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Address Reply to: Post Office Box 767
Chicago, Illinois 60690

May 16, 1985

Mr. Harold R. Denton, Director
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Subject: Quad Cities Station Unit 2
1985 IGSCC Weld Inspection
Analysis on Weld 10S-F5
NRC Docket No. 50-265

Dear Mr. Denton:

On May 1985 Commonwealth Edison (CECo) presented to the Staff the results of our Generic Letter 84-11 inspection at Quad Cities Unit 2 and in particular, addressed concerns raised by the Staff on the results for some five welds. For one of those welds 10S-F5, it was agreed to present additional analytical information to support our position that the weld with its existing crack indications is acceptable for an additional cycle of operation.

The attached summaries of analytical results for Weld 10S-F5 (Attachments A and B) demonstrate that there is no loss of design safety margin over that provided in the ASME Boiler and Pressure Vessel Code for Class 1 piping. The analysis presented in Attachment A demonstrates that this weld is in compliance with the requirements of the 1983 Edition of ASME Section XI with addenda through Winter 1983 as modified by USNRC Generic Letter 84-11. The analysis presented in Attachment B addresses the following concerns:

1. To conservatively account for postulated brittle fracture due to potential low fracture toughness of flux-welded metal, the allowable end-of-cycle flaw depth ratio is based upon newly proposed ASME Section XI Table IWB-3461-5 and Generic Letter 84-11 requirements.

2. To conservatively address the concern over the effectiveness of induction heating stress improvement (IHSI) on flawed welds, the predicted IGSCC flaw growth for a fuel cycle is based upon a weld residual stress indication only partially improved by IHSI.

We feel that these results adequately demonstrate the acceptability our position to continue operation for an additionl cycle without a weld overlay repair. These analyzes were conservatively done and demonstrated adequate margins to the applicable Codes and NRC guidance. Furthermore, this weld is on the downstream side of an isolation valve which is closed during power operation, that is, it is only open when the shutdown cooling system is in operation.

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If you have any additional questions concerning this matter, please contact this office.

One signed original and forty (40) copies of this letter and its attachments are provided for your use.

Very truly yours,

B. Rybak
Nuclear Licensing Administrator

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Attachment

cc: NRC Resident Inspector - Quad Cities
R. Bevan - NRR

ATTACHMENT A

SUMMARY OF ANALYTICAL RESULTS FOR WELD 10S-F5

Pipe Geometry:

Pipe outside diameter = 20"
Pipe wall thickness = 0.96"

Flaw Description:

Fall 1983 Outage	Spring 1985 Outage
3½" x 18% Circ. (P.S.)	9" x 11% Circ. (P.S.)
8 " x 12% Circ. (P.S.)	10" x 17% Circ. (P.S.)
	3" x 13% Circ. (P.S.)

Applied Loads:

Load Type	Dead Weight	Thermal Expansion	Seismic	Internal Pressure
Axial (lbs)	398	37,410	1,065	392,500
Moment (in-lbs)	144,315	2,698,380	163,023	0

Applied Stresses (psi):

Dead Weight	Thermal Expansion	Seismic	Internal Pressure
561	10,993	642	6,510

Flawed Pipe Analysis:

- Assumed 360° flaw length-by-17% flaw depth.
- Crack growth predicted for combination of primary (dead weight and internal pressure) and secondary (thermal expansion and as-welded/post-IHSI residual) stresses.
- Used conservative crack growth law.
- For as-welded residual stress distribution, predict through-wall IGSCC flaw growth in less than 18 months (one fuel cycle).
- Comparison of 1983 and 1985 flaw depth data shows no flaw growth, therefore, IHSI favorably altered as-welded residual stress pattern.
- For typical post-IHSI residual stress distribution, predict no flaw growth in 18 months (one fuel cycle).
- Per USNRC Generic Letter 84-11, allowable flaw depth for assumed 360° flaw length is 0.47 (2/3 of Table IWB-3641-1 source equation value) for dead weight, seismic, and internal pressure stress combination.
- Measured flaw depth is a factor of 2.76 smaller than Generic Letter 84-11 allowable flaw depth.

Limit Load Failure Analysis:

- o As required by USNRC Generic Letter 84-11, calculated limit load.
- o Used net section plastic collapse limit moment equation from Section A2.3.2 of NUREG-1061, Volume III.
- o Allowable limit moment calculated for primary loads (dead weight, seismic, and internal pressure).
- o Allowable limit moment is 2,718,453 in-lbs.
- o Applied moment is 307,338 in-lbs.
- o Applied moment is a factor of 8.85 smaller than allowable limit moment for Generic Letter 84-11 100% through-wall by measured length flaw size requirement.

ATTACHMENT B

SUMMARY OF ANALYTICAL RESULTS
FOR WELD 10S-F5
PER PROPOSED TABLE IWB-3641-5

Pipe Geometry:

Pipe outside diameter	= 20"
Pipe wall thickness	= 0.96"

Flaw Description:

Fall 1983 Outage	Spring 1985 Outage
3½" x 18% Circ. (P.S.)	9" x 11% Circ. (P.S.)
8 " x 12% Circ. (P.S.)	10" x 17% Circ. (P.S.)
	3" x 13% Circ. (P.S.)

Applied Loads:

Load Type	Dead Weight	Thermal Expansion	Seismic	Internal Pressure
Axial (lbs)	398	37,410	1,065	392,500
Moment (in-lbs)	144,315	2,698,380	163,023	0

Applied Stresses (psi):

Dead Weight	Thermal Expansion	Seismic	Internal Pressure
561	10,993	642	6,510

Allowable End-of-Cycle Flaw Depth Ratio:

- o Stress Ratio $= M(P_m + P_b + P_e/2.77) / S_m$

  $P_m + P_b$ = 561 psi + 642 psi + 6,510 psi =7,713 psi

  $P_e/2.77$ = 10,993 psi/2.77 = 3,969 psi

  M = 1.0 for pipe diameters less than 24" welded together using SMAW

  S_m = 16,950 psi for TP304 stainless steel at 550°F

  Stress Ratio = 1.0 (7,713 psi + 3,969 psi)/ 16,950 psi
  = 0.69

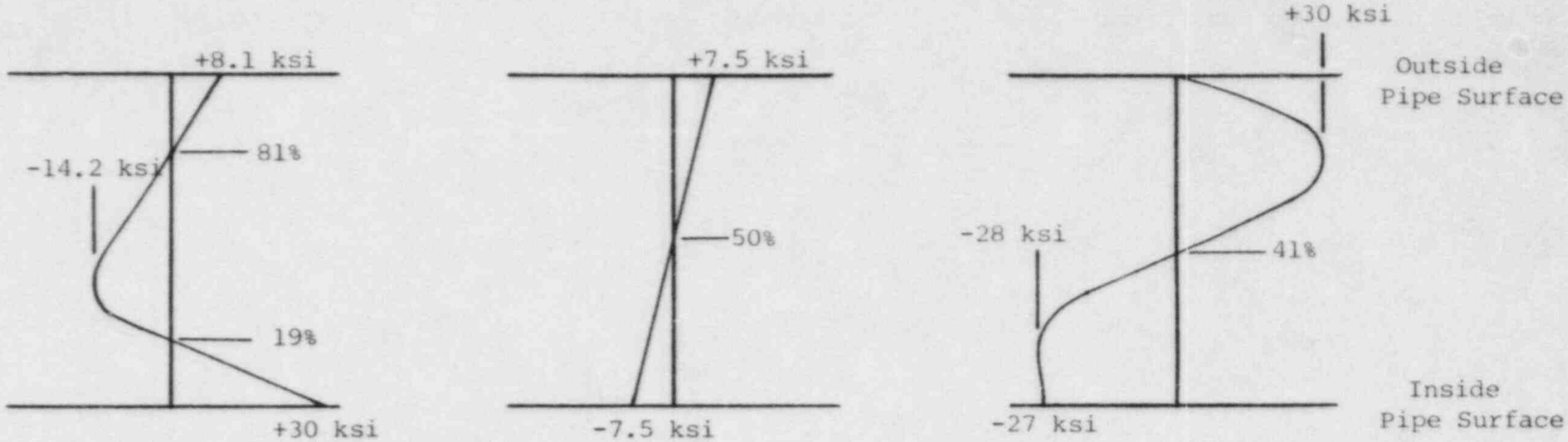
- o Flaw Length Ratio = (9" + 10" + 3") / (20" - 0.96")π
  = 0.37

- o Allowable End-of-Cycle Flaw Depth Ratio per Proposed Table IWB-3641-5 = 0.54

- o Allowable End-of-Cycle Flaw Depth Ratio per USNRC Generic Letter 84-11 = 2/3 (0.54)
  = 0.36

Flawed Pipe Analysis:

- Assumed 360° flaw length-by-17% flaw depth.
- Crack growth predicted for combination of primary (dead weight and internal pressure) and secondary (thermal expansion and as-welded/post-IHSI residual) sustained stresses.
- Used conservative crack growth law.
- For as-welded residual stress distribution (assumes no credit for IHSI) shown on Page 4 of 4, predict IGSCC flaw to grow to Generic Letter 84-11 allowable end-of-cycle flaw depth ratio in 4 months.
- For partially improved residual stress distribution shown on Page 4 of 4, predict IGSCC flaw to grow to Generic Letter 84-11 allowable end-of-cycle flaw depth ratio in 18 months (one full cycle).
- For IHSI residual stress distribution shown on Page 4 of 4, predict no IGSCC flaw growth.



AS-WELDED RESIDUAL STRESS DISTRIBUTION*

PARTIALLY IMPROVED RESIDUAL STRESS DISTRIBUTION

IHSI RESIDUAL STRESS DISTRIBUTION*

*Bounds stress distributions presented in Figure III-34 of EPRI Document No. NP-2662-LD, December 1982.