.D. and the O.D. of the bearing shell; these two indications appeared to coincide and thus to represent one through-crack in the bearing shell. Dye penetrant testing of these bearing shells indicated that these visual features were cracks.

Radiography of one of the 11-inch bearing shells containing this indication, the No. 4 upper connecting rod bearing shell from DG1O2, also indicated the presence of a discontinuity or crack in the bearing material.

The second category of bearings to be visually inspected consisted of the replacement connecting rod bearing shells which were installed at SNPS with the new 12-inch diameter crankpin crankshafts. After 100 hours of testing at full load, DG1O2 was partially disassembled for inspection. At that time several of the connecting rod 12-inch bearing shells were removed for visual inspection, dye penetrant inspection, and measurement of wall thickness.

The contact patterns on the I.D. of the bearing were evaluated to determine load distribution across the length of the bearing. A number of the bearing shells showed clear indications of edge loading in the polishing pattern on the babbitt, but not to a degree that would indicate impaired bearing performance during the life of the diesel generator unit.

In addition, the No. 2 upper connecting rod bearing from DG1O2 showed a pattern of babbitt removal at one end. Examination of this region by optical microscopy at 40X magnification showed that the babbitt removal was occurring in very localized regions and that the babbitt which remained on the surface between the localized regions of removal had no sign of babbitt fatigue or

cracking. In addition, at the bottom of the pits left by babbitt removal, the machining marks on the I.D. of the aluminum bearing material were clearly visible. On the remainder of the babbitt surface of this bearing shell there is a pattern of very small blisters in the babbitt.

The mode of removal was delamination in areas of weak adhesion of the babbitt overlay to the underlying aluminum substrate. This condition is not significant as far as the performance of the connecting rod bearings in the engine is concerned, but is primarily a cosmetic surface condition. Over the normal wear life of the connecting rod bearings, the babbitt layer, which is at most 0.002-inch thick, will be worn completely away in the highly loaded regions. Also, up to 0.003 inch of the underlying aluminum material can be worn away, for a total reduction in thickness of 0.005 inch [2-2].

The contact pattern on the back of this bearing shows that, with the change to the new connecting rods with a small 1/16-inch chamfer (see Figure 3b), full support of the bearing back has been achieved.

The third category of bearings to be visually inspected was from the Grand Gulf Nuclear Station DSRV-16-4 diesel engines. These bearings are reported by Grand Gulf to have experienced about 1200 hours of total engine operating time, of which approximately 315 hours was at or above 100% load. The bearings in the upper position showed normal babbitt contact patterns in the most highly loaded regions. In some cases there was evidence of edge loading of the bearings but, in those examples examined, even less than for the 11-inch or 12-inch SNPS bearings. The bearings from Grand Gulf did show light to moderate scoring of the overlay. In addition, there were a few isolated areas of overlay removal. These areas were, however, not in the most highly loaded region of the bearing and probably represent areas of cavitation. This apparent cavitation is confined to the babbitt overlay and shows no evidence of progressing into the underlying aluminum substrate. It had no effect on the function of the bearings.

The contact pattern on the back of the DSRV-16-4 connecting rod bearing shells from Grand Gulf Nuclear Station shows that the connecting rod bore is providing essentially full support of the bearing shell O.D..

2.2 Destructive Examination

Destructive examination was confined to the original 11-inch diameter bearing shells from SNPS. Two of the bearing shells which had cracked but not separated were destructively analyzed to expose the fracture surfaces for detailed examination.

At the FaAA Palo Alto laboratory, the No. 4 upper connecting rod bearing shell from DG103 (containing a crack approximately four inches long) was subjected to destructive examination. Two axial-radial cuts through the fracture surface were made from the end of the bearing containing the crack. This freed the major portion of the fracture surface for separation and examination. The fracture extended from the I.D of the bearing completely through to the O.D..

The No. 3 upper connecting rod bearing shell from DG103 was initially examined by TDI in Oakland. Sufficient force was applied to the cracked bearing to complete fracture to the bearing edge, freeing the fracture surface for examination. Again the crack was shown to be a through-crack from the I.D. of the bearing shell to the O.D.. In addition, the shape of the crack fronts at both ends of the crack showed that the I.D. edge of the crack was leading the O.D. edge of the crack, suggesting that the crack had initiated at the I.D. of the bearing shell.

2.3 Electron Microscopy

A portion of the fracture surface which was removed from the No. 4 upper connecting rod 11-inch bearing from DG103 was examined by scanning electron microscopy. This examination revealed significant near-surface pores which are the probable initiation sites for the cracking. These pores are approximately 0.020 inch to 0.030 inch in diameter. Examples of these pores on the fracture surface are shown in Figure 4.

The brittle character of the B850 aluminum alloy prevents it from yielding very much information about the nature of the cracking process. However, the orientation of the crack relative to the pores that were

discovered is consistent with those pores being the initiation sites for the fatigue crack. The internal surface of the pores, being rounded and showing signs of dendritic structures, indicates that their most likely origin is from shrinkage associated with solidification of the castings from which the bearing shells are made. This shrinkage may also be assisted by dissolution of gases, such as hydrogen, from the liquid aluminum during solidification. As such, the pores would be a normal effect of the manufacturing process by which the castings were made.

2.4 Chemical Composition

To confirm that the 11-inch connecting rod bearings are made from the specified material, Alcoa B850, a sample of aluminum material from the No. 4 upper connecting rod bearing from DG103 was submitted to Metallurgical Testing Corporation for chemical analysis. The results of the chemical analysis, as well as the specification for alloy B850 [2-3], are given in Table 1. The results indicate that the specified alloy was used in the manufacture of these bearings.

2.5 Tensile Properties

Mechanical properties samples were cut from the end of the subject 11-inch bearings containing the cracks, between each parting line and the fracture surface. The specimens were 1/4-inch gage diameter, 1-inch gage length per ASTM B-557-81 [2-4], the largest that could be obtained from the finished bearing, and they were oriented parallel to the axis of the bearing perpendicular to the plane of the fracture.

Ten specimens were prepared and tested according to ASTM Standards. Eight of the specimens were from the No. 4 upper connecting rod bearing shell of DG103 and two of the mechanical properties test specimens were from the No. 3 upper connecting rod bearing shell of DG103. The results are listed in Table 2. Ultimate tensile strength ranged from 23.7 ksi to 28.1 ksi with elongations ranging from 0.40% to 0.88%. Only one of the ten test specimens met the apparent original design requirement [2-1] for tensile strength and

none met the elongation requirement. When compared with TDI's current specification requirements [2-1], all ten samples met the tensile strength criterion, but again, none met the elongation requirement.

The samples were the largest that could be taken from finished bearings, but were one-half the size of samples that would be taken from unfinished castings for quality assurance. ASTM Standard B-557-81 states that elongation values obtained from smaller specimens may be less than those obtained from larger specimens.

The ultimate tensile strength results indicate that the bulk cast aluminum bearing material is suitable for its intended application. The reported ductility values are not significant, since they were measured on sub-size specimens. If full-size specimens could have been used, it is expected that the ductility would have been satisfactory.

Section 2 References

2-1. C. Matthews and G. King (Transamerica Delaval Inc., Engine and Compressor Division), private communication with L. A. Swanger (FaAA), October 4, 1983.

2-2. TRANSAMERICA DELAVAL INSTRUCTION MANUAL, Model DSR-48 Diesel Engine, Serial Nos. 74010 - 2604, 74011 - 2605, 74012 - 2606, Transamerica Delaval Inc., Engine and Compressor Division.

2-3. Aluminum Company of America, Alcoa Aluminum Design Data, Pittsburgh, Pennsylvania, 1977.

2-4. ASTM Standard B-557, "Tension Testing Wrought and Cast Aluminum and Magnesium Alloy Products," ASTM, 1981.

TABLE 1

CHEMISTRY OF DG103, No. 4 UPPER CONNECTING ROD BEARING

B850	Nominal Composition (%)	Results of Analyses (%)
Al	90.0	balance
Sn	6.0	5.26
Cu	1.0	1.86
Ni	2.0	1.38
Mg	1.0	.77
Fe	--	.36
Si	--	.25
Ti	--	.12

TABLE 2

TENSION TEST RESULTS FOR DG103
CONNECTING ROD BEARING SHELLS

Test No.	Position	U.T.S. (ksi)	Elongation (percent)
1	No. 3 Upper	25.7	0.80
2	No. 3 Upper	23.7	0.40
3	No. 4 Upper	25.2	0.70
4	No. 4 Upper	25.7	0.76
5	No. 4 Upper	26.5	0.76
6	No. 4 Upper	26.1	0.56
7	No. 4 Upper	26.7	0.72
8	No. 4 Upper	26.9	0.54
9	No. 4 Upper	28.1	0.88
10	No. 4 Upper	26.1	0.68
Specification (1976) [2-1]		27.0	2.00
Specification (1983) [2-1]		23.0	2.00

Note: Results are from 1/4-inch diameter test specimens. Specifications are for 1/2-inch diameter test specimens. The smaller test specimens result in lower elongation results, but the tensile strength results are unaffected by this difference in size.

NOTE: drawing at .74 of original

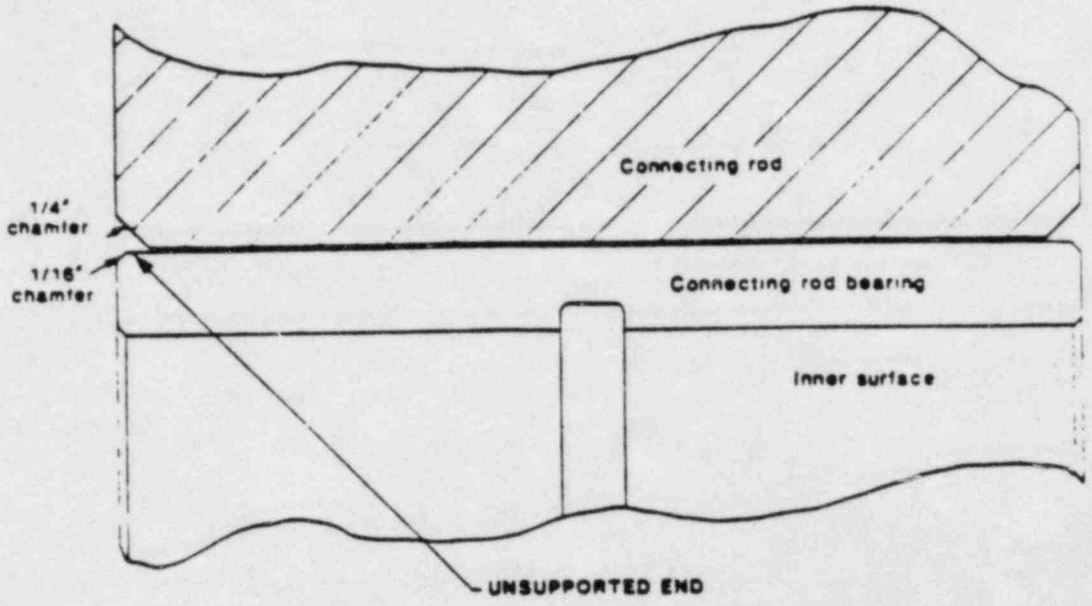


Figure 3a. Bearing: Connecting rod and bearing configuration original 11-inch journals

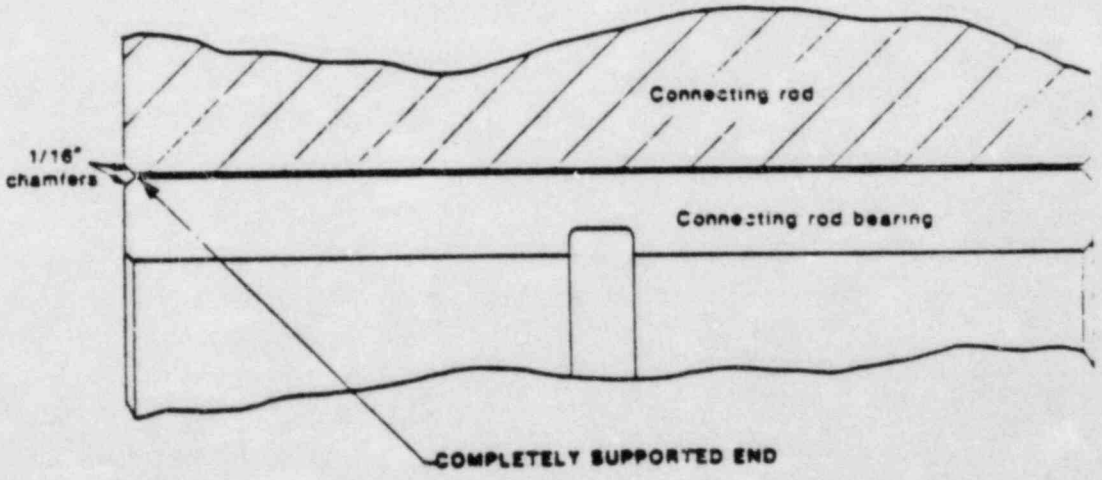
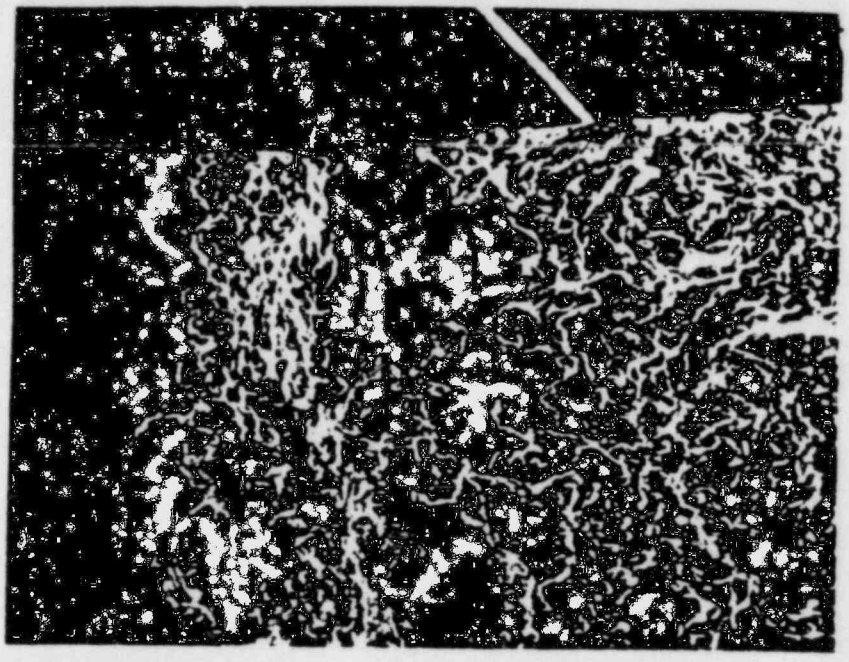
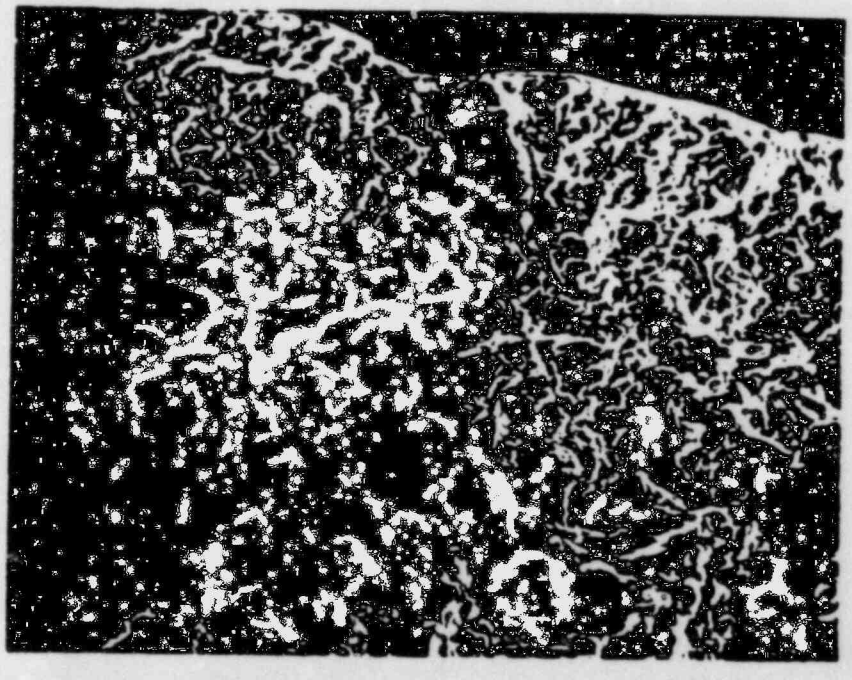


Figure 3b. Bearing: Connecting rod and bearing with replacement 12-inch journals.



26X



36X

Figure 4. Scanning electron microscope fractographs of DG103, No. 4. Voids are approximately 0.020-inch to 0.030-inch.

FSAA-84-3-1

5.3 Acceptance Criteria for Connecting Rod Bearings

Compared to the original configuration installed in the DSR-48 engines, there is a factor of 152 increase in the expected fatigue life of the bearing shells, and a 50% decrease in the stress intensity factor range. Because of the significant reduction in the tensile stress in the connecting rod bearing shells of the current configuration, the size of voids which can be tolerated is larger than would have been acceptable in the original bearings. Using the BIGIF fracture mechanics code to calculate the stress intensity factor range that would remain below the approximate threshold value of ΔK, 2.0 ksi $\sqrt{\text{inches}}$, yields an acceptable void size of 0.050 inch in the highly stressed areas of the upper connecting rod bearings. The BIGIF analysis used to generate this acceptance criterion is conservative in that the voids actually seen in the bearing material are essentially spherical with rounded interior surfaces. The BIGIF analysis assumes that the voids are sharp-edged and behave like sharp cracks from the onset of fatigue. This is conservative in that no credit is taken for the increased stress required to initiate a sharp fatigue crack from a typical casting void.

The critical zone of the connecting rod bearings, to which the 0.050-inch maximum discontinuity acceptance criterion applies, was determined by the region of the connecting rod bearing shell in which the tensile stress exceeds one-half of the maximum tensile stress in the bearing. By examining the outputs from the ANSYS finite element models of the DSR-48 and DSRV-16-4 connecting rod bearing shells, it was determined that this critical zone encompasses a band on each end of the bearing beginning 0.4 inch from the bearing end, extending inward toward the oil groove to a point 1.4 inches from the bearing end. This critical zone is also centered circumferentially on the bearing shell, extending circumferentially on either side of the center 2.5 inches. Outside of this critical zone, and in the lower connecting rod bearing shells which are much less highly loaded than the upper bearing shells, the acceptable void size is a calculated 0.250 inch.

In the case of Shoreham, the testing projections developed by the architect/engineer and based on NRC requirements show that the engines will be run at full load approximately 100 hours in every two-year cycle. Over the expected 40-year life of the power station, or 20 two-year cycles, approximately 2,000 total hours of full load running should be accumulated.

The ratio of the stress level in the connecting rod bearings currently installed at Shoreham and at Grand Gulf, relative to the stress level in the original 11-inch bearings at SNPS, provides a criterion for the acceptance of bearing shells. Calculation of the acceptable size of a normal casting void which would remain below the computed threshold stress intensity factor range shows that discontinuities up to 0.050 inch may be allowed in the critical zones of the upper connecting rod bearings.

Inspection to assure compliance with the acceptance criterion can be accomplished by radiography. Shoreham Nuclear Power Station has developed a procedure that detects discontinuities that could result in rejection of a bearing shell. A sampling procedure will be recommended to the TDI Owners Group for radiography of bearing shells for purposes of quality revalidation.

ATTACHMENT 12

FaAA-84-5-12
PA07396/CHW-03360A

EVALUATION OF CYLINDER HEADS OF TRANSAMERICA DELAVAL INC. SERIES R-4 DIESEL ENGINES

****

The report is final, pending confirmatory reviews required by FaAA's QA operating procedures.

****

Prepared by

Failure Analysis Associates
Palo Alto California

Prepared for
TDI Diesel Generator Owners Group

May 1984

4.0 CONCLUSIONS AND RECOMMENDATIONS

1. The cylinder heads are adequate for their intended service. However, there is a potential for cracks to propagate from pre-existing flaws in the head leading to leaks into the cylinders. The potential for the pre-existing flaws in Group III heads is significantly less than for Group I and II heads.

2. For Group I and II heads, the following preventative measures are recommended:

   - Inspection of all heads by liquid penetrant and/or magnetic particle methods and ultrasonic measurement of the fire deck thickness.

   - Perform the "barring-over" procedure to check for water leakage immediately prior to manual startups and at appropriate intervals after shutdown.

3. For Group III heads, FaAA recommends a sample inspection of all the heads by liquid penetrant and/or magnetic particle methods and ultrasonic measurement of the fire deck thickness.

4. If the "barring-over" procedure reveals leakage, it is recommended that the head be replaced.

Attachment 13

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

Before the Atomic Safety and Licensing Board

In the Matter of:

LONG ISLAND LIGHTING COMPANY (Shoreham Nuclear Power Station, Unit 1)	) Docket No. 50-322 (OL))

AFFIDAVIT OF JOHN C. KAMMEYER

John C. Kammeyer, being duly sworn, deposes and states as follows:

1. My name is John C. Kammeyer. I am employed by the Stone & Webster Engineering Corporation at the Shoreham Nuclear Power Station. My current job title is DRQR Program Manager. Among other things, my responsibilities include engineering matters related to the Shoreham diesel generators. A copy of my resume is attached.

2. The purpose of this affidavit is to provide information concerning the expected hours of operation of the emergency diesel generators at LILCO's Shoreham Nuclear Power Station.

3. The expected life of the Shoreham Nuclear Power Station is 40 years. The emergency diesel generators at Shoreham are each expected to operate for an approximate total of 4,500 hours.

4. Each diesel generator is expected to operate for approximately 1,300 hours during pre-operational testing.

5. Surveillance test runs will be performed pursuant to NRC Reg. Guide 1.108 § C.2.c. These tests will be conducted during the intervals between refueling cycles. A conservative estimate for test run hours for each engine to be performed within each 18 month refueling cycle is 65 hours. Therefore, it is anticipated over the 40 year life of the plant, each engine could operate for a total of approximately 1,733 hours during the surveillance test runs.

6. Twenty-seven hours of periodic operational testing of the diesel generators could be required between each refueling cycle pursuant to NRC Reg. Guide 1.108 § C.2.a. Based on an expected 40 year life of plant, and on an 18 month refueling cycle, each engine is expected to operate for approximately 720 hours during periodic testing.

7. The Probabilistic Risk Assessment for Shoreham Nuclear Power Station estimates a loss of offsite power event to occur once each 13 years or approximately 4 times over the 40 year life of the plant. Based on a conservative estimate of seven days of continuous diesel engine operation for each LOOP event, each engine should see approximately 672 hours of operation in LOOP events.

8. The total number of hours of operation for each emergency diesel generator at the Shoreham Nuclear Power Station is anticipated to be approximately 4,500 hours over the 40 year life of the plant.

_____
John C. Kammeyer

State of New York

County of Suffolk

Subscribed and sworn to before me this __ day of June, 1984.

My commission expires:

_____
Notary Public

PROFESSIONAL QUALIFICATIONS

JOHN C. KAMMEYER

Engineer - Power Division/Assistant Head,
Site Engineering Office

STONE & WEBSTER ENGINEERING CORPORATION

Education

Ohio State University - Bachelor of Science, Mechanical Engineering 1979.

Appointments

Engineer, Power Division - February, 1981
Career Development Engineer, Power Division - June, 1979

Shoreham Nuclear Power Station, Long Island Lighting Company,
(Nov. 1979 to Present)

As ENGINEER (Aug. 1982 to Present) assigned to the Site Engineering Office (SEO) in the capacity of Power Engineer and Assistant Head-SEO, responsible to the Head-SEO for the Power Division effort. Responsible for directing engineers and designers in the resolution of construction and testing problems dealing with fluid systems and related components, such as piping, valves, mechanical equipment, and equipment erection. In addition, in the absence of the Head-SEO, responsible for the operation of the Site Engineering Office.

As ENGINEER (May 1981 - July 1982), assigned to the Site Engineering Office, responsible for resolving various engineering related construction problems, principally with piping and mechanical components, requiring an immediate solution to support the construction schedule. In addition, working directly with the client's start-up organization to resolve system operation deficiencies.

As ENGINEER and CAREER DEVELOPMENT ENGINEER (November 1979 - April 1982) in the Nuclear Engineering Group, responsible for preparing reactor plant flow diagrams, specifications, and FSAR sections. As a Career Development Engineer, spent four months at the Site Engineering Office, responsibilities included maintainability study of the 850 MWe power plant.

North Anna Power Station - Units 3 & 4, Virginia Electric and Power Company (June 1979 - November 1979)

As CAREER DEVELOPMENT ENGINEER, assigned to the Nuclear Engineering Group responsible for preparing reactor plant flow diagrams, specifications and FSAR sections.

U.S. NAVY (September 1969 - July 1975)

USS James K. Polk, SSBN 645 (April 1972 - June 1975)

Responsibilities included reactor operator, reactor instrumentation maintenance, supervision of division training; honorable discharge with ETR-2(SS) rating, commendation from Commander Submarine Squadron Sixteen.

Professional Affiliations

American Society of Mechanical Engineers - Associate Member.

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

APR 25 1984

ATTACHMENT 14

Docket No. 50-416

Mr. J. P. McGaughy
Vice President
Nuclear Production
Mississippi Power and Light Company
Post Office Box 1640
Jackson, Mississippi 39205

Dear Mr. McGaughy:

SUBJECT: NRC STAFF EVALUATION OF THE TDI DIESEL GENERATOR RELIABILITY FOR POWER OPERATION AT GRAND GULF NUCLEAR STATION, UNIT 1

As a basis for operation of Grand Gulf Unit 1 at full power, Mississippi Power & Light (MP&L) submitted reports dated February 20 and April 17, 1984, concerning the MP&L program to verify and enhance the reliability of the TDI diesel generators at Grand Gulf Unit 1. These submittals were in response to the NRC questions on the TDI issue and are supplemental to other MP&L responses to the NRC requests contained in letters to J. P. McGaughy dated October 31, 1983 and December 27, 1983. Additional actions taken by MP&L to verify and enhance the reliability of onsite/offsite AC power systems were documented by letter dated February 26, 1984.

MP&L met with the NRC staff and its consultants from Pacific Northwest Laboratory (PNL) on April 13, 1984, and again with the NRC staff on April 18, 1984, to discuss TDI diesel generator reliability issues, including issues raised earlier by the staff and its PNL consultants in a letter dated April 11, 1984 (E. Adensam to J. P. McGaughy). In addition, at the meeting on April 13, 1984, the staff had its expert diesel consultants available to discuss their detailed views concerning further efforts to ensure reliability of the TDI diesels.

As we previously discussed at the April 13, 1984 meeting, and in several subsequent discussions based on a review of the information provided by MP&L, the NRC staff has been unable to conclude that the proposed MP&L program for ensuring adequate diesel generator reliability is sufficient to support operation of Grand Gulf Unit 1 at power levels in excess of 5% of full power. We have concluded that your submittals to date do not adequately address existing technical concerns without further inspection for defective components in at least one diesel engine, additional preoperational testing, and establishment of enhanced maintenance, inspection, and surveillance plans.

Our detailed findings are attached as Enclosure 1. In addition, several background documents from our consultants at PNL are attached (Enclosures 2, 3, and 4) for reference.

If you have questions or alternative proposals, we are prepared to discuss them with you at your convenience. The staff will need to review your response to this position, or receive an adequate alternate proposal from MP&L, prior to authorizing plant operation in excess of 5% of full power.

We look forward to your prompt reply to this request.

Sincerely,

Original Signed By:

Darrell G. Eisenhut, Director
Division of Licensing
Office of Nuclear Reactor Regulation

Enclosure:
As stated

cc w/enclosure:
See next page

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ENCLOSURE 1

ADDITIONAL ACTIONS TO ENSURE ADEQUATE RELIABILITY OF TDI DIESEL ENGINES AT GRAND GULF NUCLEAR STATION, UNIT 1

1.0 Introduction

The proposed MP&L program to ensure adequate reliability of the TDI diesel generators at Grand Gulf Unit 1 has been provided to the staff in references 1 through 5. Based on a review of the Mississippi Power & Light (MP&L) program, the NRC staff and its consultants from Pacific Northwest Laboratory (PNL) have been unable to conclude that the MP&L program is sufficient to support operation of Grand Gulf Unit 1 at power levels in excess of 5% of full power. One acceptable basis to support full power operation of Grand Gulf Unit 1 is discussed herein and involves additional actions addressing the following areas.

- Engine disassembly and inspection
- Pre-operational testing following engine disassembly and inspection
- Engine maintenance, inspection and surveillance.

2.0 Assumptions

The staff's position that the additional actions described herein will be sufficient to support full power operation at Grand Gulf Unit 1 is subject to the following assumptions:

a) Findings stemming from the staff review of the TDI Owners Group resolution of TDI engine issues will be satisfactorily implemented at Grand Gulf Unit 1 prior to restart from the first refueling outage.

b) Implementation of an acceptable onsite/offsite AC power arrangement and verification program. The proposed MP&L program (Reference 2) is under review by the NRC staff.

c) Appropriate actions will be taken as necessary in response to new or unexpected occurrences affecting the Grand Gulf Unit 1 or other similar TDI engines and findings from the Owners Group program which are of an urgent nature.

d) Engines will not be operated in excess of ESF maximum loads (~70% of full rated power).

3.0 Additional Actions to Ensure TDI Diesel Engine Reliability

3.1 Engine Disassembly and Inspection

The Division I engine (which has accumulated the most operating hours to date) should be disassembled for inspection of key components (identified below).

Action to be taken on the Division II engine would be contingent upon the results of the inspections conducted on the Division I engine. If no defective parts are found on the Division I engine, disassembly and inspection of the Division I engine would not be necessary provided MP&L can demonstrate through a review of the manufacturer's QA records that the two engines are essentially identical. This would involve verifying that the key engine components have been fabricated and installed to the same material (including heat treatment) and manufacturing specifications and similarly inspected and installed (including same bolt torques).

If inspection of the Division I engine reveals defective parts, or if the two engines contain dissimilarities, these would need to be evaluated as a basis for establishing inspection requirements for the Division II engine.

All defective parts found should be replaced. Possibly, the block and engine base could be excepted if cracking is not severe or in critical areas.

The types of inspections to be performed should be similar to those conducted at Shoreham and Catawba (e.g., dye penetrant, eddy current, ultrasonic, radiography, etc.) as appropriate for each component based on the kinds of problems (e.g., cracks, abnormal wear or other distress, inadequate assembly or torquing) which have previously been experienced on these components at Grand Gulf Unit 1 or other TDI engines.

Components to be inspected should include all (100%) of the following:

- Piston skirts, crowns and fasteners
- Cylinder heads
- Connecting rods. Connecting rod fasteners should be checked for torque
- Connecting rod bearings per criteria in Owners Group report on this component. Bearings should also be evaluated for abnormal wear patterns which may be indicative of crankshaft misalignment
- Wrist pin bushings

- Push rods - main and connecting
- Crankshaft (including hot and cold deflection test)
- Cylinder liners
- Crankcase capscrews for torque
- Cylinder block
- Engine base
- Head studs for torque
- Air start valve capscrews
- Rocker arm capscrews per Owners Group findings
- Turbocharger mountings, including all bolts and welds

A description of the inspections performed and the results should be submitted for NRC staff review prior to plant operation above 5% power. This report should address all indications found and the engineering basis for acceptance or rejection of the subject components.

3.2 Preoperational Testing Subsequent to Engine Disassembly and Inspection

Preoperational testing must be performed on the Division I engine following its disassembly, inspection and reassembly. In addition to adhering to the manufacturer's preoperational test recommendations, this phase of testing should include the elements listed below. If the manufacturer's recommendations already include these elements, it is not necessary to repeat them.

- 10 modified starts to 40% load
- 2 fast starts to 70% load
- 1 24-hour run at 70% load

A modified start is defined as a start including a prelube period as recommended by the manufacturer and a 3 to 5 minute loading to the specified load level and run for a minimum of one hour. The fast starts are "black starts" conducted from the control room or simulation of an ESF signal with the engine on ready standby status. The engine should be loaded to 70% and run for 4 hours at this load on each fast start test. The 24-hour performance run is suggested to detect abnormal temperatures and/or temperature excursions that might indicate engine distress. Either a modified or fast start may be utilized.

These 13 tests must be performed satisfactorily at the first attempt, i.e., the 10 modified starts should be performed successively with no failure. A failure is defined as an inability of the engine to start, or an abnormal condition during the respective run which would ultimately preclude the engine from continuing to operate. If the preoperational tests are not satisfactorily completed in the first attempt, the NRC staff will review the need for additional testing requirements.

3.3 Maintenance, Inspection and Surveillance

Detailed maintenance, inspection, and surveillance requirements should be established in conjunction with the engine manufacturer's recommendations and should include all maintenance, inspection, and surveillance identified by MP&L in References 4, 5, and 6. In addition, special attention should be given to selected components as described below. If defects are noted, the parts should be replaced. The nature of the defect will determine if this is all that is required.

A. Cylinder heads - Following engine shutdown, the engine should be rolled over with air pressure after four hours (during cooldown) with the indicator cocks open. Subsequent to cooldown, engines should be air rolled every 24 hours. Any cylinder heads discovered leaking must be replaced. MP&L should confirm that the written procedures are adequate to ensure that the cocks are closed following each air roll.

B. Engine block and base - Inspect the engine block and base every month or 24 hours of operation, whichever comes first. The inspection should be an external visual inspection requiring no disassembly. No other special maintenance is required if any defects found are "non-critical." Non-critical indications are defined as not causing oil or water leakage; not propagating; and not adversely affecting cylinder liners or stud holes.

C. Connecting rods - After each interval of 25 starts, 50 hours of operation or 6 months, whichever occurs first, all connecting rods should be visually inspected and all connecting rod bolts should be retorqued and the results recorded.

D. Lube oil checks - The lube oil should be checked for water following preoperational testing and then weekly and after each 24 hours of operation, whichever comes first. It should also be checked on a monthly basis for particulates and chemical contaminants associated with wear of bushings and bearings. Also at intervals of one month, a sample should be collected from the bottom of the sump to check for water. All filters and strainers should also be checked monthly.

E. Cylinder head studs, rocker arm capscrews, air start valve capscrews - Each month 25% of the capscrews should be spot checked for torque.

F. Push rods - Following preoperational testing and then subsequently after each 24 hours of operation, cams, tappets, push rods, etc. should be visually checked. This can be done one at a time with the engine shutdown but without affecting its availability for service.

Items A through F above apply to both engines. For the engine(s) which are disassembled and inspected in accordance with Section 3.1 above, the starting point for implementing items A through F should be upon engine reassembly; therefore, subsequent pre-operational testing should be included in the appropriate maintenance, inspection, and surveillance intervals above. Should it not be necessary to disassemble and inspect the Division II engine in accordance with Section 3.1, items A through F above should be implemented. One hour of engine operation at any load is considered to be one hour of engine operation in determining inspection intervals.

3.4 Additional Surveillance

During standby, the lube oil filter pressure drop should be checked daily rather than monthly as suggested by MP&L. Hot and cold deflection tests of the crankshaft should be performed every 6 months with the hot deflection test performed within 15 minutes of engine shutdown.

During engine operation, the exhaust temperature for each cylinder should be monitored continuously by the operator and recorded on a log at hourly intervals, as should the temperatures entering and exiting the turbocharger. Other temperature and pressure readings for which the engine is instrumented should also be monitored continuously, and recorded hourly, or more frequently if specified by the manufacturer. These should at least include lube oil, jacket water, intercooler temperature, and air pressure. If the engine is equipped with an accelerometer on the main bearings and turbocharger, these should also be monitored continuously and recorded at hourly intervals. If the engine is not equipped with an accelerometer at these points, main bearing oil temperature should be monitored continuously and recorded hourly. Also, lube oil filter pressure should be monitored daily during engine operation.

References

1. MP&L letter dated February 20, 1984, "Diesel Generators, Comprehensive Reliability Report."

2. MP&L letter dated February 26, 1984, "Onsite/Offsite AC Power Reliability."

3. MP&L letter dated April 17, 1984, "Updated Report, Diesel Generators."

4. MP&L letter dated April 17, 1984, "TDI Diesel Engine, Supplemental Information."

5. Meeting Passout, April 13, 1984, "GGNS Maintenance/Testing Program."

6. Meeting Passout, April 18, 1984, "GGNS D-G Maintenance Testing Program."

ATTACHMENT 15

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

[illegible]

In the matter of [illegible]

[illegible]

[illegible] T. INGALLS, CSR [illegible]

COMPUTERIZED TRANSCRIPT

We also have to deal with seismic -- or seismic; I don't know the pronunciation -- we have to take into account the effect of a collision on the ship and what would happen in the deacceleration period of a collision.

MR. STROOPE: Q. Is that with regard only to the main propulsion system?

A. Generally in the main propulsion system because of its mass.

Q. I think my questions was only in regard to the main propulsion system.

Do you take that into account with the auxiliary engine?

A. If you had a very large auxiliary engine, such as in a passenger ship, then you would take it into account because some of those auxiliary engines are larger than the main propulsion units on a small cargo ship. Then it would be taken into account.

It would depend on the massiveness of the machinery.

Q. Are there any components other than the foundation of the auxiliary diesel engines on board ship that can be affected by the force of wave action?

A. Could I have that question read back, please?

(Record read).

THE WITNESS: Yes.

The ships hull does move; it stresses and it's subject to stress, and therefore it has str in on it.

The strains which a ship is subjected to can be

quite heavy, both from the point of view of the weather and from the loading. And these things will affect the alignment of the crank shaft, the crank shaft of the running gear and a whole host of things besides the foundation.

MR. STROUDE: Q. And I assume that is even more so, in fact, with regard to the main propulsion?

A. That is, correct.

Q. Is that because that unit has the direct link with the ocean itself?

A. All the parts of the ship's machinery room have a direct link with the ocean through their foundation. They're all subjected to movement from the action of the sea, the ship at sea.

But the main propulsion engine is much, much larger, has a greater length than the other pieces of machinery and is subject to the action of the sea more than the other parts.

Q. Doesn't it also -- strike that.

Isn't it also subjected to additional action of the sea by virtue of the fact that a propeller and a propeller shaft can extend into the the ocean?

A. Yes, it is.

Q. Did all the engines on board ship -- and again I'm speaking here with regard to the main propulsion engine that were the diesels in the Sea Train fleet -- operate on heavy fuel out of port?

A. Some ships did, some ships didn't.

We also have to deal with seismic -- or seismic; I don't know the pronunciation -- we have to take into account the effect of a collision on the ship and what would happen in the deacceleration period of a collision.

MR. STROUPE: Q. Is that with regard only to the main propulsion system?

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Status of Shoreham Technical Review
by TDI Owners Group

Owners Group File No.	Date Submitted	Title
TDI-1	February 28, 1984	Task Descriptions
TDI-2	February 27, 1984	Investigation of Types AF and AE Piston Skirts by FaAA
TDI-3	March 2, 1984	TDI Owners Group Program Plan
TDI-4	March 3, 1984	Design Review Report on the Connecting Rod Bearing Shells for the Shoreham and Grand Gulf Diesel Generators by FaAA
TDI-5	March 13, 1984	Rocker Arm Capscrew Stress Analysis Report by Stone & Webster
TDI-6	March 23, 1984	TDI Diesel Generator Air Start Valve Capscrew by FaAA
TDI-8	March 30, 1984	TDI Diesel Generator Cylinder Head Stud Stress Analysis Report by Stone & Webster
TDI-9	April 11, 1984	Rocker Arm Capscrew Stress Analysis by FaAA
TDI-14	April 16, 1984	Supplement to the Cylinder Head Stud Stress Analysis and Supplement to the Air Start Valve Capscrew Dimension and Stress Analysis by Stone & Webster

Owners Group File No.	Date Submitted	Title
TDI-15	April 16, 1984	Engine Driven Jacket Water Pump Design Review by Stone & Webster
TDI-16	April 19, 1984	Design Review of Push Rods for Transamerica Delaval Diesel Generators by FaAA
TDI-17	April 20, 1984	Evaluation of Emergency Diesel Generator Crankshafts at Shoreham and Grand Gulf Nuclear Power Stations by FaAA
TDI-18	April 24, 1984	Emergency Diesel Generator Engine and Auxiliary Module Wiring Termination to IEEE-383-1974 by Stone & Webster
TDI-19	April 25, 1984	TDI Diesel Generator Supplement to the Rocker Arm Capscrew Stress Analysis by Stone & Webster
TDI-20	April 27, 1984	TDI Engine Instruction Manuals For All TDI Owners Group Diesel Engines, Except River Bend
OGTP-06	April 27, 1984	TDI Owners Group Current Engine Inspection Schedule
OGTP-08	April 27, 1984	Emergency Diesel Generator Fuel Oil Injection Tubing by Stone & Webster
OGTP-09	April 27, 1984	Design Review of Connecting Rods of Transamerica Delaval InLine DSR-48 Emergency Diesel Generators by FaAA

Owners Group File No.	Date Submitted	Title
OGTP-10	April 27, 1984	Design Review of Engine Base and Bearing Caps for Transamerica Delaval Diesel Engines by FaAA
OGTP-13	April 30, 1984	Interim Reports on Turbochargers, Cylinder Heads and Cylinder Blocks/Cylinder Liners by FaAA
OGTP-25	April 14, 1984	Evaluation of Cylinder Heads of Transamerica Delaval Inc. Series R-4 Diesel Engines by FaAA
OGTP-26	May 14, 1984	Design Review of Elliot Model 906 Turbocharger Used on Transamerica Delaval DSR-48 and DSRV-16 Emergency Diesel Generator Sets by FaAA
OGTP-39	May 24, 1984	Evaluation of Emergency Diesel Generator Crankshafts at Shoreham and Grand Gulf Nuclear Power Stations by FaAA
OGTP-40	May 24, 1984	Design Review of Connecting Rods for Transamerica Delaval DSRV-4 Series Diesel Engines by FaAA
OGTP-41	May 24, 1984	Investigation of Types AF and AE Piston Skirts by FaAA (supersedes the February 27, 1984 piston skirt report)
OGTP-50	May 30, 1984	Design Review of Connecting Rods for Delaval DSRV-4 Series DGs - Errata

Owners Group File No.	Date Submitted	Title
OGTP-72	June 19, 1984	The Influence of Thermal Distortion on the Fatigue Performance of AF and AE Piston Skirts by FaAA