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May 31, 1984

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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 MARCH 30, 1984
DOCUMENT DISCOVERY REQUESTS

LILCO hereby responds to Suffolk County's Document Discovery Requests dated March 30, 1984.

General Response

In accordance with the Board's guidelines at the February 17, 1984 prehearing conference and consistent with LILCO's response to the County's February 29, 1984 Document Discovery Requests, LILCO has conducted a search to identify documents that contain the substantive information requested by the County. LILCO has not searched for every document in existence that may be technically responsive to the County's requests.

Many of the documents requested by the County are articles, books or papers that are in the public domain. LILCO has not conducted a search to determine whether these documents are in its possession or control and objects to such a search when the documents can be obtained by the County without the assistance of LILCO. Considering the multitude and scope of the

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document discovery requests submitted by the County to LILCO, a search for and production of documents that are accessible in the public domain to the County is entirely unreasonable and adds needlessly to the existing burden imposed upon LILCO in the course of this discovery.

As noted below, documents responsive to several of the requests are not in the possession or control of LILCO, but may be in the possession of Transamerica Delaval, Inc. (TDI). LILCO has requested TDI to cooperate in responding to these requests.

Some of the documents responsive to the March 30, 1984 Document Discovery Requests include reports by the TDI Owners Group Design Review Quality Revalidation program. Consistent with its response to the February 29, 1984 Document Discovery Requests, LIICO will not produce all documents developed as a part of the DRQR program. As has been the practice, however, final reports have been forwarded to the County as they are completed. Most of those reports have been furnished to the County.

To date, LILCO has not withheld any documents otherwise responsive to the March 30, 1984 Document Discovery Requests under a claim of work product privilege or trial preparation privilege or attorney-client privilege. LILCO did, however, raise such an objection to production of a document specifically requested by letter from the County dated May 2, 1984. The County requested handwritten notes and a report concerning a meeting held on October 17, 1983. By letter dated May 11, 1984, LILCO responded separately to this request objecting to the

production of the report under a claim of attorney-client privilege and work product or trial preparation privilege. Consistent with the Board's February 17 direction, LILCO also reserves the right to make any such objection where appropriate to the March 30, 1984 Document Discovery Requests.

Specific Responses

I. Copies of the references cited in the FaAA reports concerning the Shoreham EDGs or their components, including the following references cited in

A. "Investigation of Types AF and AE Piston Skirts," dated 2/27/84:

1. R. C. Dove and P. H. Adams, Experimental Stress Analysis and Motion Measurement, Charles E. Merrill Books, Inc., Columbus, Ohio, 1964.

Response: LILCO produced this document in response to a request by the Nuclear Regulatory Commission Staff. A copy was also made available to the County.

2. Iron Castings Handbook, edited by C. F. Walton and T. J. Opar, Iron Casting Society, Inc., 1981.

Response: LILCO produced a portion of this document in response to a request by the Commission Staff. A copy was also made available to the County. The entire publication is available in the public domain and is as easily accessible to the County as it is to LILCO. LILCO does not know whether a copy of this document is in its

possession, but objects to the search for and production of a document to the County that is available publicly and can be obtained by the County without undue hardship.

3. R. Reipert, H. Moebus, and K. Schellmann, "Computer Design of a Steel-Nodular Cast Iron Piston Capable of Withstanding High Loads for Application in Medium Speed Diesel Engines," Paper No. 83-DGEP-8, American Society of Mechanical Engineers, New York, 1983.

Response: This document is available in the public domain and is as easily accessible to the County as it is to LILCO. LILCO does not know whether a copy of this document is in its possession, but objects to the search for and production of a document to the County that is available publicly and that can be obtained by the County without undue hardship.

4. H. O. Fuchs, "A Set of Fatigue Failure Criteria," Journal of Basic Engineering, pages 333-343, June 1965.

Response: See response to Reqest No. I.A.3. above.

5. H. O. Fuchs and R. S. Stephens, Metal Fatigue in Engineering, John-Wiley and Sons, Inc., New York, 1980.

Response: See response to Request No. I.A.3. above.

6. D. Broek, Elementary Engineering Fracture Mechanics, Sijthoff and Noordhoff, Alphen aan den Rijn, Netherlands, 1978.

Response: See response to Request No. I.A.3. above.

7. R. K. Nanstad, F. J. Worzalz, and C. R. Loper, Jr., "Static and Dynamic Fracture Toughness of Ductile Cast Iron," AFS Transactions, Proceedings of 79th Annual Meeting, Vol. 83, pages 245-256, 1975.

Response: See response to Request No. I.A.3. above.

8. B. Ostensson, "Fracture Toughness and Fatigue Crack Growth in Nodular Cast Iron," Scandinavian Journal of Metallurgy 2, Vol. 2, No. 4, pages 194-196, 1973.

Response: See response to Request No. I.A.3. above.

9. D. G. Smith, and K. P. Jen, "Fracture Properties of Nodular Iron Castings, Grade 80-55-06," Tennessee Technological University Department of Civil Engineering Report TTU-CE-82-1, Cookville, Tennessee, October 1982.

Response: See response to Request No. I.A.3. above.

10. M. Castagna, P. Ferrero, R. Medana, and E. Natalu, "Fatigue Properties of 'In-Mold' Ductile Iron," AFS International Cast Metals Journal, Vol. 4, No. 4, pages 63-72, December 1979.

Response: See response to Request No. I.A.1. above.

11. M. S. Starkey and P. E. Irving, "A Comparison of the Fatigue Properties of Machined and As-Cast Surfaces of SG Iron," International Journal of Fatigue, page 129-136, July 1982.

Response: See response to Request No. I.A.3. above.

12. S. T. Rolfe and J. M. Barson, Fracture and Fatigue Control in Structures, Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 1977.

Response: See response to Request No. I.A.3. above.

13. P. M. Besuner, et al., "BIGIF - Fracture Mechanics Code," EPRI Report NP-1830-CCM, Electric Power Research Institute, Palo Alto, California, 1981.

Response: See response to Request No. I.A.3. above.

14. A. Yuen, S. W. Hopkins, G. R. Leverant, and C. A. Rau, "Calculations Between Fracture Surface Appearance and Fracture Mechanics Parameters for Stage II Fatigue Crack Propagation in Ti-6Al-4V," Metallurgical Transactions, Vol. 5, pages 1833-1842, August 1974.

Response: See response to Request No. I.A.3. above.

15. P. M. Besuner, and S. A. Rau, "Stress and Subcritical Crack Growth Analysis Under Contained Plastic Conditions," EPRI Report NP-81-8-LD, Electric Power Research Institute, Palo Alto, California, 1981.

Response: See response to Request No. I.A.3. above.

16. H. Neuber, "Theory of Stress Concentration for Shear Strained Prismatical Bodies with Arbitrary Nonlinear Stress-Strain Law," Journal of Applied Mechanics, pages 544-550, December 1961.8.

Response: See response to Request No. I.A.3. above.

B. "Design Review of Connecting Rod Bearing Shells for Transamerica Delaval Enterprise Engines," dated 3/12/84, and "Analysis of Replacement Connecting Rod Bearings for Emergency Diesel Generators, Fatigue Life Prediction, Shoreham Nuclear Power Station," dated 12/15/83:

1. Aluminum Company of America, Alcoa Aluminum Design Data, Pittsburgh, Pennsylvania, 1977.

Response: See response to Request No. I.A.3. above.

2. R. Ewing (Manager of Engineering, Heavy Bearings, Imperial Clevite Inc., Engine Parts Division), private communication with L. A. Swanger (FaAA), November 2, 1983.

Response: LILCO produced a document responsive to this request.

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

Response: LILCO produced a document responsive to this request.

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

Response: See response to Request No. I.A.3. above.

5. Ross, J. M. and R. R. Slaymaker, "Journal Center Orbits in Piston Engine Bearings," SAE Paper 690114, Society of Automotive Engineers, Warrendale, Pennsylvania, 1969.

Response: See response to Request No. I.A.3. above.

6. Hollander, M. and K.A. Bryda, "Interpretation of Engine Bearing Performance by Journal Orbit Analysis," SAE Paper 830062, Society of Automotive Engineers, Warrendale, Pennsylvania, 1983.

Response: See response to Request No. I.A.3. above.

7. W. A. Yahraus (Manager of Product Analysis, Imperial Clevite Inc., Engine Parts Division), private communication with L. A. Swanger (FaAA), October 4, 1983.

Response: LILCO produced a document responsive to this request.

8. Journal Orbital analyses of TDI Enterprise R-48 Diesel Engine performed by Imperial Clevite Inc. for FaAA, October 6, 1983.

Response: LILCO produced a document responsive to this request.

9. H. O. Fuchs and R. I. Stephens, Metal Fatigue in Engineering, John Wiley & Sons, New York, 1980.

Response: See response to Request No. I.A.3. above.

10. Besuner, P. M., S. S. Rau, C. S. Davis, G. W. Rogers, J. L. Grover and D. C. Peters, "BIGIF: Fracture Mechanics Code for Structures," (Manuals 1, 2 and 3) EPRI Technical Report NP-1830, Failure Analysis Associates Report, April 1981.

Response: This information may be subject to a proprietary agreement with the Electric Power Research Institute. LILCO is attempting to determine what portion can be produced and will forward the information as soon as it becomes available.

C. "Emergency Diesel Generator Crankshaft Failure Investigation, Shoreham Nuclear Power Station," dated 10/31/83:

1. Thomson, William T., Theory of Vibration with Applications, 2nd ed., Prentice-Hall, 1981.

Response: See response to Request No. I.A.3. above.

2. Hartog, Den, Mechanical Vibrations, 3rd ed., McGraw-Hill, 1947.

Response: See response to Request No. I.A.3. above.

3. Yang, Roland, Torsional and Lateral Critical Speed Analysis: Engine Numbers 74010/12 Delaval-Enterprise Engine Model DSR-48 3500 KW/4889 BHP at 450 RMP, Transamerica Delaval Inc., Engine and Compressor Division, Oakland, California, August 1, 1974, revised May 1, 1975.

Response: TDI produced this document to the County for review on March 22 and 23, 1984. LILCO also produced a document responsive to this request.

4. Yang, Roland, Torsiograph and Shaft Amplitude Tests: Stone and Webster Engineering Corporation for Long Island Lighting Company Delaval-Enterprise Engine Model DSR-48 Serial No. 74010, January 5, 1976.

Response: LILCO produced a document responsive to this request.

5. Porter, Frederic P., Harmonic Coefficients of Engine Torque Curves. Journal of Applied Mechanics, March 1943.

Response: See response to Request No. I.A.3. above.

6. Craig, Roy R., Jr., Structural Dynamics: An Introduction to Computer Methods, Wiley, 1981.

Response: See response to Request No. I.A.3. above.

7. Standard Practices for Low and Medium Speed Stationary Diesel and Gas Engines, Diesel Engine Manufacturers Association, 6th ed., 1972.

Response: See response to Request No. I.A.3. above.

8. Yang, Roland, Proposed Torsional and Lateral Critical Speed Analysis: Engine Numbers 74010/12 Delaval-Enterprise Engine Model DSR-48 3500 KW/4889 BHP at 450 RPM, Transamerica Delaval Inc., Engine and Compressor Division, Oakland, California, August 22, 1983.

Response: LILCO produced a document responsive to this request.

9. Long Island Lighting Company, Diesel Generator Sets, Purchase Spec., Sh1-89, Rev. 2, January 26, 1983.

Response: LILCO produced a document responsive to this request.

10. Timoshenko, S., D. H. Young, and W. Weaver, Jr., Vibration Problems in Engineering, 4th ed., Wiley, 1974.

Response: See response to Request No. I.A.3. above.

11. Lloyd's Register of Shipping, Guidance Notes on Torsional Vibration Characteristics of main and Auxiliary Oil Engines.

Response: See response to Request No. I.A.3. above.

12. Bridge, Thomas M., Field Torsiograph Test Report for Long Island Lighting Company Enterprise Engine Model DSR-48, Serial Number 74010, LILCO DG-101, Transamerica Delaval Inc., Engine and Compressor Division, Oakland, California, October 5, 1983.

Response: LILCO produced a document responsive to this request.

D. "Failure Analysis of Fractured Rocker Arm Hold Down Capscrew TDI Enterprise Emergency Generators," dated 2/27/84:

1. IITRI FRACTURE HANDBOOK, Edited by S. Bhattacharyya, F. E. Johnson, S. Agarwal, and M. A. H. Howes.

Response: See response to Request No. I.A.3. above.

2. Failure Analysis of Metallic Materials by Scanning Electron Microscopy, IIT Research Institute, Chicago, Illinois, January 1979.

Response: See response to Request No. I.A.3. above.

II. Copies of the references cited in Stone & Webster reports and analyses concerning the components of the Shoreham EDGs, including the following references cited in:

A. "Emergency Diesel Generator Rocker Arm Capscrew Stress Analysis, March 1984":

1. SWEC Calculation 11600.60-245.1-M2.

Response: See response to Request No. I.A.1. above.

2. Mechanical Engineering Design, J. E. Shigley, 3rd edition.

Response: See response to Request No. I.A.1. above.

3. Engineering Properties of Steel, ASM 1982.

Response: See response to Request No. I.A.3. above.

4. Simple Diagrams in Analyzing Forces in Bolted Joints, Assembly Engineering, G. Meyer 1972.

Response: See response to Request No. I.A.4 above.

III. Documents showing the <u>results</u> of photoelastic analyses performed on the original and replacement connecting rods on the Shoreham EDGs.

Response: Photoelastic analyses have not been performed on the original or replacement connecting rods.

IV. Documents showing the results of stress analyses performed to verify the change in design from the original to the replacement connecting rods on the Shoreham EDGs.

Response: The TDI Owners Group recently issued the report on Design Review of Connecting Rods of Inline DSR-48 Engines that is responsive to this request. A copy was made available to the County. LILCO also produced other documents responsive to this request.

V. Documents showing the results of analyses performed on the effect of thermal stress or distortion of the piston crown and wrist pin on the TDI type AE and AF pistons.

Response: A TDI Owners Group report that will contain information responsive to this request in regard to the piston crown will be issued within the next several weeks. At that time, a copy will be made available to the County.

VI. Documents showing the results of x-ray inspections of connecting rod bearings (see NRC Morning Report dated March 16, 1984).

Response: LILCO produced documents responsive to this request.

VII. Documents and drawings showing the modifications made to the Shoreham turbochargers as a result of the turbocharger thrust bearing failures in February 1984. See NRC Morning Reports dated February 6, 10, and 14.

Response: The TDI Owners Group recently issued a report on the Design Review of Elliot Model 90G Turbocharger used on TDI DSR-48 and DSRU-16 Emergency Diesel Generator Sets that is responsive to this request. A copy was made available to the County.

VIII. Documents showing the results of inspections, reports, examinations and failure analyses of:

A. the exhaust pipe that cracked on EDG 101 (see Morning Reports dated February 28-29 and March 1, 1984) and any other exhaust pipe that cracked or had linear indications on TDI series R-4 diesel engines;

Response: LILCO produced documents responsive to this request.

B. the connecting rod wrist pin bronze bearing on EDG 102 that had linear indications (see NRC Morning Report dated February 16, 1984) and any other such bearing that had linear indications, cracks or failures on TDI series R-4 diesel engines;

Response: The TDI Owners Group recently issued the report on Design Review of Connecting Rods of Inline DSR-48 Engines that is responsive to this request. A copy was made available to the County. LILCO also produced other documents responsive to this request.

C. the exhaust manifold support that broke on EDG 101 (see NRC Morning Report dated March 5, 1984); and any other such

bolt that broke, cracked, had linear indications or failed on TDI series R-4 diesel engines;

Response: LILCO produced documents responsive to this request.

D. the jacket water pump from which the impeller came loose from the shaft (see NRC Morning Reports dated March 6, 7, 8, and 9);

Response: The TDI Owner's Group recently issued a report entitled Emergency Diesel Generator Design Review Engine Driven Jacket Water Pump, S&W Calculation Jacket Water Pump that is responsive to this request. A copy was made available to the County. LILCO also produced other documents responsive to this request.

E. the connecting rod wrist pin bushings that cracked on EDG 103 (see NRC Morning Report dated March 13, 1984) and any other such bushings that cracked, had linear indications or failed on TDI series R-4 diesel engines;

Response: See response to Request No. VIII.B. above.

F. the failure of EDG 103 to reach power levels beyond 3890 KW (see NRC Morning Reports dated March 5-9, 1984).

Response: LILCO produced documents responsive to this request.

IX. Sales literature for the TDI series R-4 diesel engine.

Response: LILCO does not have in its possession documents responsive to this request, but has asked TDI to cooperate in responding to this request.

X. Minutes, notes and other documents reflecting meetings or discussions with DEMA, ABS, Det Norske Veritas, Nippon Kaiji Kyokai and Lloyd's, and correspondence with the foregoing, concerning the TDI series R-4 diesel engine or its components.

Response: The TDI Owners Group recently issued the Diesel Generator Report on the Evaluation of Emergency Diesel Generator Crankshafts that is, in part, responsive to this request. LILCO does not have additional documents in its possession that are responsive to this request, but has asked TDI to cooperate in responding to this request.

XI. Current Organizational Charts for the TDI Engine and Compressor Division.

Response: See response to Request No. IX. above.

XII. Photographs of all defects and deficiencies in the components of the Shoreham EDGs since August 12, 1983, and photographs of the failed cylinder heads that were replaced immediately prior to the August 12 crankshaft failure at Shoreham.

Response: The TDI Owners Group recently issued the Diesel Generator Report on Design Review of Connecting Rods of Inline DSR-48 Engines that is, in part, responsive to this request. In addition, LILCO produced photographs of the

cylinder block during the May 2, 1984 deposition held in Wading River, New York. Upon reasonable notice of the time and identification of the specific photographs desired, LILCO will make additional photographs responsive to this request available for inspection by the County at the Shoreham Nuclear Power Station in Wading River, New York.

XIII. Documents showing the results of inspections, reports, examinations and failures analyses of, Elliott turbochargers on the Shoreham EDGs and on other TDI series R-4 or RV-4 diesel engines with the same design turbocharger.

Response: See response to Request No. VII above.

XIV. Documents showing the results of inspections, reports, examinations and failure analyses of, exhaust valves on the Shoreham EDGs and on other TDI series R-4 or RV-4 diesel engines with the same design valve.

Response: LILCO produced documents responsive to this request regarding the Shoreham EDGs. The component tracking system, which has already been provided to the County, responds to this request regarding other TDI series R-4 or tne RV-4 diesel engines.

XV. Documents showing the spring rate for exhaust valve springs on the Shoreham EDGs, and documents showing the amount of

compression per inch and the amount of compression on the spring when held in place on the valve for the Shoreham EDGs.

Response: See Response to Request No. IX. above.

XVI. Documents showing the cetane number or cetane index for the type of fuel used for the test bed engine characteristics data for the Shoreham EDGs.

Request: LILCO produced documents responsive to this request.

XVII. Documents showing installation procedures for the Shoreham EDGs and their components.

Response: LILCO produced documents responsive to this request.

XVIII. To the extent not previously requested by the County, documents showing

A. valve timing data for inlet and exhaust valves on the Shoreham EDGs,

Response: Volume I of the TDI Owners Manual, which is already in the County's possession, contains information responsive to this request.

B. fuel injection timing data for the Shoreham EDGs,

Response: See response to Request No. XVIII.A. above.

C. "isicorder continuous plots of cyli-der pressure against time/angle (showing four pressure waves) 75%, 100% and 110% loads for the TDI series R-48 and R-46 diesel engines.

Response: See response to Request No. IX above.

D. fuel pump characteristics and fuel consumption data for the Shoreham EDGs,

Response: Volume III of the TDI Owners Manual, which is already in the County's possession, contains information responsive to this request.

E. engine characteristics curves based on test bed data for the Shoreham EDGs, and

Response: See response to Request No. IX above.

F. P/V diagrams for the Shoreham EDGs.

Response: See response to Request No. IX above.

XIX. Documents showing

A. Nippon Kaiji Kyokai Rule "Rules and Detailed Rules for Diesel Engine Crankshafts and Those Explanations,"

Response: See response to Request No. I.A.3. above.

B. IACS Draft "Rules for the Calculation of Crankshafts for Diesel Engines, (edited version and unedited version), and

Response: See response to Request No. I.A.3. above.

C. Cimac Proposal "Rules on Calculation of Crankshafts for Diesel Engines (4. Draft).

Response: See response to Request No. I.A.3. above.

Respectfully submitted,

LONG ISLAND LIGHTING COMPANY

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DATED: May 31, 1984

LILCO, May 31, 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 March 30, 1984 Document Discovery Requests was served this date upon the following by first-class mail, postage prepaid, or by Federal Express as noted by an asterisk:

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DATED: May 31, 1984