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A-C-39. 9/20/84
DOCKETED
USNRC

LILCO, August 14, 1984

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

Before the Atomic Safety and Licensing Board

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OFFICE OF SECRETARY
DOCKETING & SUPPORT
AL/CO

In the Matter of)
LONG ISLAND LIGHTING COMPANY)
(Shoreham Nuclear Power)
Station, Unit 1))

Docket No. 50-322(OL)

CRANKSHAFT EXHIBITS

TESTIMONY OF ROBERT L. MCCARTHY, PAUL R. JOHNSTON,
EUGENE MONTGOMERY AND SIMON K. CHEN

AND

TESTIMONY OF EDWARD YOUNGLING
AND FRANZ PISCHINGER

AND

TESTIMONY OF CLIFFORD WELLS, DUANE
JOHNSON, HARRY WACHOB, CRAIG SEAMAN, DOMINIC CIMINO
AND N. K. BURRELL

VOLUME IV

Exhibits 27 - 39

LILCO, August 14, 1984

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NUCLEAR REGULATORY COMMISSION

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

CRANKSHAFT EXHIBITS

- C-1 Evaluation of Emergency Diesel Generator Crankshafts at Shoreham and Grand Gulf Nuclear Power Stations prepared for TDI Diesel Generator Owners Group dated May 22, 1984 (hereinafter "Owners Group Crankshaft Report"), Figure 3-4.
- C-2 Specification for Diesel Generator Sets, Shoreham Nuclear Power Station - Unit 1, Spec. No. SH1-89, Revision 2, January 26, 1983, page 1-20.
- C-3 U.S. Nuclear Regulatory Commission Regulatory Guide 1.9, Revision 2, December 1979.
- C-4 IEEE Standard Criteria for Diesel-Generator Units Applied as Standby Power Supplies for Nuclear Power Generating Stations, Std 387-1977.
- C-5 Transcript of July 11, 1984 meeting of the TDI Diesel Generator Owners Group, pages 124-25.
- C-6 Available Logged Hours of Operation of DSR-48, Rated 3500 KW @ 450 RPM.
- C-7 TDI Diesel Generator Run History - Shoreham Nuclear Power Station - Unit 1 - August 6, 1984.
- C-8 Results of non-destructive examinations of replacement crankshafts at Shoreham after 100 hours of operation at full load or greater.
- C-9 American Bureau of Shipping, Rules for Building and Classing Steel Vessels (1983), § 37.17.1.

- C-10 American Bureau of Shipping, Rules for Building and Classing Steel Vessels (1983), Table 34.3.
- C-11 TDI Crankshaft Drawing Number 03-310-05-AC.
- C-12 American Bureau of Shipping Reports on Castings or Forgings of Replacement Crankshafts.
- C-13 American Bureau of Shipping letter to TDI dated May 3, 1984.
- C-14 Diesel Engine Manufacturers Association Standard Practices for Low and Medium Speed Stationary Diesel and Gas Engines (1972 ed.), pages 53-56.
- C-15 TDI Proposed Torsional and Lateral Critical Speed Analysis, August 22, 1983.
- C-16 Field Test of Emergency Diesel Generator 103 with 13 x 12 Crankshaft, April, 1984.
- C-17 Owners Group Crankshaft Report.
- C-18 Crankshaft Torsional Stress Calculations for 8L 17 x 21 Engine-Generator Set, July 19, 1984.
- C-19 Table 2.2 from Owners Group Crankshaft Report showing natural frequencies from TDI analysis.
- C-20 Table 2.4 from Owners Group Crankshaft Report showing single order nominal stresses from TDI analysis.
- C-21 Table 2.5 from Owners Group Crankshaft Report showing nominal stresses calculated from torsigraph.
- C-22 Crankshaft Torsional Stress Calculations for 8L 17 x 21 Engine-Generator Set, July 19, 1984, page 11.
- C-23 Figure 3-3 from Owners Group Report showing comparison of measured and calculated torque.
- C-24 Tables 3.6 and 3.7 from Owners Group Crankshaft Report showing comparison between analytical and test results.
- C-25 Figure 3-13 from Owners Group Crankshaft Report showing fatigue endurance limit of replacement crankshafts on Goodman diagram.
- C-26 Oberg and Jones, Machinery's Handbook (18th Ed.) pages 352-53; Shigley, Mechanical Engineering Design (McGraw-Hill) pages 212-13; Rothbart (editor), Mechanical Design and Systems Handbook (McGraw-Hill) page 18-4.

- C-27 Engineering and Design Coordination Report No. F-46109G.
- C-28 Military Specification No. 13165B, Amendment 2, June 25, 1979.
- C-29 LILCO Operational Quality Assurance Reports (EDG 102 and 103 Crankshafts).
- C-30 Metal Improvement Company Certificate of Shot Peening (EDG 102 and 103 Crankshafts).
- C-31 Certificate of Non-Destructive Testing Issued by Krupp Stahl AG (EDG 102 and 103 Crankshafts).
- C-32 LILCO Magnetic Particle Testing and Liquid Penetrant Testing Records (EDG 102 and 103 Crankshafts).
- C-33 LILCO Ultra Sonic Testing Records (EDG 102 and 103 Crankshafts).
- C-34 H. Fuchs and R. Stevens, Metal Fatigue in Engineering (1980) at pages 226-227; H. Uhlig, Corrosion and Corrosion Control at pages 132-133.
- C-35 Metal Improvement Company Certificate of Shot Peening (EDG 101 Crankshaft).
- C-36 LILCO Operational Quality Assurance Reports (EDG 101 Crankshaft).
- C-37 Certificates of Non-Destructive Testing Issued by Krupp Stahl AG (EDG 101 Crankshaft).
- C-38 LILCO Magnetic Particle Testing, Liquid Penetrant Testing and Ultra Sonic Testing Records (EDG 101 Crankshaft).
- C-39 Kirk, Behavior of Peen-Formed Steel Strip on Isochronal Annealing, Proceedings of the Second International Conference on Shot Peening at page 231, (May, 1984).

NUCLEAR REGULATORY COMMISSION

Docket No. 50-322-06 Official Exh. No. C-27

In the matter of LILCO - Shoreham

Staff ✓ IDENTIFIED ✓

Applicant ✓ RECEIVED ✓

Intervenor _____ REJECTED _____

Cont'g Off'r _____ DATE 9-20-84

Contractor _____ Witness Panel

Other _____

Reporter ACE

C-27-1

STONE & WEBSTER ENGINEERING CORPORATION
ENGINEERING & DESIGN COORDINATION REPORT

NO. P-4610
JOB NO. 117703

PROJECT / CLIENT: SHOREHAM NUCLEAR POWER STATION UNIT 1
LONG ISLAND LIGHTING COMPANY R43. A/B

REFERENCES:

PROBLEM DESCRIPTION:

Delaval has identified "holidays" or lack of shot peen coverage in the fillet areas of the new diesel crankshafts, purchased in accordance with E&DCR F-46109C. These holidays have been determined to be functionally acceptable by TDI, however, recent analysis performed by Failure Analysis Associates indicate that 100% peening coverage is beneficial.

Please resolve.

RECEIVED
DOCUMENT CONTROL
SEP 19 1983
CONSTRUCTION OFFICE
SHOREHAM PROJECT

TELECOPY DATE
REQUESTING UNIT
Sent:
Revised:

Requested By: J.C. Kammerer Dept. or Div. SEO Total Est. 404 Date 9/15/83 Approved By: J.C. Kammerer

PROBLEM SOLUTION:

Since the crankshafts are delivered to the site, Metal Improvements Co., a local firm with extensive experience in shot peening of crankshafts, will perform the rework. The fillet areas shall be re-peened in accordance with the requirements of MIL-S-13165B to assure 100% coverage of the fillet areas. Peening shall be performed by Metal Improvements Co. on site and the crankshaft inspected by OQA for 100% peening at the fillet areas. Refer to attached procedure.

TDI QC inspection of journal bearing masking is required prior to commencing shot peening.

TDI approval for shot peening procedure has been obtained, AFFECTS WORK UNDER SPECIFICATION SHI-89 written approval to be filed with IMPLEMENTATION VERIFICATION ☐ IS REQUIRED ☒ IS NOT VERIFIED BY R/R at close out.

TELECOPY DATE
RESPONDING UNIT
Sent:
Revised:

Furnished By: J.C. Kammerer Date 9/16/83 Responsible Lead Engr. J.C. Kammerer R.N. Zisch Date 9/16/83

- ☐ INFORMATION ONLY
- ☒ DRAWING CHANGE
- ☒ MANUAL CHANGE
- ☐ PROCEDURE CHANGE
- ☐ ENG. SERV. SCOPE OF WORK CHANGE
- Change will ☒ be incorporated in the ☐ following documents:

Project Design Engr. NR Date 9/16/83
Equipment Specialist NR Date 9/16/83
Qual. Sys. Div. or Eng. Assur. Div. NR Date 9/16/83
Materials Engr. NR Date 9/16/83

ESAR CHANGE 7 NR
CLIENT APPROVAL
☒ Required ☐ Not Req.
Obtained Date: 9/16/83
Reference: Taken up check

- ☒ Nuclear Safety Related (QA Cat I)
- ☐ Not Nuclear Safety Related (☐ QA Cat II ☐ QA Cat III)

Project Engineer Approval & Date
J.C. Kammerer 9/16/83
La P. Holden

- CLIENT DISTRIBUTION - CLIENT USE ONLY
- ☐ Engineering
- ☐ Project Manager
- ☐
- ☐

HEADQUARTERS		FIELD DISTRIBUTION		CONST. SUPERVISORS	
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<input type="checkbox"/> Resp. Engr.	<input type="checkbox"/> Supt. Const. Serv.	<input checked="" type="checkbox"/> Client Const. Insp.	<input checked="" type="checkbox"/> <u>M. W. Sullivan</u>	<input type="checkbox"/> Electrical	<input type="checkbox"/>
<input type="checkbox"/> Equip. Spec.	<input type="checkbox"/> Ch. Engr.-EA Div.	<input checked="" type="checkbox"/> SEW FOC	<input checked="" type="checkbox"/> <u>C. K. Smith</u>	<input type="checkbox"/> Piping	<input type="checkbox"/>
<input checked="" type="checkbox"/> Mat'l Engr.	<input checked="" type="checkbox"/> <u>R. N. Zisch</u>	<input checked="" type="checkbox"/> SGW Res. Engr.	<input checked="" type="checkbox"/> <u>P. M. Smith</u>	<input type="checkbox"/> Welding	<input type="checkbox"/>
<input type="checkbox"/> QA-Qual. Sys. D.	<input type="checkbox"/>	<input type="checkbox"/> Fil. Des. Engr.	<input checked="" type="checkbox"/> <u>G. V. Kelly</u>	<input type="checkbox"/> Instrument	<input type="checkbox"/>
<input type="checkbox"/> QA-POC Div.	<input checked="" type="checkbox"/> <u>L. F. Frazier</u>	<input type="checkbox"/> Head-File Est. O.	<input checked="" type="checkbox"/> <u>R. C. Cordella</u>	<input type="checkbox"/> Planning	<input type="checkbox"/>
<input type="checkbox"/> QA-FOC Div.	<input checked="" type="checkbox"/> <u>J. P. O'Neil</u>	<input checked="" type="checkbox"/> T. Brown	<input checked="" type="checkbox"/> <u>R. E. Smith</u>		

Delaval

185th Avenue
Box 2161
Oakland, California 94621
(415) 577-7400

EIDCR F46.09

Pg 2 of 3

Date: September 12, 1983

To: John Kammeyer

From: Ken Kropf

Subject: Diesel Generators TDI S/N 74010-12
Holidays in Shot-Peening on Crankshaft
#693, PC# 8162, HT# 821487

There are two areas on top of # 1 Pin directly adjacent to the crank pin and at the outer edge of the crank radius that have Holidays in the Shot-Peening. These holidays are in a relatively low stressed area of the crankshaft. I have looked at these areas and disposition them functionally acceptable.

The TDI procedure for shot peening the LILCO crankshaft is also attached.

Ken Kropf

Ken Kropf
Supervisor, Quality Control

cc: V. Dilworth
R. Giordanelli
R. Boyer
J. Gee
D. Wulf

Procedure for Peening Crankshafts

1. Machinery used to perform peening shall be qualified using Almen C strip to an arc height of .008" to 0.10".

Machinery shall be qualified prior to beginning each shift and every 4 hours thereafter.

Almen C strips shall be marked with the date, time, operator and Almen C reading forwarded to permanent plant file.

2. Shot for peening shall conform to the following. Shot shall be in conformance with the requirements of MI 550. Hardness of shot shall be R_c 45 to 52.
3. FaAA shall document via pictures of the before and after condition of fillets.
4. Peening on crankshaft shall be confined to fillets. TDI and FaAA shall approve all masked areas prior to peening. Tolerances for masking is 0" into fillet and $\frac{1}{32}$ " into pin.
5. Peening of the unmasked areas shall be performed in accordance with MIL-S-13165B.
6. Peened areas shall be inspected by peenscan method. Acceptance criteria is 100% as verified by lack of UV trace in peened areas.

F-46109 G

79 308 3

LILCONUCL SHRM

SEPTEMBER 16, 1983

ATTN: MR. JOHN KAMMEYER

TRANSAMERICA DELAVAL (TDI) REITERATES THAT THE 12 X 13 LDCR CRANKSHAFTS SUPPLIED TO LILCO DO NOT REQUIRE ANY SHOT PEENING. LILCO DIRECTED TDI TO SHOT PEEN THE FILLETS OF THOSE TITLE SHAFTS AND TDI HAS COMPLIED BY SO DOING IN THE MANNER THAT HAS BEEN OUR STANDARD PRACTICE ON OTHER SIMILAR CRANKSHAFTS. BOTH TDI AND SLECO (LILCO'S REPRESENTATIVE) INSPECTED AND ACCEPTED THE SHOT PEENING PRIOR TO SHIPMENT OF THE TWO SHAFTS NOT ON-SITE.

LILCO HAS NOW ADVISED TDI THAT THIS SAME WORK HAS BEEN REINSPECTED AND IS JUDGED BY LILCO'S CONSULTANTS TO PERMITS REWORK IN THE FORM OF FURTHER SHOT PEENING. WE DISAGREE BUT ARE WILLING TO OBSERVE SUCH REWORK AND VERIFY THAT BEARING SURFACES ARE NOT DAMAGED IN THE PROCESS.

WE ARE COMPLETELY WITHOUT PRIOR EXPERIENCE WITH RE-SHOT PEENED CRANKSHAFTS. FROM A TECHNICAL VIEWPOINT, WE AGREE THAT RE-SHOT PEENING THE CRANKSHAFT FILLETS MAY BRING THE SURFACE IMPROVEMENT AND SEE NO REASON FOR LILCO NOT TO FOLLOW THE ADVICE OF ITS CONSULTANTS.

WE HAVE REVIEWED THE PROPOSED PROCEDURE AND FIND IT TO BE ACCEPTABLE FOR THE SHOT PEENING OF LARGE ENGINE CRANKSHAFTS.

REGARDS
GEOFF KING
MANAGER, PRODUCT ENGINEERING
TRANSAMERICA DELAVAL INC.
LILCONUCL SHRM
.....
ENTERPRISE OAK

ATTACHMENT TO
E & OOR NO F. 46109 G
Pg 4 of 4

NUCLEAR REGULATORY COMMISSION

Docket No. 50-322-06 Official Exh. No. C-28
in the matter of LILCO - Shoreham
Staff _____ IDENTIFIED ✓
Applicant ✓ RECEIVED ✓
Intervenor _____ REJECTED _____
Cont'g Off'r _____ DATE 9-20-84
Contractor _____ Witness Panel
Other _____
Reporter ACE