Florida Power & Light Company, 6501 S. Ocean Drive, Jensen Beach, FL 34957

FPL

April 6, 2004

L-2004-085
EA-03-09(IV)(F)(2)

U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555

Re: St. Lucie Unit 1
Docket No. 50-335
Order (EA-03-009) Relaxation Requests 1 and 2
Examination Coverage of Reactor Pressure
Vessel Head Penetration Nozzles – Supplement 2

On February 11, 2003, the NRC issued Order EA-03-009 requiring specific inspections of the reactor pressure vessel (RPV) head and associated penetration nozzles at pressurized water reactors. By letter L-2003-283 dated November 21, 2003, and pursuant to the procedure specified in Section IV, paragraph F of the Order, Florida Power & Light Company (FPL) requested relaxation from certain requirements specified in Section IV, paragraph C (1) for St. Lucie Unit 1. On February 20, 2004, the NRC issued First Revised Order EA-03-009. On March 4, 2004 during a conference call between FPL and the NRC, FPL was asked to clarify the need for the staff to continue the review of St. Lucie Unit 1 Relaxation Requests 1 and 2. On March 23, 2004, FPL docketed the clarification by letter L-2004-071.

During conference calls on April 2, 2004 and April 4, 2004, the NRC and FPL discussed the St. Lucie Unit 1 relaxation requests under review by the NRC and the results of the FPL RPV head inspections. As a result of the inspection results, FPL has determined that Relaxation Request 1 is no longer required and is withdrawn. The attached revision to Relaxation Request 2 provides the information requested by the NRC during the above conference calls.

Attachment 1 provides revision 1 of Relaxation Request 2. Attachment 2 provides a summary table of the RPV head ultrasonic test results. Attachment 3 provides the requested stress plots versus distance above the weld toe developed by Westinghouse for St. Lucie Unit 1.

FPL requests that the NRC complete its review and approval of Relaxation Request 2 as soon a reasonably achievable. St. Lucie Unit 1 is currently scheduled to enter Mode 4 on April 16, 2004.

A101

Please contact George Madden at (772) 467-7155 if there are any questions about the relaxation.

Very truly yours,

William Jefferson, Jr.
Vice President
St. Lucie Plant

Attachments (3)

WJ/GRM

St. Lucie Unit 1 Relaxation Request No. 2 Revision 1
From NRC First Revised Order EA-03-009

Hardship or Unusual Difficulty Without Compensating Increase in Level of Quality or Safety

1. ASME COMPONENTS AFFECTED

St. Lucie (PSL) Unit 1 has 78 ASME Class 1 reactor pressure vessel (RPV) head penetrations (including the vent). The scope of this relaxation is applicable to 17 of the 69 RPV Control Element Drive mechanism (CEDM) head penetrations

The St. Lucie Unit 1 Order Inspection Category in accordance with Section (IV.A.) is currently determined as "high", based on an approximate 16.7 EDY at the SL1-19 refueling outage (RFO).

2. APPLICABLE EXAMINATION REQUIREMENTS:

The First Revised NRC Order (EA-03-009) Order[1] was issued on February 20, 2004, establishing interim inspection requirements for reactor pressure vessel heads of pressurized water reactors. Section IV.C. of the Order states the following:

All Licensees shall perform inspections of the RPV head using the following frequencies and techniques:

(1) For those plants in the High category, RPV head and head penetration nozzle inspections shall be performed using the techniques of paragraph IV.C.(5)(a) [Bare Metal Visual] and paragraph IV.C.(5)(b) [Non Visual NDE] every refueling outage.

> (5)(b) For each penetration, perform a non visual NDE in accordance with either (i), (ii) or (iii):
>
> > (i) Ultrasonic testing of the RPV head penetration nozzle volume (i.e., nozzle base material) from 2 inches above the highest point of the root of the J-groove weld (on a horizontal plane perpendicular to the nozzle axis) to 2 inches below the lowest point at the toe of the J-groove weld on a horizontal plane perpendicular to the nozzle axis (or the bottom of the nozzle if less than 2 inches [see Figure IV-1]); OR from 2 inches above the highest point of the root of the J-groove weld (on a horizontal plane perpendicular to the nozzle axis) to 1.0-inch below the lowest point at the

[1] US NRC Letter EA-03-009, Issuance of First Revised NRC Order (EA-03-009) Establishing Interim Inspection Requirements for Reactor Pressure Vessel Heads at Pressurized Water Reactors, from William Borchardt (NRC) to all Pressurized Water Reactor Licensees, dated February 20, 2004.

toe of the J-groove weld (on a horizontal plane perpendicular to the nozzle axis) and including all RPV head penetration nozzle surfaces below the J-groove weld that have an operating stress level (including all residual and normal operation stresses) of 20 ksi tension and greater (see Figure IV-2). In addition, an assessment shall be made to determine if leakage has occurred into the annulus between the RPV head penetration nozzle and the RPV head low-alloy steel.

(ii) Eddy current testing or dye penetrant testing of the entire wetted surface of the J-groove weld and the wetted surface of the RPV head penetration nozzle base material from at least 2 inches above the highest point of the root of the J-groove weld (on a horizontal plane perpendicular to the nozzle axis) to 2 inches below the lowest point at the toe of the J-groove weld on a horizontal plane perpendicular to the nozzle axis (or the bottom of the nozzle if less than 2 inches [see Figure IV-3]); OR from 2 inches above the highest point of the root of the J-groove weld (on a horizontal plane perpendicular to the nozzle axis) to 1.0-inch below the lowest point at the toe of the J-groove weld (on a horizontal plane perpendicular to the nozzle axis) and including all RPV head penetration nozzle surfaces below the J-groove weld that have an operating stress level (including all residual and normal operation stresses) of 20 ksi tension and greater (see Figure IV-4).

(iii) A combination of (i) and (ii) to cover equivalent volumes, surfaces and leak paths of the RPV head penetration nozzle base material and J-groove weld as described in (i) and (ii). Substitution of a portion of a volumetric exam on a nozzle with a surface examination may be performed with the following requirements:

1. On nozzle material below the J-groove weld, both the outside diameter and inside diameter surfaces of the nozzle must be examined.
2. On nozzle material above the J-groove weld, surface examination of the inside diameter surface of the nozzle is permitted provided a surface examination of the J-groove weld is also performed.

Relaxation is requested from part IV.C.(5)(b)(i) of the Order to perform ultrasonic testing (UT) of the RPV head penetration inside the tube from 2 inches above the highest point of the root of the J-groove weld to 2 inches below the lowest point at the toe of the J-groove weld on horizontal plane perpendicular to the nozzle axis (or the bottom of the nozzle if less than 2 inches). Specifically, the relaxation requested is that the 2 inch UT examination distance above the weld root be changed to a minimum of 1.11 inches above the weld (on a horizontal plane perpendicular to the nozzle axis) on the uphill side. The relaxation is required for 17 CEDM nozzles listed in Attachment 2 that have less than the required 2 inches of UT examination distance above the weld root.

3. REASON FOR REQUEST:

Pursuant to the First Revised Order Section IV.F which states "...all Licensees shall notify the Commission if (1) they are unable to comply with any of the requirements of Section IV or (2) compliance with any of the requirements of Section IV is unnecessary," FPL is requesting this relaxation for St. Lucie Unit 1, since compliance with the Order for specific nozzles would result in hardship or unusual difficulty, without a compensating increase in the level of quality and safety.

A typical example of the St. Lucie Unit 1 CEDM nozzle, guide sleeve and funnel configuration is shown in Figure 1 for the center nozzle. Figure 1 also shows the counterbore that is limiting UT examination up to 2 inches above the weld root for 17 CEDMs.

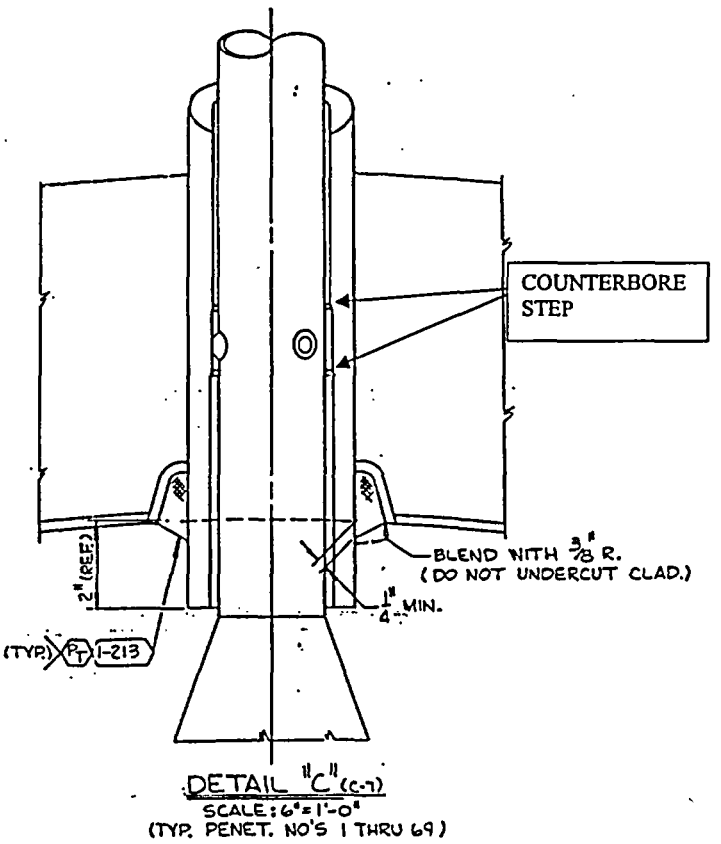

Figure 1: St. Lucie Unit 1 CEDM Nozzle Configuration showing the Guide Sleeve and Counterbore.

FPL has completed the UT examination for the St. Lucie Unit 1 RPV head penetrations. The results are shown in Attachment 2 and are sorted by the minimum UT coverage above the weld root on the uphill side. The results show complete UT coverage from a minimum of 1.65 to 1.95 inches above the weld root (on a horizontal plan) down to the bottom of the nozzle for 17 CEDM nozzles (nos. 35, 24, 62, 6, 12, 26, 38, 60, 34, 63, 14, 19, 25, 32, 33, 23, and 28) identified in Attachment 2. The remaining 61 RPV nozzles had UT coverage that met the requirements of the First Revised Order and do not require relaxation from the Order required examination volume. The summary of the RPV head examination is as follows:

- There were no recordable UT indications.
- The leak path assessment was completed on all 77 interference fit RPV head nozzles, with no identified leakage.
- The visual inspection of the RPV head surface identified no evidence of leakage from any of the RPV head nozzles.

The hardship is based on the following points:

- The UT blade probe design was used based on its ability to interrogate the nozzle penetration material with the permanently installed guide sleeve and funnel in place. However, as shown in Figure 1, a counterbore reduces the clearance for the blade probe to travel at a distance above the weld. For 17 CEDM nozzles this distance was 1.65 inches to 1.95 inches above the weld root. New probe designs and the ability of the delivery equipment to push the guide sleeve (industry lessons learned) provided significant improvement in data collection over the examination of the RPV nozzle penetrations performed in 2002.[2] These improvements did not allow inspection above the counterbore region.
- Deployment of an eddy current testing (ECT) technique would not improve the coverage distance above the weld. The ECT probe is delivered on a blade type delivery devise that would also be limited by the counterbore.
- To employ a rotating UT probe, capable of interrogating all the material up to two (2) inches above the weld, would require destructive removal and replacement of 17 permanently installed thermal sleeves. The destructive removal and reinstallation of thermal sleeves in two CEDM nozzles during the fall 2002 St. Lucie Unit 1 inspection resulted in approximately 4.8 Rem of exposure. This effort would be time and dose intensive, without a resultant commensurate increase in safety.

Accordingly, FPL is requesting a reduction of the examination coverage area based on the low stress levels above the weld root in the reduced exam

[2] FPL Letter L-2002-233, St. Lucie Units 1 and 2 Docket Nos. 50-335 and 50-389 Reactor Pressure Vessel Head (RPVH) Inspection NRC Bulletin 2002-02 Supplemental Response, D. E. Jernigan to NRC, November 21, 2002.

coverage area. As discussed below, this approach will provide an acceptable level of quality and safety with respect to reactor vessel structural integrity and leak integrity.

4. PROPOSED ALTERNATIVE AND BASIS FOR USE:

The proposed alternative is to perform the UT examination to the maximum extent practical, but not less than 1.11 inches above the weld root (on a horizontal plane perpendicular to the nozzle axis) on the uphill side for the 17 CEDMs (nos. 35, 24, 62, 6, 12, 26, 38, 60, 34, 63, 14, 19, 25, 32, 33, 23, and 28) identified in Attachment 2. In all cases, the examination area will include all nozzle material with operating stress levels of 20 ksi or greater.

The proposed 1.11-inch minimum distance above the weld root on the uphill side is based on a plant specific stress analysis WCAP-15945.[3] This analysis was previously submitted by FPL letter L-2002-233 dated November 21, 2002 for the previous RPV nozzle penetration inspection in 2002. Additional work has been performed by Westinghouse to identify the distance above the weld root at which the operational hoop stress levels drop below 20 ksi tensile. This work shows that:

1. The operational stress levels on the inside diameter of the penetration drop below 20 ksi at approximately 1.11 inches above the weld root on the uphill side for all penetrations modeled (0° through 42.5°).

2. The operational stress levels on the outside diameter of the penetration are bounded by the stress levels on the ID and drop below 20 ksi within 0.56 inches above the weld root on the uphill side.

The plots of stress versus distance above the weld root are provided in Attachment 3. The uphill plots of stress levels versus distance are limiting for all locations, except the zero degree nozzle. For the zero degree nozzle, the uphill and downhill stress levels are identical. These plots show that the stress levels in the actual area of missing UT coverage (≥ 1.65 inches above the weld) on the uphill side are well below 20 ksi. Therefore, it is unlikely that a flaw would initiate in this low stress area. Any flaw in this area would have propagated from the higher stressed area below, which is within the examination boundary. Finally, a review of prior plant inspection data from a large cross-section of US pressurized water reactors, documented in MRP-95[4] (Figure 5-1 of MRP-95), revealed that of the 237 flaw indications reported, all flaws would have been detected had the inspections been limited to the 1.11 inches proposed examination zones.

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[3] WCAP-15945-P, Structural Integrity Evaluation of Reactor Vessel Upper Head Penetrations to Support Continued Operation: St. Lucie Unit 1, Westinghouse Electric Co. LLC, September 2002

[4] MRP-95, Materials Reliability Program Generic Evaluation of Examination Coverage Requirements for Reactor Pressure Vessel Head Penetration Nozzles, EPRI Topical Report, September 2003

Therefore, the reduced UT examination coverage area above the weld will not preclude the ability of FPL to assess the structural integrity of the RPVH or RPVH penetration nozzles.

Conclusion

The proposed inspection ensures that there are no concerns with the structural integrity of the St. Lucie Unit 1 RPV penetration nozzles that could be caused by cracking in the excluded NRC Order coverage areas.

This conclusion is based on the following:

- The stress levels in the uninspected zones of 17 CEDM nozzles are below a threshold stress (20 ksi) for which primary water stress corrosion cracking is considered highly unlikely.
- All flaw indications reported in the industry to date would have been detected had the inspections been limited to the proposed 1.11 inches examination scope of this relaxation request.[5]
- No flaw indications were identified in the remaining 61 RPV nozzles that were inspected to 2 inches above their welds.

5. DURATION OF PROPOSED ALTERNATIVE:

This relaxation is applicable to the spring 2004 refueling outage (SL1-19) for St. Lucie Unit 1. The St. Lucie Unit 1 RPV head is scheduled for replacement during the next refueling outage (SL1-20).

[5] MRP-95, Materials Reliability Program Generic Evaluation of Examination Coverage Requirements for Reactor Pressure Vessel Head Penetration Nozzles, EPRI Topical Report, September 2003

St. Lucie Unit 1

SL1-19 Refueling Outage

Reactor Pressure Vessel Head Penetration

Ultrasonic Test Inspection Data

Nozzle Data			Extent of UT Coverage in RVHP Nozzle Material				Leak Path Data	
Nozzle Use	Nozzle Angle °	Pen #	Above Weld Root Uphill Side	Arc < 2.0" Above Weld Root (Degrees)	Circumferential Coverage (Degrees)	Examined to End of Noz	Min. Dist. Above Interference Fit Region	Determination Possible?
CEDM	35.6	35	1.65	89.00	360	Yes	1.45	Yes
CEDM	25.3	24	1.75	77.70	360	Yes	1.44	Yes
CEDM	42.5	62	1.75	67.00	360	Yes	1.53	Yes
CEDM	11.0	6	1.80	12.00	360	Yes	1.20	Yes
CEDM	22.4	12	1.80	47.00	360	Yes	1.41	Yes
CEDM	29.1	26	1.80	64.00	360	Yes	1.51	Yes
CEDM	35.6	38	1.80	75.00	360	Yes	1.48	Yes
CEDM	42.5	60	1.80	54.00	360	Yes	1.26	Yes
CEDM	35.6	34	1.85	21.00	360	Yes	1.47	Yes
CEDM	42.5	63	1.85	48.00	360	Yes	1.36	Yes
CEDM	23.9	14	1.90	17.00	360	Yes	1.29	Yes
CEDM	25.3	19	1.90	51.00	360	Yes	1.33	Yes
CEDM	25.3	25	1.90	27.00	360	Yes	1.50	Yes
CEDM	29.1	32	1.90	21.00	360	Yes	1.59	Yes
CEDM	29.1	33	1.90	48.00	360	Yes	1.57	Yes
CEDM	25.3	23	1.95	9.00	360	Yes	1.71	Yes
CEDM	29.1	28	1.95	60.00	360	Yes	1.76	Yes
CEDM	11.0	2	2.00	N/A	360	Yes	1.51	Yes
CEDM	11.0	4	2.00	N/A	360	Yes	1.50	Yes
CEDM	22.4	10	2.00	N/A	360	Yes	1.44	Yes
CEDM	22.4	13	2.00	N/A	360	Yes	1.48	Yes
CEDM	23.9	15	2.00	N/A	360	Yes	1.54	Yes
CEDM	25.3	21	2.00	N/A	360	Yes	1.65	Yes
CEDM	25.3	22	2.00	N/A	360	Yes	1.61	Yes
CEDM	35.6	41	2.00	N/A	360	Yes	1.59	Yes
CEDM	38.5	43	2.00	N/A	360	Yes	1.41	Yes
CEDM	38.5	47	2.00	N/A	360	Yes	1.07	Yes
CEDM	38.5	48	2.00	N/A	360	Yes	1.54	Yes
CEDM	38.5	49	2.00	N/A	360	Yes	1.51	Yes
CEDM	42.5	61	2.00	N/A	360	Yes	1.39	Yes
CEDM	35.6	37	2.04	N/A	360	Yes	1.62	Yes
CEDM	0.0	1	2.05	N/A	360	Yes	1.45	Yes

Nozzle Data			Extent of UT Coverage In RVHP Nozzle Material				Leak Path Data	
Nozzle Use	Nozzle Angle °	Pen #	Above Weld Root Uphill Side	Arc < 2.0" Above Weld Root (Degrees)	Circumferential Coverage (Degrees)	Examined to End of Noz	Min. Dist. Above Interference Fit Region	Determination Possible?
CEDM	11.0	3	2.05	N/A	360	Yes	1.60	Yes
CEDM	22.4	11	2.05	N/A	360	Yes	1.50	Yes
CEDM	23.9	16	2.05	N/A	360	Yes	1.69	Yes
CEDM	29.1	29	2.05	N/A	360	Yes	1.66	Yes
CEDM	29.1	30	2.05	N/A	360	Yes	1.59	Yes
CEDM	29.1	31	2.05	N/A	360	Yes	1.69	Yes
CEDM	35.6	39	2.05	N/A	360	Yes	1.35	Yes
CEDM	35.6	40	2.05	N/A	360	Yes	1.75	Yes
CEDM	42.5	69	2.05	N/A	360	Yes	1.60	Yes
CEDM	11.0	5	2.10	N/A	360	Yes	1.35	Yes
CEDM	11.0	7	2.10	N/A	360	Yes	1.40	Yes
CEDM	11.0	9	2.10	N/A	360	Yes	1.65	Yes
CEDM	25.3	18	2.10	N/A	360	Yes	1.24	Yes
CEDM	25.3	20	2.10	N/A	360	Yes	1.70	Yes
CEDM	29.1	27	2.10	N/A	360	Yes	1.24	Yes
CEDM	42.5	64	2.10	N/A	360	Yes	1.62	Yes
CEDM	11.0	8	2.15	N/A	360	Yes	1.60	Yes
CEDM	42.5	59	2.15	N/A	360	Yes	1.71	Yes
CEDM	42.5	65	2.15	N/A	360	Yes	1.56	Yes
CEDM	38.5	44	2.20	N/A	360	Yes	1.46	Yes
CEDM	38.5	45	2.20	N/A	360	Yes	1.33	Yes
CEDM	42.5	58	2.20	N/A	360	Yes	1.55	Yes
CEDM	38.5	42	2.25	N/A	360	Yes	1.65	Yes
CEDM	38.5	46	2.25	N/A	360	Yes	1.58	Yes
CEDM	42.5	67	2.25	N/A	360	Yes	1.67	Yes
CEDM	35.6	36	2.35	N/A	360	Yes	1.77	Yes
CEDM	37.1	51	2.40	N/A	360	Yes	1.93	Yes
CEDM	42.5	66	2.40	N/A	360	Yes	1.72	Yes
CEDM	37.1	50	2.45	N/A	360	Yes	1.87	Yes
CEDM	37.1	57	2.50	N/A	360	Yes	2.17	Yes
CEDM	37.1	52	2.60	N/A	360	Yes	1.99	Yes
CEDM	37.1	53	2.70	N/A	360	Yes	2.09	Yes
CEDM	37.1	54	2.70	N/A	360	Yes	1.88	Yes

Nozzle Data			Extent of UT Coverage in RVHP Nozzle Material				Leak Path Data	
Nozzle Use	Nozzle Angle °	Pen #	Above Weld Root Uphill Side	Arc < 2.0" Above Weld Root (Degrees)	Circumferential Coverage (Degrees)	Examined to End of Noz	Min. Dist. Above Interference Fit Region	Determination Possible?
CEDM	37.1	56	2.75	N/A	360	Yes	2.08	Yes
CEDM	37.1	55	3.10	N/A	360	Yes	2.36	Yes
CEDM	42.5	68	5.86	N/A	360	Yes	5.48	Yes
CEDM	23.9	17	7.58	N/A	360	Yes	7.04	Yes
ICI	54.8	70	5.24	N/A	360	Yes	4.96	Yes
ICI	54.8	71	5.00	N/A	360	Yes	4.40	Yes
ICI	54.8	72	5.65	N/A	360	Yes	5.18	Yes
ICI	54.8	73	6.10	N/A	360	Yes	4.40	Yes
ICI	54.8	74	5.70	N/A	360	Yes	5.30	Yes
ICI	54.8	75	5.50	N/A	360	Yes	5.20	Yes
ICI	54.8	76	3.73	N/A	360	Yes	3.45	Yes
ICI	54.8	77	5.98	N/A	360	Yes	5.55	Yes
Vent	0-11	Vent	3.68	N/A	360	Yes	N/A	N/A

Notes: Each nozzle examined with the blade UT probe design was scanned from the bottom of the nozzle to the nozzle inside surface counterbore above the weld. The nozzle counterbore restricted access of the blade probe into the gap between the thermal sleeve and the nozzle. This scan area provided maximum coverage of the required examination volume. Each penetration was examined to the end of the nozzle below the weld. Examination coverage is determined on a horizontal plane with the nozzle axis at the maximum distance above and below the weld where complete coverage is obtained of the full nozzle volume.

Performed By: K. J. Hacker, UT Level III Date: 4/5/2004

Verified By: M. J. Jenniges, UT Level II Date: 4/5/2004

Stress Plots Vs. Distance Above The J-Groove Weld

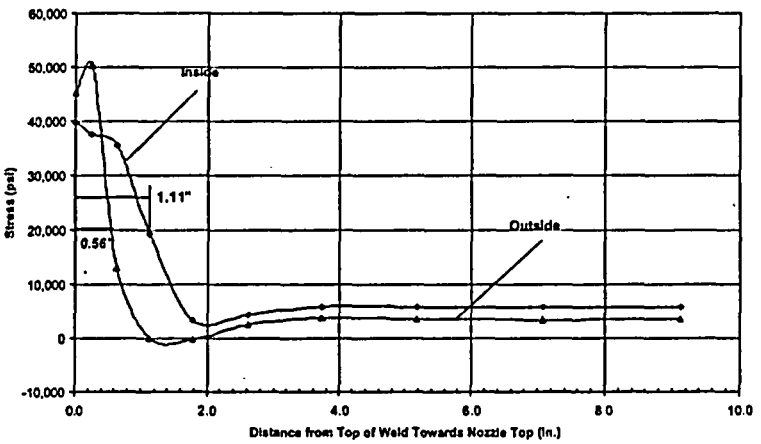
The Stress Curves were Generated for the

St. Lucie Unit 1 Reactor Pressure Vessel Head

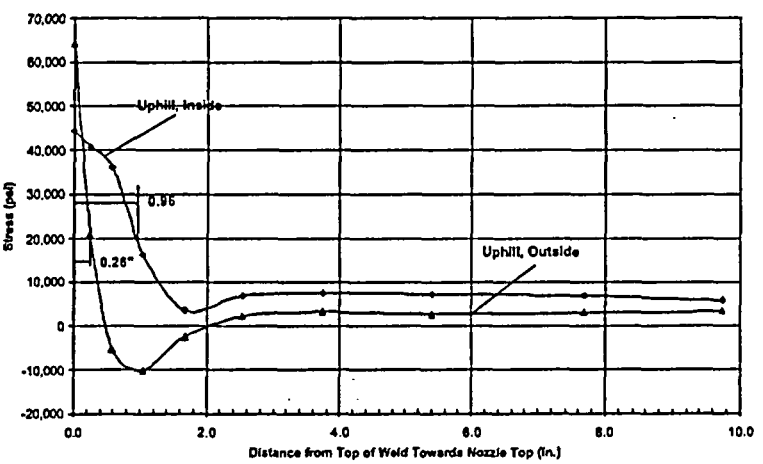
Penetration Nozzles by

Westinghouse Electric Company LLC

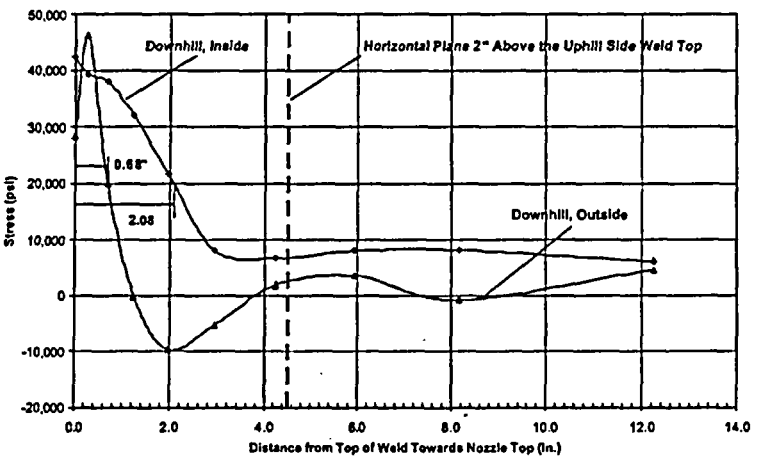
Hoop Stress in 0° CEDM Nozzle vs. Distance from Top of Weld, Uphill and Downhill



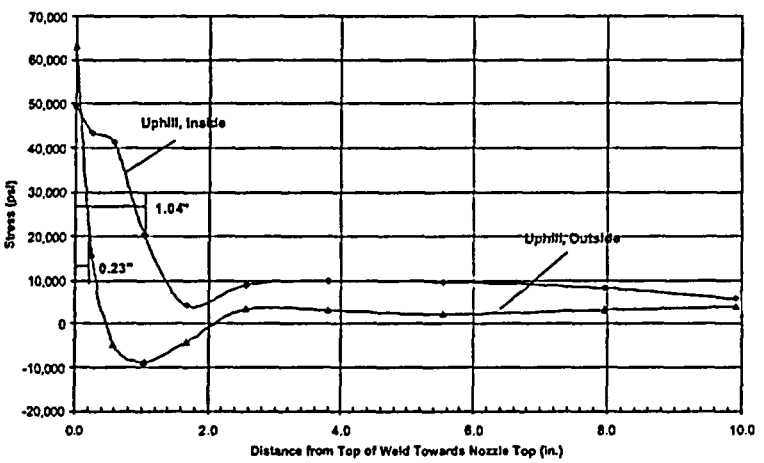
Hoop Stress in 29.1° CEDM Nozzle vs. Distance from Top of Weld, Uphill



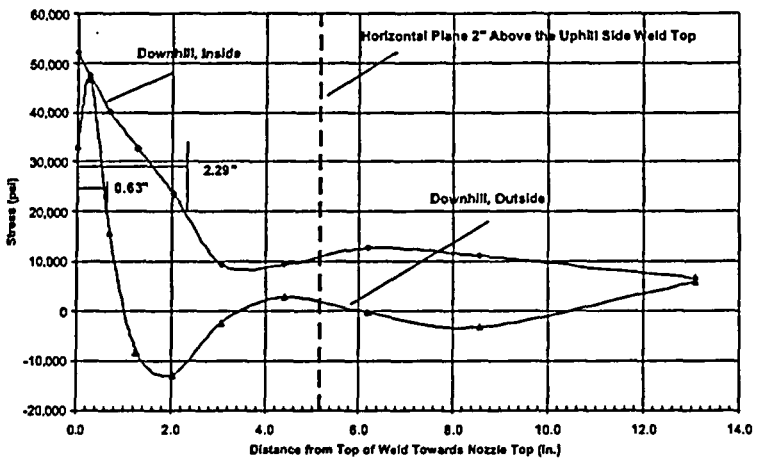
Hoop Stress in 29.1° CEDM Nozzle vs. Distance from Top of Weld, Downhill



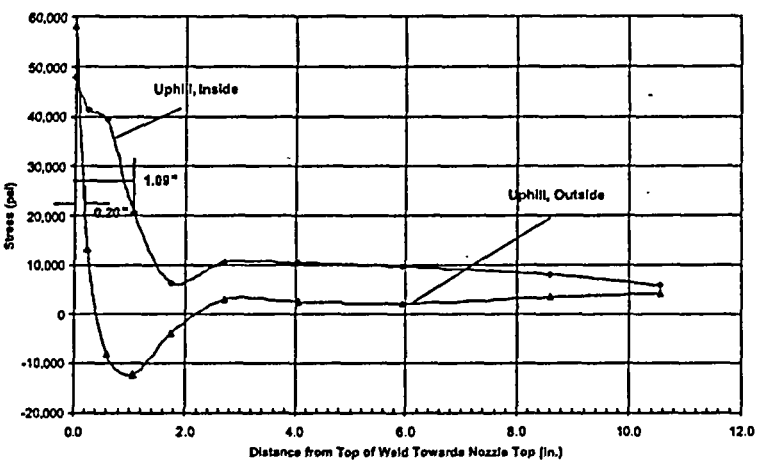
Hoop Stress in 37.1° CEDM Nozzle vs. Distance from Top of Weld, Uphill

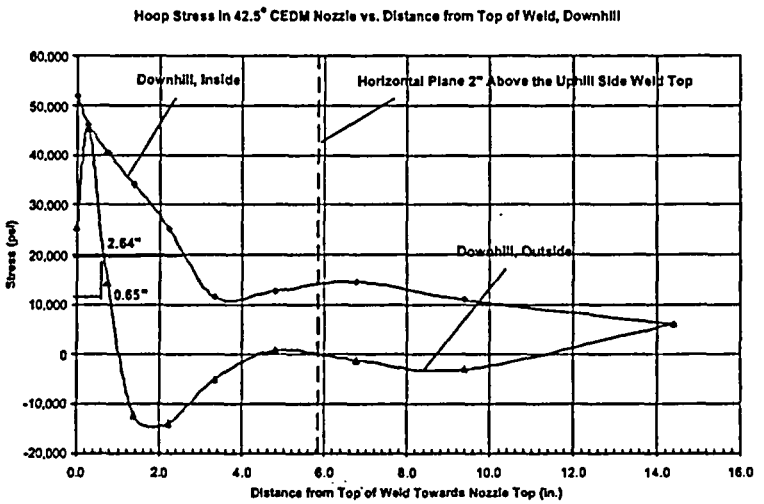


Hoop Stress in 37.1° CEDM Nozzle vs. Distance from Top of Weld, Downhill



Hoop Stress in 42.5° CEDM Nozzle vs. Distance from Top of Weld, Uphill




Hoop Stress in 42.5° CEDM Nozzle vs. Distance from Top of Weld, Downhill
Downhill, Inside
Horizontal Plane 2" Above the Uphill Side Weld Top
Downhill, Outside
2.64"
0.65"
Stress (psi)
60,000
50,000
40,000
30,000
20,000
10,000
0
-10,000
-20,000
0.0
2.0
4.0
6.0
8.0
10.0
12.0
14.0
16.0
Distance from Top of Weld Towards Nozzle Top (in.)