UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

January 30, 1996

50-498/499

LICENSEE: Houston Lighting and Power Company (HL&P), et al.

FACILITY: South Texas Project, Units 1 and 2 (STP)

SUBJECT: SUMMARY OF JANUARY 18, 1996, MEETING ON THE RESIDUAL HEAT REMOVAL (RHR) PUMP IMPELLER CRACKING

On January 18, 1996, representatives of HL&P and NRC staff met to discuss the above subject. Meeting attendees are listed in Attachment 1. Handouts provided by the licensee are in Attachment 2.

This issue arose in late September 1995 when maintenance technicians were replacing gaskets on the 1C RHR pump and noticed several cracks on the impeller. The licensee replaced the 1C impeller and sent the cracked impeller to a vendor for analysis. Preliminary results were that the martensitic impeller was subjected to weld repair, the weld metal did not conform to specification, the impeller was not post-weld heat treated as specified, and that the shroud area near the lower ring area was machined to a thickness below specification. However, the licensee performed an operability evaluation and concluded that the 1C pump was still operable.

At the suggestion of NRC, the licensee inspected the 2B RHR impeller in November 1995. The licensee's preliminary conclusion of the 2B impeller was that no visible cracks were observed and that it was an acceptable spare.

The licensee has determined that there were three types of cracking on the 1C RHR impeller. They were wear ring axial cracking, shroud circumferential cracking, and vane weld repair cracking.

The wear ring axial cracking was due to improper flame hardening which made the wear ring susceptible to stress corrosion cracking. The proper flame hardening depth was not achieved on the suction ring wear side. However, the licensee verified that the proper flame hardening depth was achieved for the 1C backside wear ring and 4 additional wear rings.

The circumferential cracking in the shroud radius region was a result of overmachining of the impeller shroud radius. The design nominal thickness is 0.325 inch and the minimum 1C shroud thickness was 0.015 inch. However, the licensee verified proper thickness of the 2B impeller and two spare impellers.

The cracking in the heat affected zones of vane weld repairs was caused by improper weld filler material. Austenitic weld filler material was used to make repairs in the martensitic material, producing residual tensile stresses. However, the licensee observed that weld repairs with the proper (martensitic) weld material did not crack because the use of martensitic weld material produced residual compressive stresses.

The licensee concluded that the cracking identified in the 1C impeller was an isolated condition and that no generic issues exist with the impellers. The licensee's reasons for this conclusion are that there is no evidence of similar problems with the other RHR impellers at STP (including impeller 2B), that there is no evidence of similar problems with other emergency core cooling system (ECCS) impellers at STP, and that there is no evidence of similar problems at plants with pump impellers (and spares) of similar design (i.e., Wolf Creek and Callaway).

The licensee indicated that they will take advantage of corrective and preventative maintenance opportunities to perform visual inspections of ECCS impellers. They also committed to formally submit their final engineering report on the docket within the next few weeks.

The staff thanked the licensee for the meeting and indicated that it was useful in understanding the RHR pump impeller cracking at STP. The staff plans to review the licensee's report and provide an evaluation.

Original signed by

Thomas W. Alexion, Project Manager
Project Directorate IV-1
Division of Reactor Projects III/IV
Office of Nuclear Reactor Regulation

Docket Nos. 50-498 and 50-499

Attachments: 1. List of Meeting Attendees
2. HL&P Meeting Handouts

cc w/atts: See next page

DISTRIBUTION: Meeting on January 18, 1996

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Document Name: STRHR.MTS **See previous concurrence***

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DATE	1/30/96	1/29/96
COPY	YES/NO	YES/NO

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MEETING BETWEEN HL&P AND NRC ON RHR PUMP IMPELLER CRACKING

January 18, 1995

Name	Organization
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K. House	HL&P
S. Thomas	HL&P
K. Moser	HL&P
Q. Huynh	HL&P
J. Cottam	HL&P
S. Head	HL&P
D. Schulker	HL&P
P. Riccardella	SIA
L. Swanger	Failure Analysis Associates
T. Alexion	NRC
S. Sheng	NRC
D. Powers	NRC
J. Davis	NRC
D. Terao	NRC
J. York	NRC
R. Hermann	NRC

ATTACHMENT 1

SOUTH TEXAS PROJECT
ELECTRIC GENERATING STATION

RESIDUAL HEAT REMOVAL PUMP IMPELLER CRACKING

January 18, 1996

SOUTH TEXAS PROJECT

STP: A WORLD CLASS POWER PRODUCER

ATTACHMENT 2

SOUTH TEXAS PROJECT
RESIDUAL HEAT REMOVAL PUMP IMPELLER CRACKING

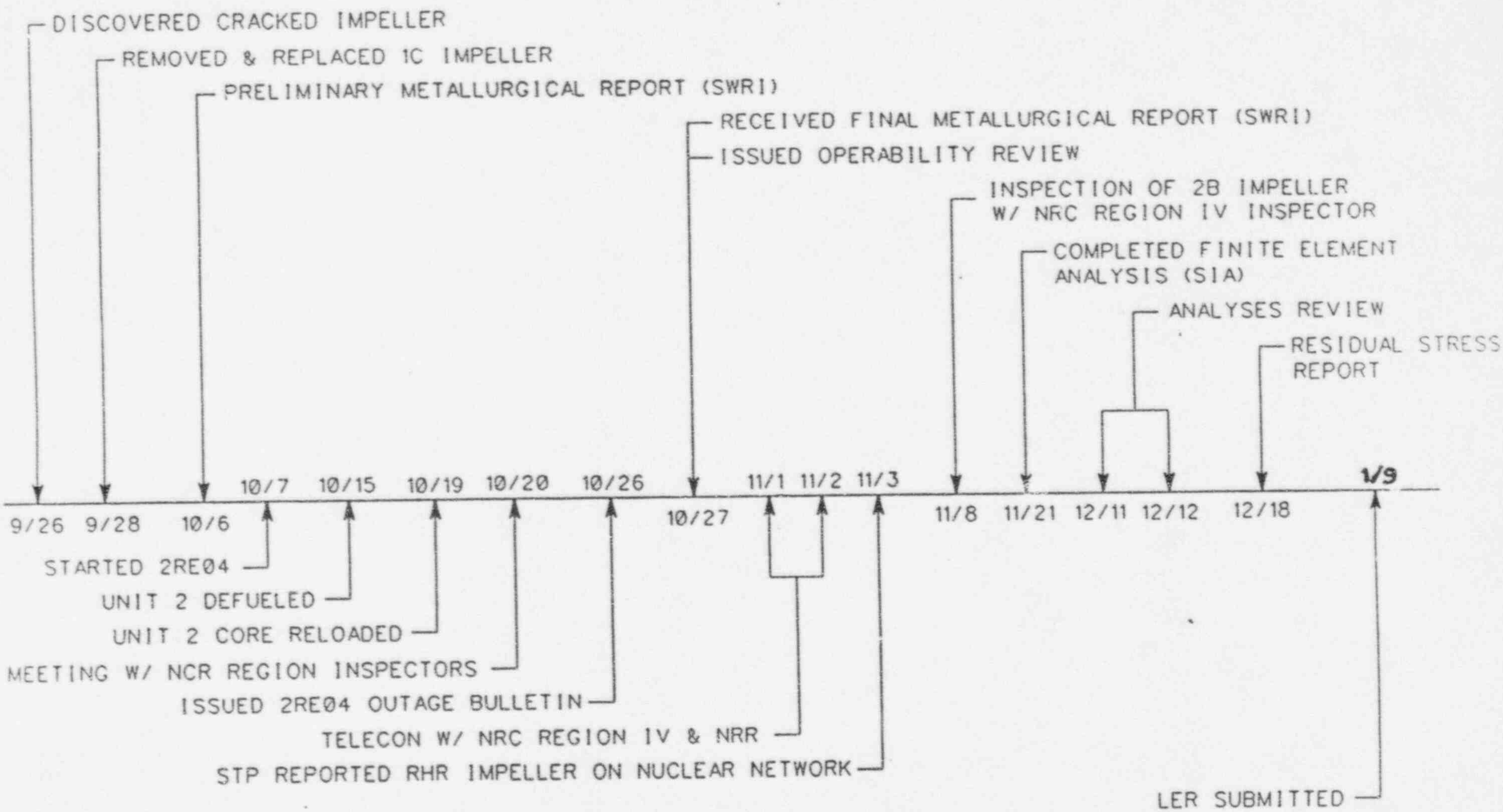
AGENDA

HL&P REPRESENTATIVES

Steve Thomas, HL&P, Design Engineering Department Manager
Jeff Cottam, HL&P, Design Engineering NSSS Supervisor
Ken House, HL&P, Mechanical Engineer, Design Engineering
Quoc Huynh, HL&P, Mechanical Engineer, Design Engineering
Keith Moser, HL&P, Welding Engineer, Design Engineering
Mark McBurnett, HL&P, Nuclear Licensing Manager
Dave Schulker, HL&P, Nuclear Licensing
Dr. Lee Swanger, Failure Analysis Associates, Inc. (C)
Dr. Peter Riccardella, Structural Integrity Associates, Inc. (C)

(C) - CONTRACTOR

RHR IMPELLER EVALUATION TIMELINE



ROOT CAUSES OF RHR IMPELLER CRACKING

- The Wear Ring Axial Cracking was due to Improper Flame Hardening which made the Wear Ring Susceptible to Stress Corrosion Cracking (SCC)

- The Circumferential Cracking in the Shroud Radius Region was a result of Improper Machining of the Impeller

- Cracking in the Heat Affected Zones of Vane Weld Repairs was caused by Improper Weld Filler Material

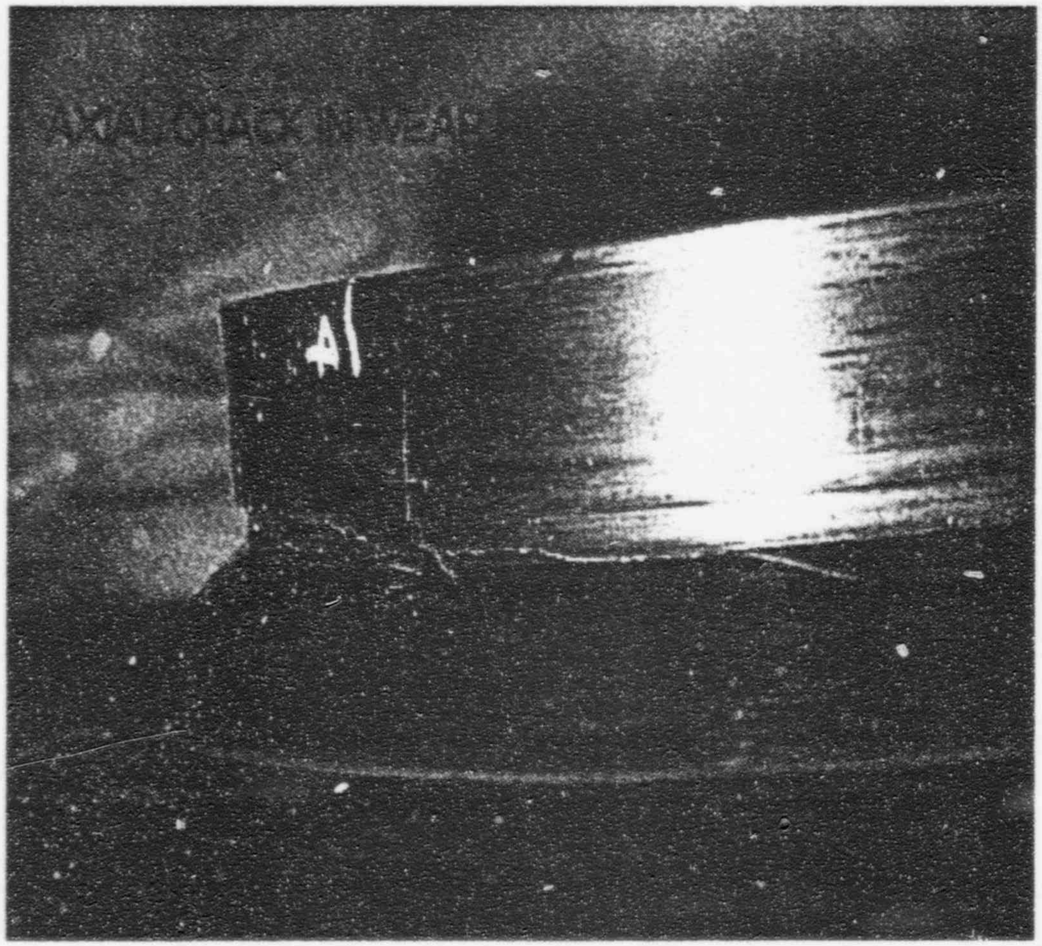
- STP concludes that the cracking identified in the 1C RHR impeller is an isolated condition and no generic issues exist with Ingersoll-Dresser impellers

IMPROPER FLAME HARDENING
(WEAR RING AXIAL CRACKING)

- Axial Cracking Initiated and Propagated by SCC
- Proper Flame Hardened Depth not Achieved on Suction Wear Ring
- Shallow Flame Hardening Increases Susceptibility to SCC
- No Cracking on 1C Backside Wear Ring
- Verified Proper Flame Hardened Depth for 1C Backside Wear Ring (and 4 additional wear rings)
- Proper Flame Hardening Produces Residual Compressive Stresses

SUCTION SIDE WEAR RING AXIAL CRACKING ON 1C RHR IMPELLER

- The axial cracks were primarily intergranular in nature.



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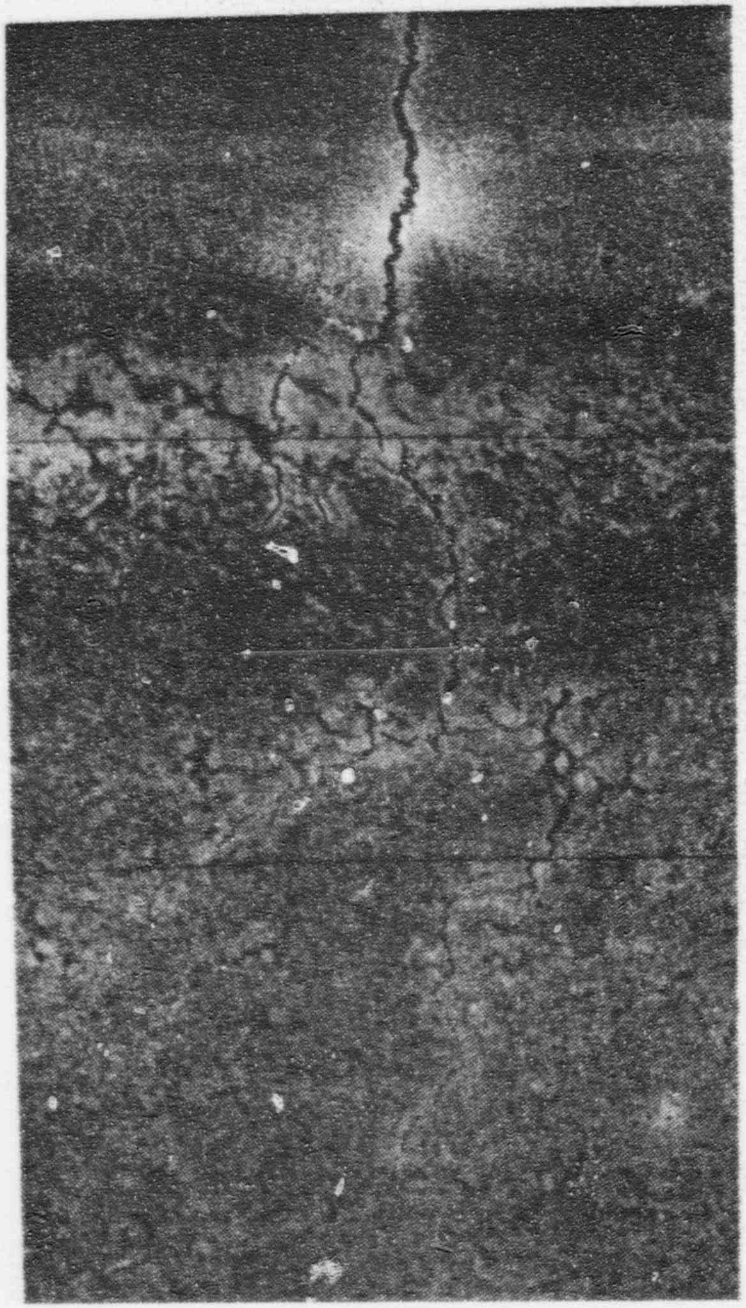
PHOTOMICROGRAPH OF THE INTERGRANULAR PATTERN OF THE AXIAL CRACK

SUCTION SIDE WEAR RING AXIAL CRACKING

FLAME HARDENING DEPTH WAS LESS THAN NORMAL AND APPEARS TO HAVE OVERLAPPED A PREVIOUS FLAME HARDENED LAYER OF GREATER DEPTH. THIS IS BELEIVED TO HAVE SET UP RESIDUAL TENSILE STRESSES AT THE SURFACE.



FLAME HARDENED REGION

DEPTH 0.055"

HARDNESS HRC 52.1

HAZ DEPTH 0.010" HRC 42

SOFT INTERMEDIATE LAYER

DEPTH 0.055"

HARDNESS HRC 27

SECOND HARDENED ZONE

DEPTH 0.050"

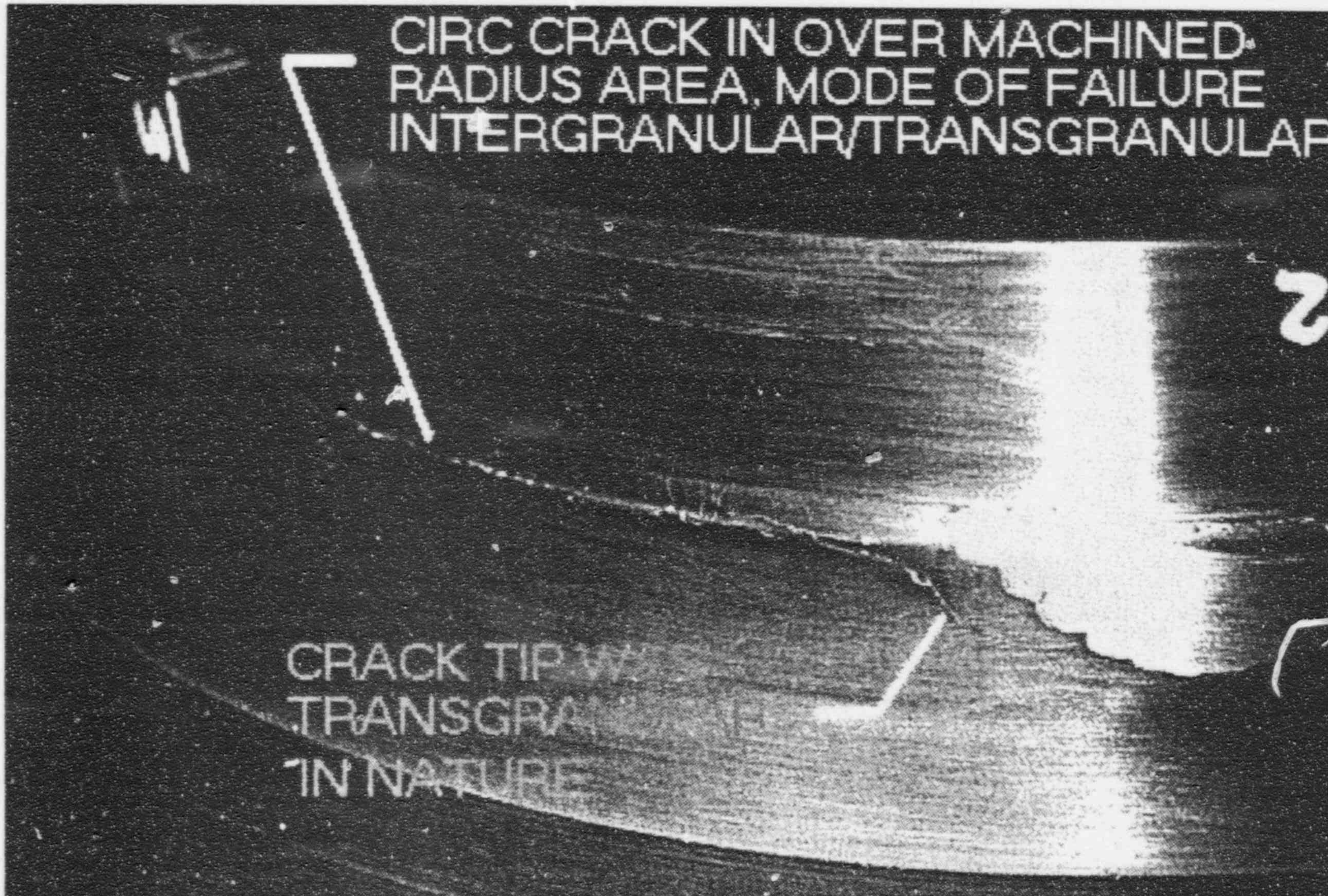
HARDNESS HRC 42

NOTE: ASM METAL HANDBOOK VOLUME 4, STATES THAT SURFACE HARDENING DEPTHS LESS THAN 0.075" ARE COMMONLY RESIDUALLY STRESSED IN TENSION, WHILE HARDENING TO A DEPTH OF 0.105" ENSURES THAT RESIDUAL STRESSES ARE COMPRESSIVE.

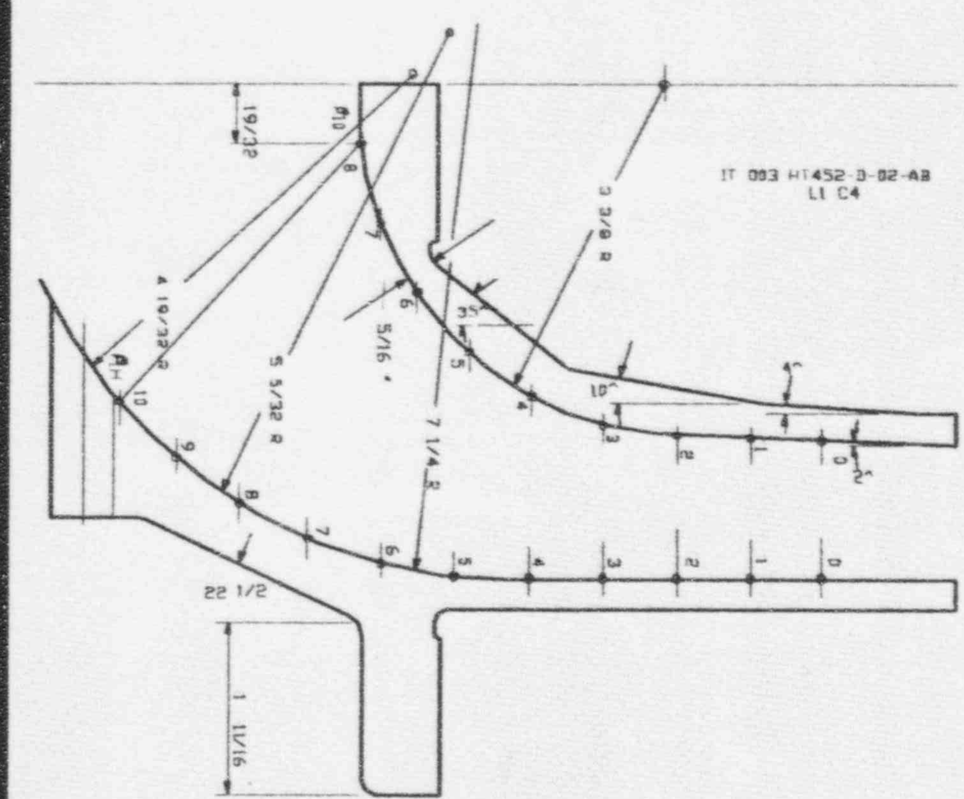
IMPROPER MACHINING OF IMPELLER RADIUS
(CIRCUMFERENTIAL CRACKING)

- Circumferential Cracks Initiated and Propagated by SCC
- Minimum 1C Shroud Radius Thickness was 0.015"
  (Design Nominal Thickness = 0.3125")
- Overmachining of the Shroud Radius Coupled with Wear Ring Flame Hardening Produced Residual Tensile Stresses
- Verified Proper Thicknesses of 2B and Two Spare RHR Impellers

CIRCUMFERENTIAL CRACKING IN SHROUD AREA OF 1C RHR IMPELLER



CIRCUMFERENTIAL CRACKING IN SHROUD AREA OF 1C RHR IMPELLER

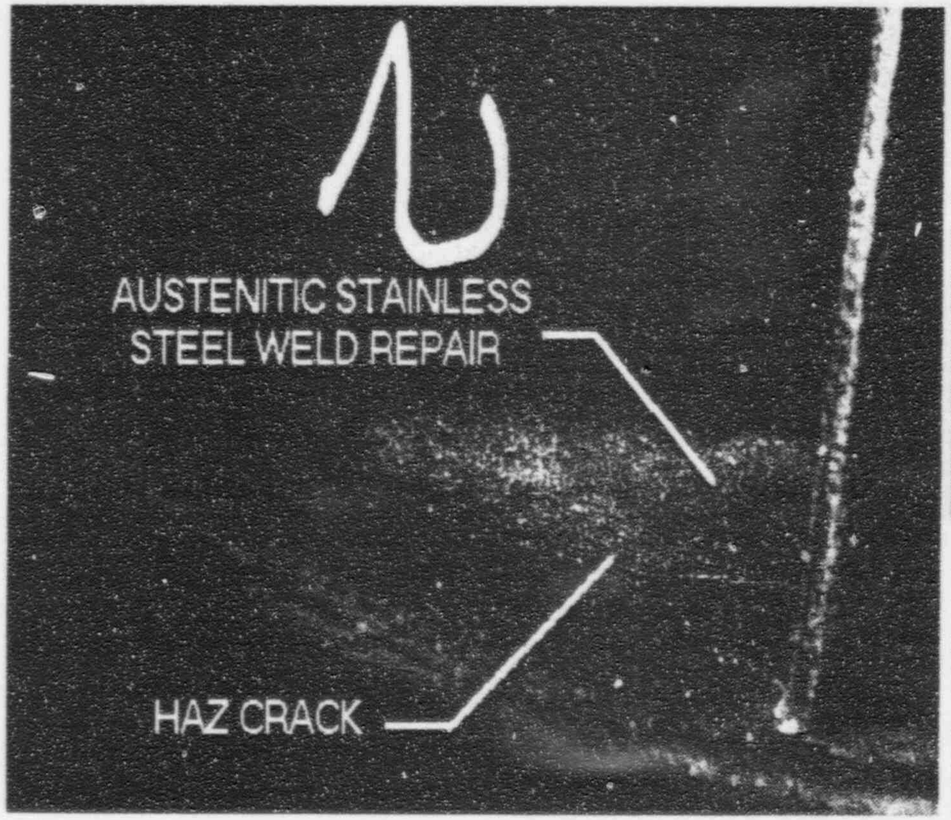


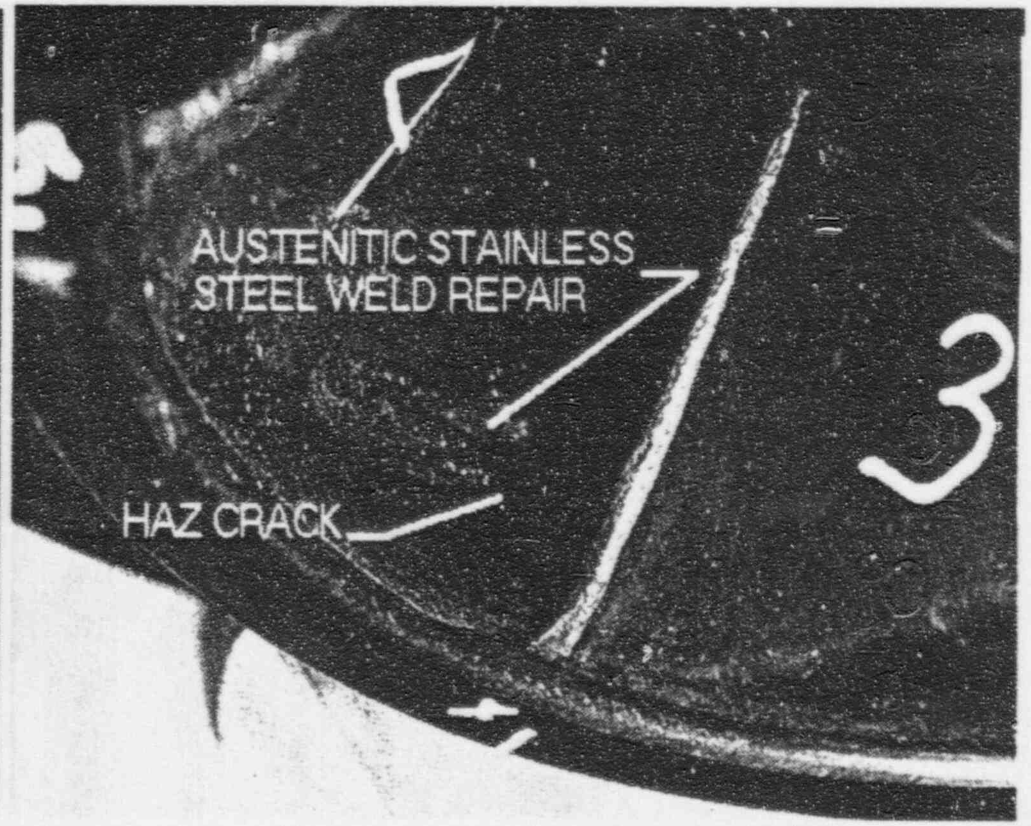
DESIGN DRAWING

IMPROPER WELD FILLER MATERIAL
(WELD REPAIR HAZ CRACKING)

- Heat Affected Zone (HAZ) Cracking Initiated by SCC
- Chemical Composition Testing Confirmed that AUSTENITIC Weld Filler Material was used on the Cracked Repairs
- Austenitic Weld Repairs in Martensitic Material Produce Residual Tensile Stresses
- Martensitic Weld Repairs did not crack
- Martensitic Weld Repairs Produced Residual Compressive Stresses

WELD REPAIR HAZ CRACKING ON 1C RHR IMPELLER





CONCLUSIONS AND FOLLOW-UP ACTIONS

- STP concludes that the cracking identified in the 1C RHR impeller is an isolated condition and no generic issues exist with Ingersoll-Dresser impellers

- STP will take advantage of corrective/preventive maintenance opportunities to perform visual inspections of ECCS impellers

- STP intends to purchase spare RHR impellers and will establish appropriate engineering hold points to ensure quality manufacturing performance