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RELATED CORRESPONDENCE



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

November 28, 1984

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Atomic Safety and Licensing Board
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

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Dr. George A. Ferguson
Administrative Judge
School of Engineering
Howard University
2300 - 6th Street, N.W.
Washington, D.C. 20059

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

Dear Administrative Judges:

Enclosed is the response to the letter concerning TDI crankshafts (letter Berlinger to Ray, dated October 10, 1984) which was referenced in the NRC Staff's proposed findings of fact at page 6, footnote 3. The original letter, as well as the response, is enclosed for the convenience of the Board and parties.

The referenced footnote stated that "The Staff has not concluded that the response contains any new significant information which is material to the subject matter of this proceeding, and none is apparent to the Licensing Board."

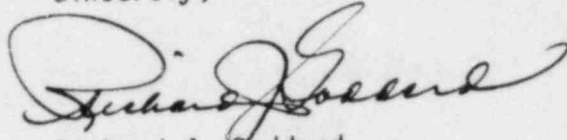
The Staff has now completed its review of the response. The Staff does not deem any material contained therein to be information of such significance as to alter the conclusions regarding adequacy of the crankshafts contained in the testimony of Staff witnesses.

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The Staff will furnish the Board and parties with a report evaluating this response, as directed by the Board at Tr. 26,928 (November 16, 1984).

Sincerely,



Richard J. Goddard
Counsel for NRC Staff

Enclosure:
As stated

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November 6, 1984

OGTP-484-N-43

Mr. C. H. Berlinger
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D. C. 20555

Re: TDI Diesel Generator Owners Group
Request for Additional Information
(C. H. Berlinger to C. L. Ray of October 10, 1984)
File No.: MTS-4086

Dear Mr. Berlinger:

An item by item response for the information requested in the subject letter is provided below:

- 1) The crankshaft forging process is performed in accordance with ASTM A668 with supplementary requirements as noted in Attachment 1. Basically, the crank throws are flame-cut and individually twisted to the angle as per the manufacturer's drawing. Thermal treatment, testing, final machining and final inspection follow in that sequence.
- 2) The location for obtaining tensile specimens is as defined in ASTM A668, subsection 7.1.5.
- 3) Tensile Specimens are machined and tested in accordance with ASTM A370. Specifically, see Section 6, "Test Specimen Parameters".
- 4) See "Emergency Diesel Generator Crankshaft Failure Investigation Shoreham Nuclear Power Station" FaAA-83-10-2. Attached are Figures 3-2, 3-6, 3-54, 3-55, 3-56, 3-58, 3-59 and 3-60 showing pieces of failed crankshaft. Figure 3-2 is a photo of the section worked upon. Figure 3-6 shows the A section of the piece shown in Figure 3-2. Marked upon 3-6 are the cuts made for macroetching, tension test specimens, and hardness measurement. Figures 3-54, 3-55 and 3-56 are photos of the macroetched longitudinal, radial and transverse sections after macroetching. Figures 3-58, 3-59 and 3-60 show the same pieces marked for tension test specimen blanks. The blanks were cut from the flat pieces, and from them were machined tension test specimens that complied with ASTM A370 dimension for 0.250-inch diameter specimens. The tension test data measured using these specimens is listed in Table 3-7.
- 5) No significant variation was observed in the mechanical strength measured using the specimens shown in 4) above. It can also be observed in Figures 3-54, 3-55 and 3-56 that the flow lines changed smoothly from location to location; no laps or sharp directional changes were seen. From these data it was concluded that their mechanical strength was isotropic and uniform in the forged crankshaft.

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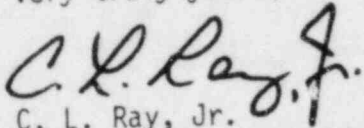
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Mr. C. H. Berlinger
OGTP-484-N-43
November 6, 1984
Page Two

- 6) In addition to the tension tests described above and the macroetched appearance of the samples shown in Figures 3-54, 3-55 and 3-56, the hardness tests were performed on the same cross sections. The hardness data indicated no significant variations over the entire area of the cut cross sections.

Should you have any questions concerning this information, please call R. J. Deese at (704) 373-3489.

Very truly yours,



C. L. Ray, Jr.
Technical Program Director
TDI Diesel Generator Owners Group

CLR/RJD/cth

cc w/attachments: Executive Contacts
Licensing Contacts
H. R. Denton
R. J. Deese

Attachment 1
CRANKSHAFT FORGING SPECIFICATION

1. SCOPE

- 1.1. This specification covers Transamerica Delaval Engine and Compressor Division forgings for crankshafts.

2. GENERAL

- 2.1. The general specification is ASTM A668 E. A certificate of compliance with ABS Grade 4 is also required. The following modifications and additions to the ASTM specification will apply.

2.1.1. The steel shall be vacuum degassed.

2.1.2. The crankshaft flange end shall correspond to the bottom of the ingot. Where more than one crankshaft is formed from a single billet or slab, the flanges shall be in the center of the length.

2.1.3. Ladie chemical range as per ASTM Grade AISI C 1042.

3. SUPPLEMENTARY REQUIREMENTS

3.1. Ultrasonic Testing

- 3.1.1. The shaft shall be ultrasonically inspected in the rough machined and/or finished condition. Ultrasonic inspection and acceptance shall be in accordance with ASTM A503. Sensitivity shall be adjusted per paragraph 5.2.1. of ASTM A503.

3.2. Magnetic Particle Inspection

- 3.2.1. The finished shaft will be magnetic particle inspected by Engine and Compressor Division at Oakland, California. Acceptance will be based on ASTM specification A456-71 (Reapproved 1976).

3.3. Inclusion Test

- 3.3.1. Sufficient stock shall be furnished, at the end corresponding with the top of the ingot, to perform the test for inclusion content as set forth in paragraphs 6 to 10 inclusive of ASTM specifications E45. The unmachined quarter section will be sent to Transamerica Delaval Inc., Engine and Compressor Division at Oakland, California who will machine the cylinder and perform the test. If, in the opinion of Engine and Compressor Division, the results of this test indicate that the finish machined shaft will not pass the requirements, the manufacturer will be notified.

- 3.3.1.1. In the event a shaft is purchased in the finish machined condition, the requirements of paragraph 3.3.1. will also apply.

3.4. Test Reports and Certificates

- 3.4.1. Three copies of all tests conducted by vendor and inspection agency shall be forwarded to the Purchasing Department of Transamerica Delaval Inc., Engine and Compressor Division at Oakland, California 94621 for internal distribution.

3.5. Deviation from Specifications

- 3.5.1. Material defects, dimensional discrepancies or any other deviation from this specification must be reported to Transamerica Delaval Inc., Engine and Compressor Division in triplicate and approval obtained in writing from the Manager of Quality Control prior to shipment. Under no circumstances will welding be permitted.

TRANSAMERICA DELAVAL INC.
ENGINE AND COMPRESSOR DIVISION

850-85th AVENUE, OAKLAND, CALIFORNIA 94621

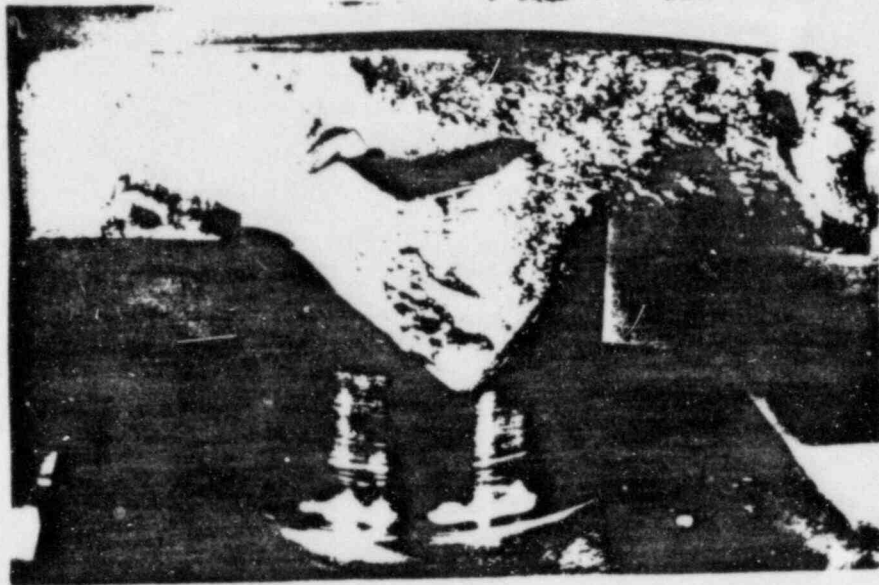


Figure 3-1. Fracture surface through the web and No. 7 crank pin journal.

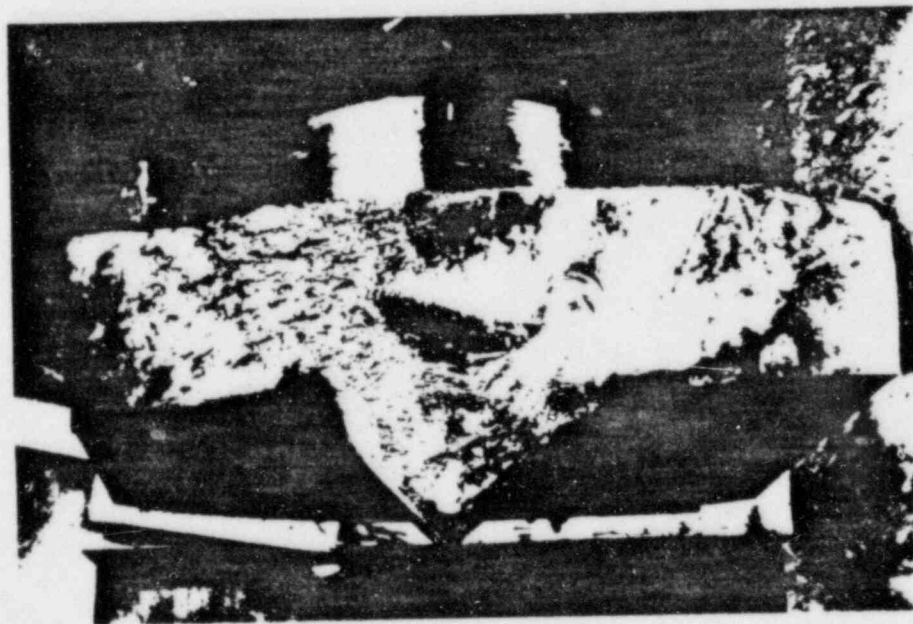


Figure 3-2. Mating fracture surface to the fracture shown in Figure 3-1. Note the No. 9 main journal at the top portion of the web.

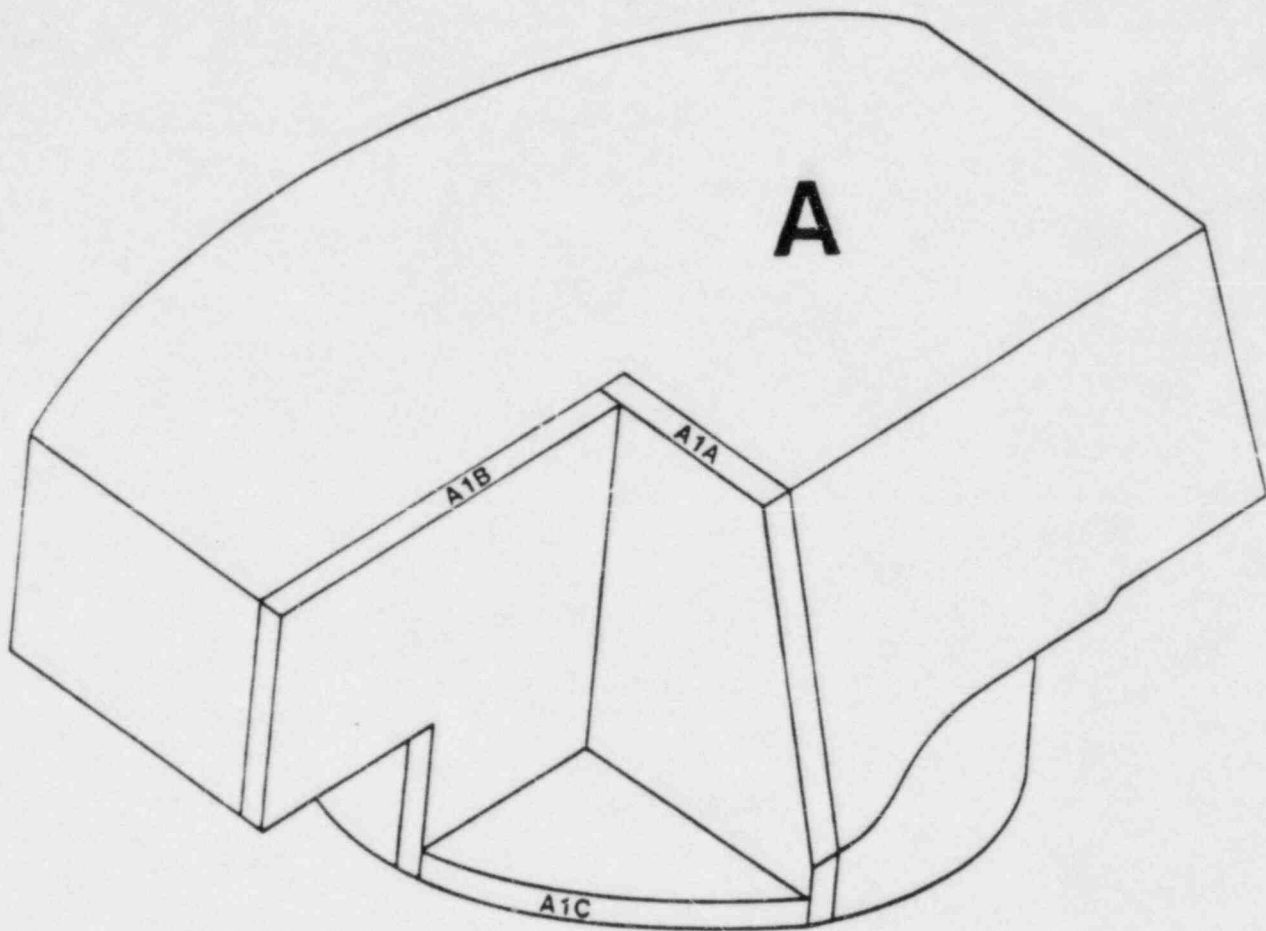


Figure 3-6. Sketch of section A that indicates the location of the orthogonal plates removed for macroetching, tensile tests, and hardness testing.

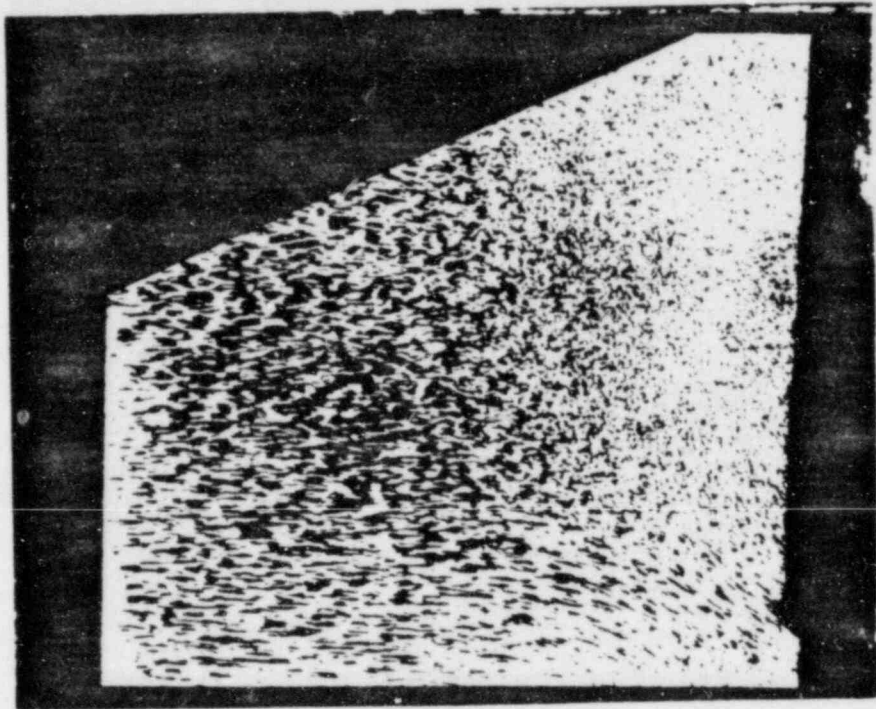


Figure 3-54. Photograph of the macroetched longitudinal (A1A) section.

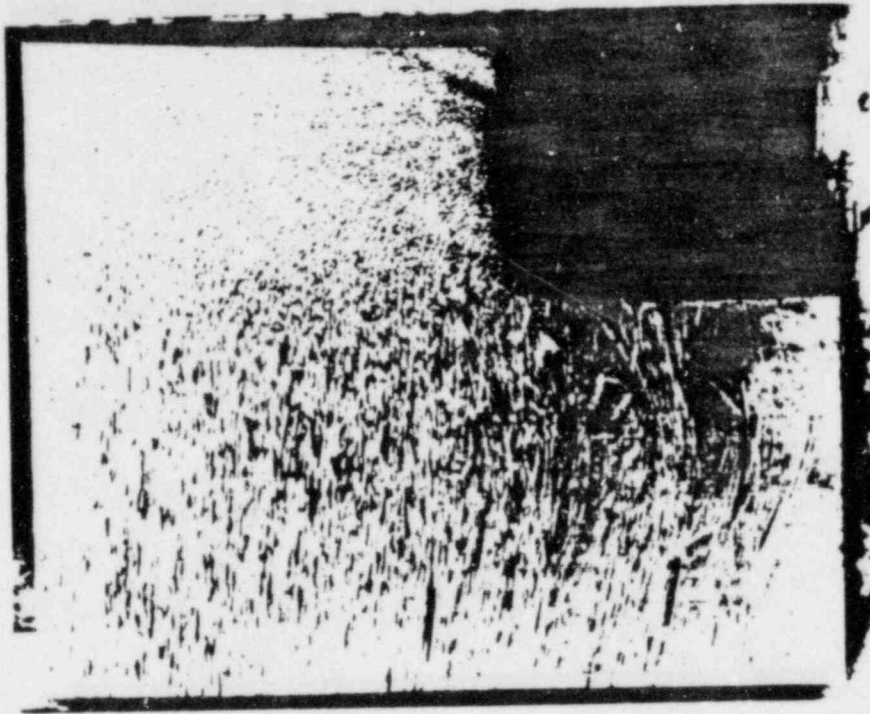


Figure 3-55. Photograph of the macroetched radial (A1B) section.

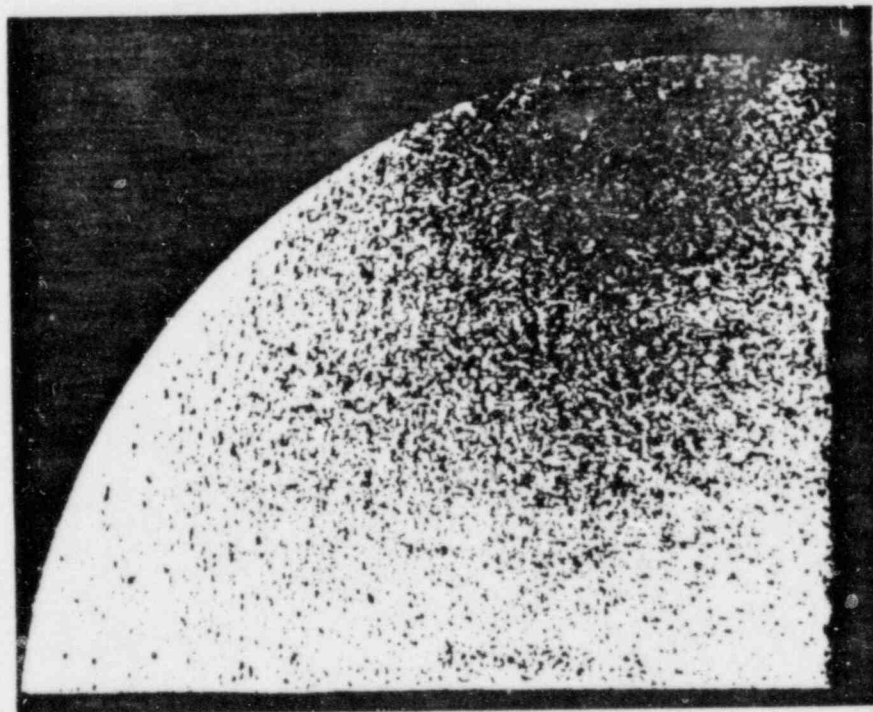


Figure 3-56. Photograph of the macroetched transverse (A1C) section.

Failure
Analysis
Associates

FaAA-83-10-2

TABLE 3-1

Rockwell "B" Hardness of Longitudinal Section

<u>Reading</u>	<u>Rockwell B Hardness</u>
1	84.8
2	86.7
3	87.0
4	82.9
5	86.1
6	87.2
7	87.5
8	83.0
9	86.0
10	88.9
11	86.3
12	87.0
13	85.0
14	86.4
15	83.6
16	84.3

TABLE 3-3

Rockwell "B" Hardness of Transverse Section

<u>Reading</u>	<u>Rockwell B Hardness</u>
1	85.0
2	84.2
3	83.6
4	83.6
5	83.0
6	85.0
7	85.0

3.9 Mechanical Properties

Mechanical properties of the forged crankshaft were measured. Two specimens were taken from each of the macroetch slabs (A1A, A1B, and A1C). Exact locations of longitudinal, radial, and transverse specimens are shown in Figures 3-58, 3-59, and 3-60. Both strength and ductility parameters were measured following guidelines set forth in ASTM specification A370. A constant extension rate of 1/16 inch per minute per inch of gage length was maintained throughout the tests. The mechanical properties measured for each specimen are summarized in Table 3-7. The average yield strength of 45.6 ksi and ultimate strength of 88.8 ksi exceed the minimum values of 37.5 ksi and 75 ksi required by the ABS-Grade 3 specification. In addition, the minimum elongation and reduction in area measurements also exceed the minimum specified value for this steel grade. As a matter of fact, the crankshaft mechanical properties meet the higher requirements of ABS-Grade 4, except for the reduction in area specification.

TABLE 3-7

Summary of Tensile Tests

Specimen Number	Yield Stress (ksi)		Ultimate Strength (ksi)	Elongation (%)	Reduction in Area (%)
	Upper	Lower			
R1	46.6	45.0	89.0	25.4	42.0
R2	45.3	44.9	89.4	30.0	45.1
T1	47.1	45.9	87.6	37.1	49.1
T2	46.9	46.9	88.2	39.0	47.6
L1	47.3	45.9	89.5	25.1	35.3
L2	47.4	44.8	89.1	23.0	30.6
ABS Grade 3		37.5	75.0	19.0	30.0
ABS Grade 4		43.0	83.0	20.0	35.0

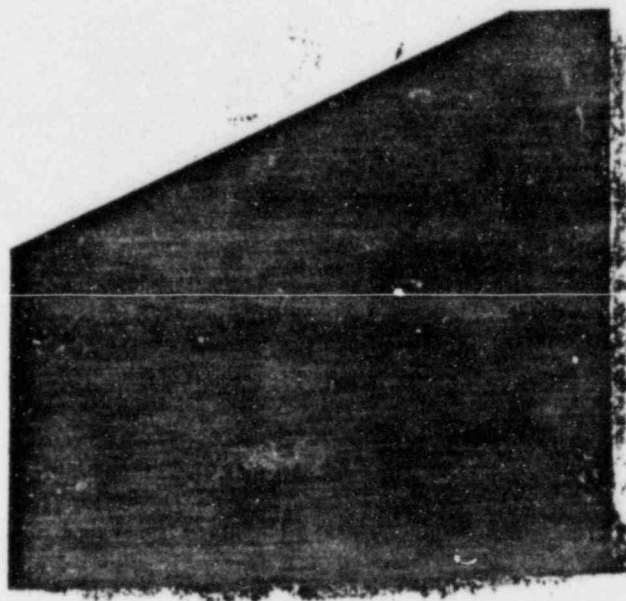


Figure 3-58. Photograph showing the location of the tensile specimens from the longitudinal section.

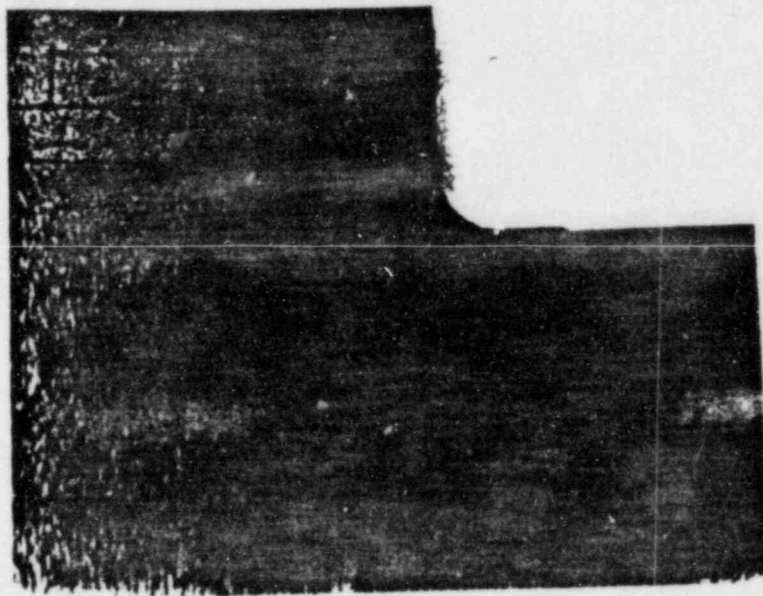


Figure 3-59. Photograph showing the location of the tensile specimens from the radial section.

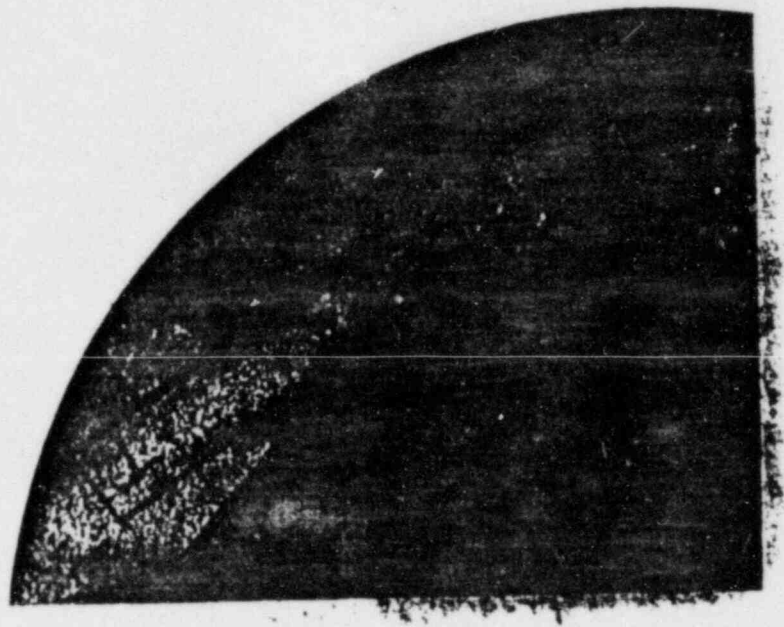


Figure 3-60. Photograph showing the location of the tensile specimens from the transverse section.

TRANSAMERICA DELAVAL, INC.
EMERGENCY DIESEL GENERATOR DISTRIBUTION

<u>Plant</u>	<u>Docket</u>	<u>Utility</u>
Shoreham	50-322	Long Island Lighting
Grand Gulf 1, 2	50-416, 417	Middle South Energy
San Onofre 1	50-205	Southern California Edison
Rancho Seco	50-312	SMUD
River Bend	50-458, 459	Gulf States Utilities
Shearon Harris 1, 2	50-400, 401	Carolina Power and Light
Catawba 1, 2	50-413, 414	Duke Power
Perry 1, 2	50-440, 441	Cleveland Electric Illuminat
Bellefonte 1, 2	50-438, 439	TVA
Comanche Peak 1, 2	50-445, 446	Texas Utilities Services
Vogtle 1, 2	50-424, 425	Georgia Power
Midland 1, 2	50-329, 330	Consumers Power
WNP-1	50-460	Washington Public Power

UNITED STATES
NUCLEAR REGULATORY COMMISSION

WASHINGTON, D. C. 20555

October 10, 1984

Docket Nos.: 50-416/417; 50-322

Mr. Clarence Ray, TDI Owners Group
Transamerica Delaval, Inc.
550 8th Avenue
Post Office Box 2161
Oakland, California 94621

*part of
generic review of
TDI*

Dear Mr. Ray:

SUBJECT: REQUEST FOR ADDITIONAL INFORMATION ON FIGURE 3.13 FaAA REPORT
85-3-16, "EVALUATION OF EMERGENCY DIESEL GENERATOR CRANKSHAFTS
AT SHOREHAM AND GRAND GULF NUCLEAR POWER STATIONS"

In the subject report, Failure Analysis Associates concludes that stresses in the replacement crankshafts for Transamerica Delaval (TDI) diesel generators at the Shoreham Nuclear Power Station are below levels that might lead to crankshaft failure. An evaluation of crankshaft fatigue life requires that these stresses be related to the mechanical properties of the crankshaft. If the stresses remain the same but tensile properties are reduced, the safety margin is reduced accordingly. The same applies for an increase in safety margin with an increase in strength.

In connection with our review of the subject report, we need the following information to evaluate Figure 3.13 and the conclusions drawn by FaAA from that figure concerning fatigue life of the replacement crankshafts:

1. A complete description of the crankshaft forging process with emphasis on whether all forging was limited to two planes or if it covered four surfaces of the billet.
2. A description of the locations of tensile specimens for the replacement crankshafts with regard to region from which taken, depth below surface, orientation, specimen size, etc.
3. Criteria used in selection and testing of specimens (e.g., ASTM, ABS, Purchase Specification).
4. Location of specimens taken by FaAA from the failed crankshaft relative to forged surfaces--depth, specimen size, specimen orientation, etc.
5. Validation other than hardness measurements regarding uniformity of tensile properties across crankshaft thickness.

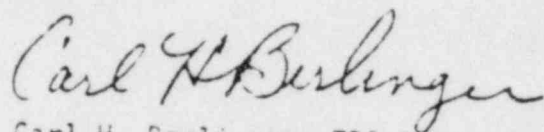
Mr. C. Ray

- 2 -

6. Data to validate lack of anisotropy including bases for selection of specimens (e.g., macro-etching to determine flow lines), type, size, locations and testing conditions of specimens.

Issuance of the NRC staff Safety Evaluation Report on crankshafts is targeted for the end of December 1984. In order to meet this schedule, the above information is requested by November 2, 1984.

Sincerely,



Carl H. Berlinger, TDI Project
Group Leader
Division of Licensing

cc: See next page

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