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

FPL

March 28, 2003

L-2003-086
EA-03-09(IV)(F)(2)

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

Re: St. Lucie Unit 2
Docket No. 50-389
Order (EA-03-009) Relaxation Requests 1 and 2
Examination Coverage of Reactor Pressure
Vessel Head Penetration Nozzles – Supplemental Data

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. Pursuant to the procedure specified in Section IV, paragraph F of the Order, Florida Power & Light (FPL) requests relaxation from the requirements specified in Section IV, paragraph C.(1)(b)(i) for St. Lucie Unit 2 for the reactor pressure vessel head (RPVH) penetration nozzles for which ultrasonic testing requirements can not be completed as required. Relaxation is also requested from the requirements specified in Section IV, paragraph C.(1)(a) for an area of the reactor head surface that is inaccessible for visual inspection.

Attachments 1 and 2 to this letter provide relaxation requests. As demonstrated in the attachment hereto, the requested relaxation meets item IV.F.(2) of the Order, as compliance with this Order for the specific areas described in the requests would result in hardship or unusual difficulty without a compensating increase in the level of quality or safety.

FPL requests approval of the subject relaxation by April 21, 2003, the currently scheduled date for St. Lucie Unit 2 reactor reassembly. The refueling outage completion is currently scheduled for May 20, 2003.

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

Very truly yours,

Donald E. Jernigan
Vice President
St. Lucie Plant

Attachments

A101

ST. LUCIE UNIT 2 RELAXATION REQUEST NO. 1
FROM US NRC 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 2 has 102 ASME Class 1 reactor pressure vessel (RPV) head penetrations (including the vent).

The St. Lucie Unit 2 Order Inspection Category in accordance with Section (IV.A.) is currently determined as "high" based on 14.0 EDY at this refueling outage[1] (RFO).

FPL Drawing No. 2998-3130, Rev. 3 (PSL-2)

2. US NRC ORDER EA-03-009 APPLICABLE EXAMINATION REQUIREMENTS:

The NRC issued an Order[2] EA-03-009 on Februay 11, 2003 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 techniques and frequencies:

(1) For those plants in the high category, RPV head and head penetration nozzle inspections shall be performed using the following techniques every refueling outage

(a) Bare metal visual examination of 100% of the RPV head surface (including 360° around each RPV head penetration nozzle), and

(b) Either:

(i) Ultrasonic testing of each RPV head penetration nozzle (i.e., nozzle base material) from two inches above the J-groove weld to the bottom of the nozzle and an assessment to determine if leakage has occurred into the interference fit zone, OR

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[1] FPL letter L-2002-185, "St. Lucie Units 1 and 2, Docket Nos. 50-335, 50-389, Turkey Point Units 3 and 4, Docket Nos. 50-250 and 50-251, Response to NRC Bulletin 2002-02, *Reactor Pressure Vessel Head Penetration Nozzle Inspection Programs*," R. S. Kundalkar to NRC, September 11, 2002.

[2] US NRC Letter EA-03-009, "Issuance Of Order Establishing Interim Inspection Requirements For Reactor Pressure Vessel Heads At Pressurized Water Reactors," from Samuel J. Collins (NRC) to all Pressurized Water Reactor Licensees, Dated February 11, 2003.

(ii) Eddy current testing or dye penetrant testing of the wetted surface of each J-Groove weld and RPV head penetration nozzle base material to at least two inches above the J-groove weld.

Relaxation is requested from part IV.C.(1)(b)(i) of the Order to perform ultrasonic testing (UT) of the RPV head penetration inside the tube from two inches above the J-groove weld to the bottom of the penetration at St. Lucie Unit 2. Specifically, the relaxation is related to UT examination of a limited portion of the non-pressure boundary portion of the end of the RPV penetration nozzle equal to or greater than one inch below the weld to the bottom of the nozzle.

3. REASON FOR REQUEST:

Pursuant to Order Section IV.F.(2) "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", FPL is requesting this relaxation for St. Lucie Unit 2. The 91 CEDM nozzles contain areas that will have less coverage than required by the NRC Order. The Order requires examination from two inches above the J-groove weld to the bottom of the RPV head penetration nozzle. The reduced coverage is caused by the nozzle configuration, and the limitations of probe design used for the Ultrasonic (UT) examination. Specifically, actual coverage below the weld, in the non-pressure boundary portion of the nozzle, is precluded by the threaded area used for attachment of the guide cone as shown in Figure 1.

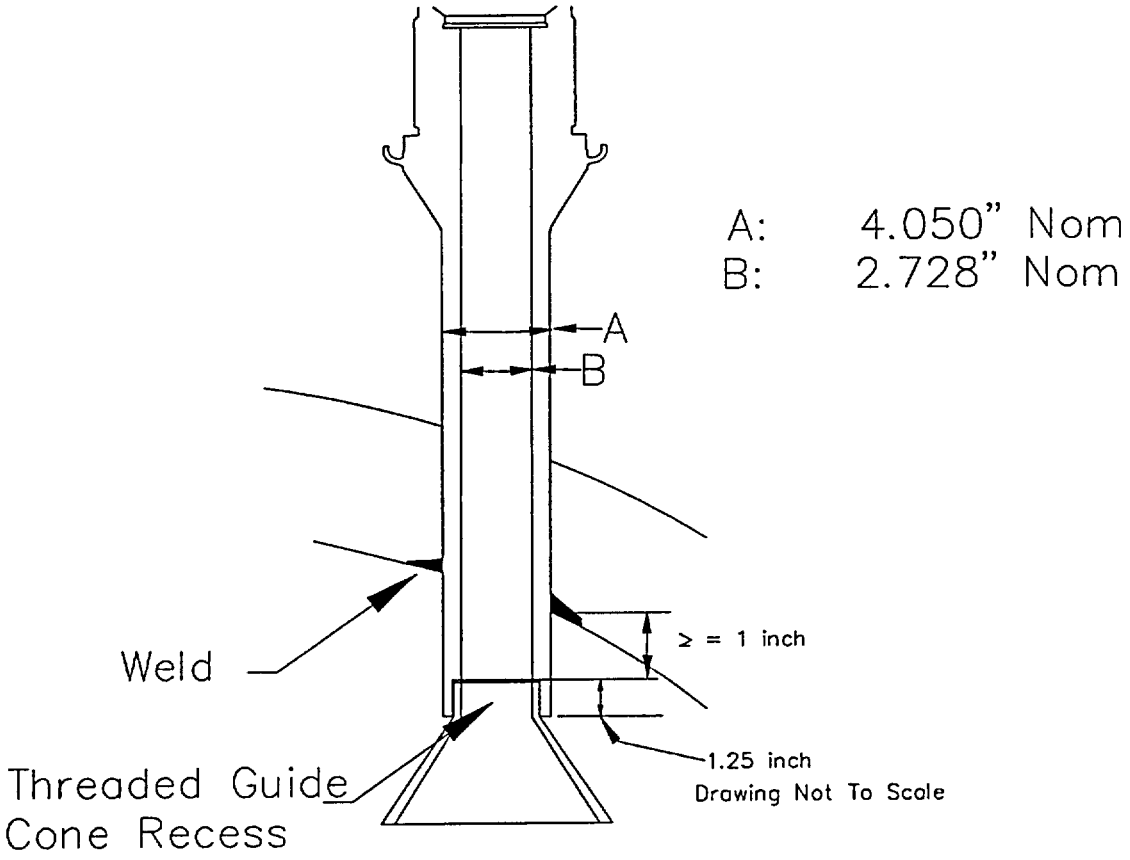

Figure 1: Typical RPV Nozzle with Threaded Guide Funnel

4. PROPOSED ALTERNATIVE AND BASIS FOR USE:

The proposed alternative is to perform the UT examination to the extent practical. This is defined as "the examination shall be performed to include two inches above the weld down as far as UT data can be acquired below the weld." FPL anticipates acquiring UT data to the maximum extent possible. This minimum dimension of area examined (approximately 1 inch below the weld) exists on the downhill side of the nozzle and increases towards the uphill side.

Basis For Relaxation

The scope of the examination is to perform a 360° volumetric examination from two inches above the J-groove weld down to the bottom of the RPV penetration nozzles. The 91 St. Lucie Unit 2 CEDM nozzles are used for a variety of functions, but present similar examination conditions. These RPV penetration nozzles have an inside threaded end and permanently attached externally threaded guide cones. Due to this design condition, the UT beam can not be transmitted into the nozzle material in the area of the externally threaded guide cones. This nozzle design condition results in an area of the tube material that can not be examined with the UT rotating probe examination technique. Therefore, the UT examination technology currently available for the St. Lucie Unit 2 RPV penetration nozzle inspections will result in areas where data can not be acquired below the weld at the end of the nozzle.

Although the Order provides for ultrasonic testing (UT) and assessment of leakage, or surface examination eddy current testing (ECT) or dye penetrant testing (PT) to assess the condition of the vessel head penetration nozzles and J-groove welds, our inspection vendor does not currently have eddy current capability to examine the missing nozzle material. The available method for performing outside surface inspections is manual PT. Preparation and inspection of the subject outside surfaces would increase exposure, without obtaining information leading to a corresponding increase in safety, due to the low stresses in the affected zones. Additionally, examination of the inside portions of the nozzles is not practical. This could only be accomplished by removal of the 91 guide cones and the development of special tooling to inspect the threaded nozzle surface.

To evaluate the significance of the lack of UT inspection coverage, the inspection coverage data was broken into two distinct regions. These regions include the nozzle base material from two inches above the weld to one inch below the weld, and from equal to or greater than one inch below the weld. FPL anticipates acquiring UT data to the maximum extent possible (approximately one inch below the weld minimum).

To determine the significance of the lack of UT examination coverage, the effect of a postulated axial and circumferential flaw in the nozzle material was evaluated relative to the areas of examination coverage identified above.

From two inches above the weld to one inch below the weld: The areas of prime interest because of the safety concern for nozzle ejection and loss of coolant accident (LOCA) are circumferential cracks located in the nozzle material at the weld root and above the weld. This is also the area that axial cracks would have to propagate to in order for a leak to occur through the RPV penetration nozzle material. The UT examinations of the RPV penetration nozzles will have bounded this area (the safety significant region), by providing complete 360° coverage of the nozzle base material (from two inches above the weld to one inch below the weld). Therefore, reliable assurance is provided to conclude that safety significant circumferential flaws do not exist at or above the weld root.

Equal to or greater than one inch below the weld to the bottom of the nozzle: Axial flaws in the area of non-coverage in the nonpressure boundary nozzle base material below the weld are of no structural significance, however, a postulated flaw could grow above the weld to the point of leakage followed by wastage and/or potential initiation of an outside diameter (OD) circumferential flaw.

To determine the significance of an axial flaw that is contained in the nonpressure boundary nozzle material in the uninspected region equal to or greater than one inch below the weld, a flaw tolerance approach is used. A flaw evaluation was performed postulating an axial flaw in the area of missed coverage below the weld using WCAP-16038-P[3]. A through wall flaw is postulated in the nozzle material from the bottom of the penetration to one half-inch from the bottom of the weld. The flaw evaluation in WCAP-16038-P is based on St. Lucie Unit 2 specific stresses in the nozzle penetrations. Since the stresses equal to or greater than one inch below the weld are too low to propagate an axial flaw, the WCAP-16038-P flaw evaluations start at one-half inch below the weld, and evaluate the time to propagate the flaw in the nozzle to the bottom of the weld (start of the pressure boundary portion of the nozzle material or toe of the J-groove weld). Assuming a through wall flaw below the weld, with the flaw end located at one-half inch below the weld (which is in the area of complete UT examination coverage), an axial flaw would take greater than 5 years of operation (Figures 6-12 through 6-20 in WCAP-16038-P) in any nozzle location to grow to the point of contact with the weld. This time period is significantly greater than the current inspection frequency of every refueling cycle (18 months for St. Lucie Unit 2) identified in NRC Order EA-03-009. As an added conservatism, this evaluation does not attempt to evaluate the time for the axial flaw to grow from the bottom of the weld through the pressure boundary. Figure

[3] *Structural Integrity Evaluation of Reactor Vessel Upper Head Penetrations to Support Continued Operation: St. Lucie Unit 2*, Westinghouse Electric Co. LLC, WCAP-16038-P Revision 0, March 2003.

flaw to grow from the bottom of the weld through the pressure boundary. Figure 2 provides a graphical presentation of the above flaw evaluation discussion for the outer most penetration location.

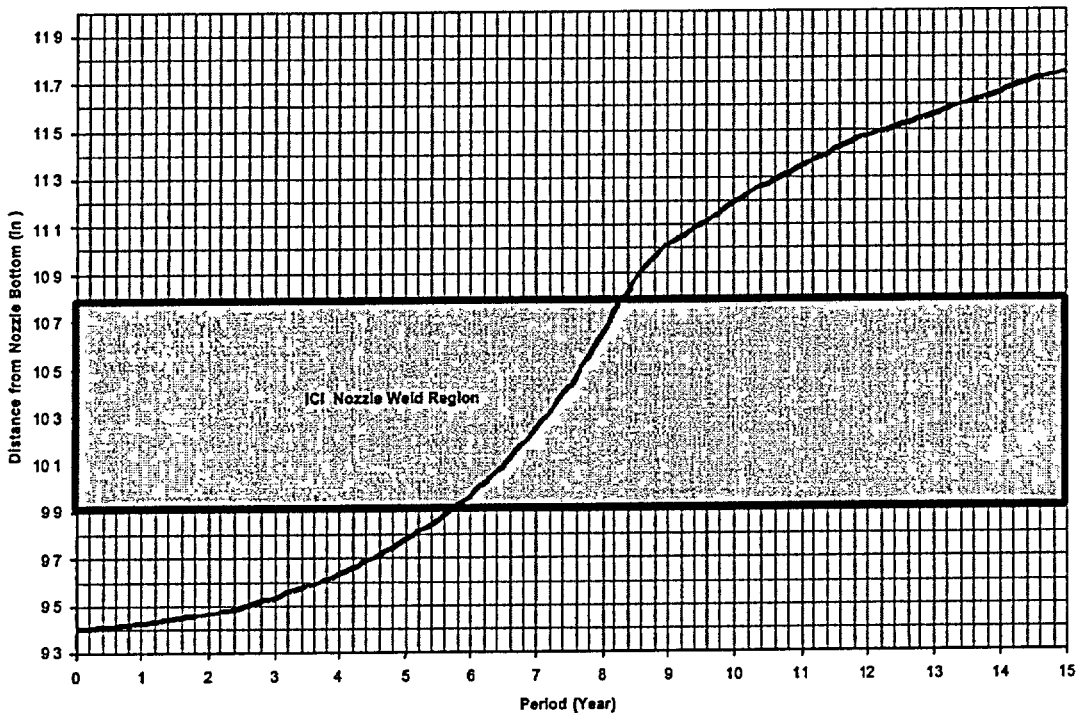

Figure 2: Through-Wall Axial Flaws Located in the 55.3 Degrees Row of Penetrations, Uphill Side - Crack Growth Predictions (From Figure 6-19, WCAP-16038-P)

Hoop Stress Distribution

Figures 3 to 9 provided below (Appendix E, Figures E-1 through E-7 of WCAP-16038-P), show the hoop stress distribution as a function of distance from the bottom of the weld. These are the same nozzles whose stress distribution is shown in Figures 5-4 through 5-7 of WCAP-16038-P. These figures provide assurance that the stress levels below one inch are quite low, thereby reducing the potential for cracking.

Effect of Yield Stress Level on the Trend in Stresses Below The Weld

The trend in stresses in a typical head penetration is not affected by the yield stress used in the analysis. Westinghouse stress evaluations are done using a cyclic stress-strain curve determined from laboratory tests carried out on actual

head penetration material. The equivalent 0.2% offset yield for this curve is about 50 ksi.

Therefore, compliance with the requirement for UT coverage to the bottom of the nozzle is unnecessary in that the inspection limitation does not preclude UT examination of the portion of these nozzles that are of primary interest. There are no concerns with the structural integrity of the RPV penetration nozzles that could be caused by axial cracking in the missed coverage areas in the nonpressure boundary portion of the nozzle material below the weld, due to the permanently attached threaded cones, for a period of > 5 years of operation.

This conclusion is based on the following results:

- UT inspection of the most highly stressed portion of the nozzle (the weld heat affected zone) is unaffected by this limitation,
- UT of the interference fit zone above the weld (for leakage assessment) is unaffected by the limitation, and
- Cracks initiating in the unexamined bottom portion (nonpressure boundary) of the nozzle would be of minimal safety significance with respect to pressure boundary leakage or nozzle ejection, since this portion of the nozzle is below the pressure boundary and any cracks would have to grow through the examined portion of the tube to reach the pressure boundary.

A hardship or unusual difficulty without a compensating increase in level of quality or safety, would result if physical modifications (removal of the permanently attached cones), or development of new UT equipment, were pursued to achieve the complete coverage in the nonpressure boundary portion of the RPV nozzle material below the weld as required by the Order.

5. DURATION OF PROPOSED ALTERNATIVE:

This relaxation is applicable to the April/May 2003 refueling outage (SL1-14) for PSL-2.

6. PRECEDENTS

The technical basis for this relaxation request has been previously reviewed and approved by the NRC for Turkey Point Unit 3, Docket No. 50-250, and TAC No. MB7990.

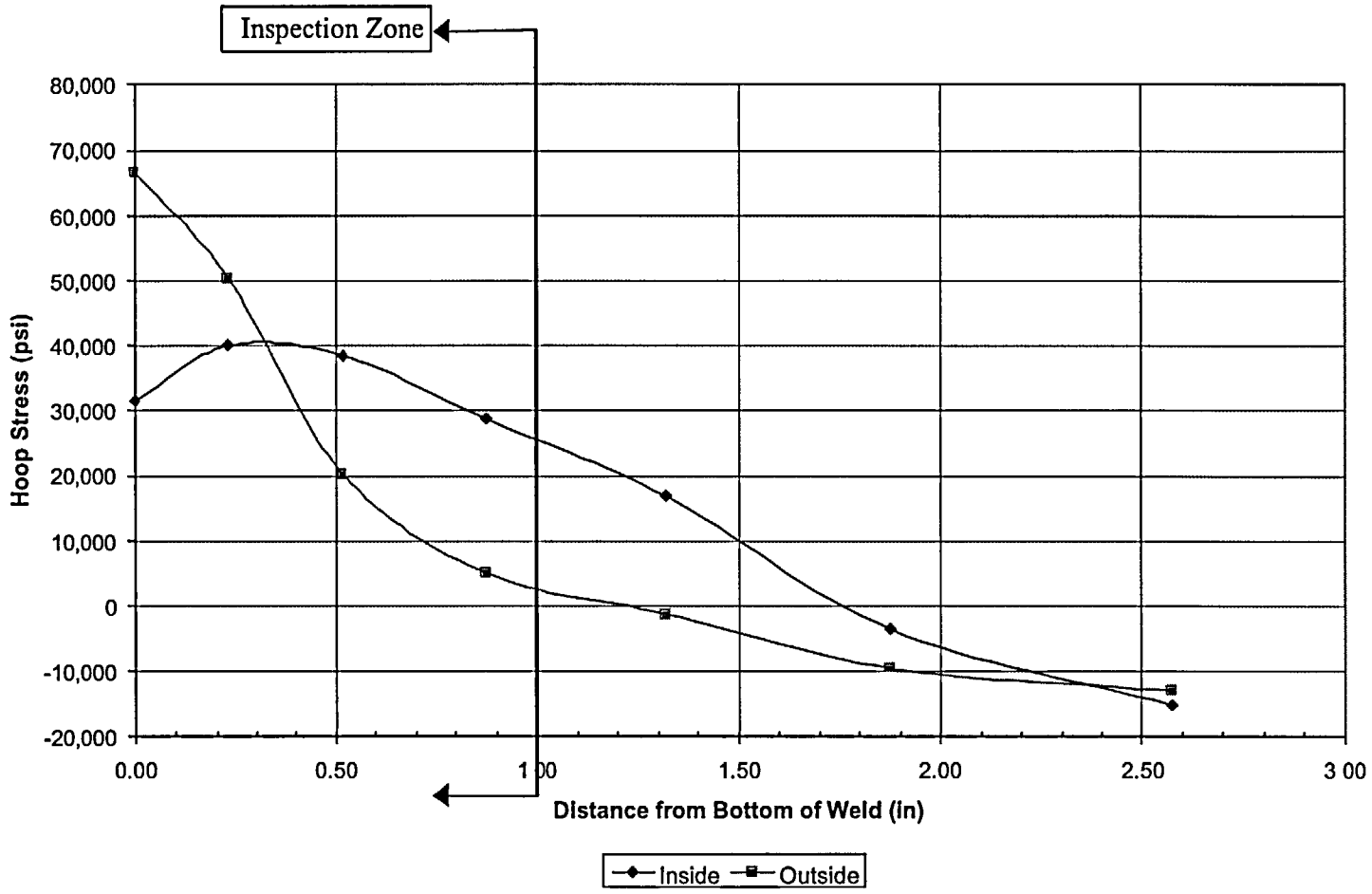

Figure 3: Hoop Stress Vs Distance from Bottom of Weld Plot for the Center CEDM Penetration

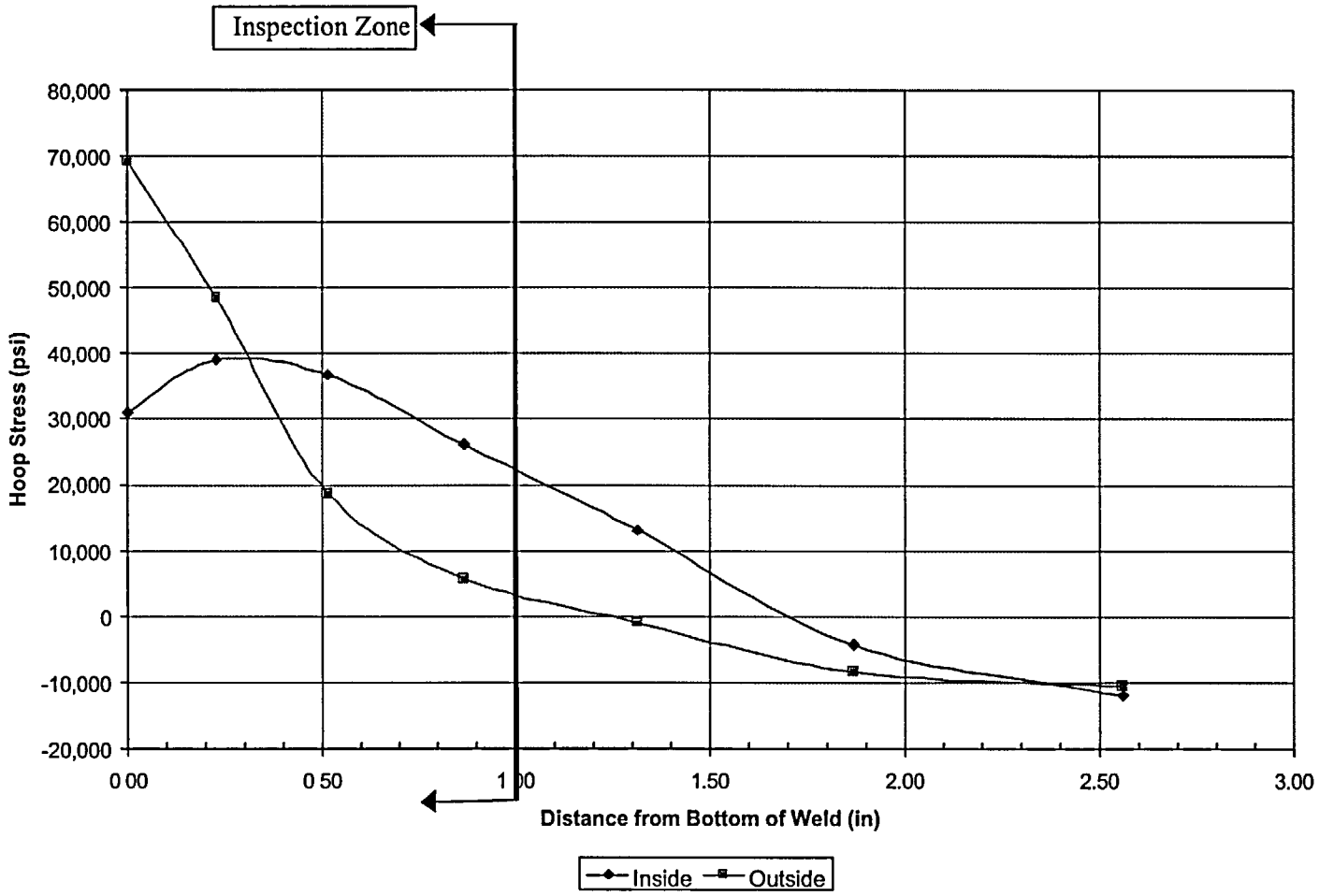

Figure 4: Hoop Stress Vs Distance from Bottom of Weld Plot for the 7.8 Degrees Row of Penetration, Downhill Side

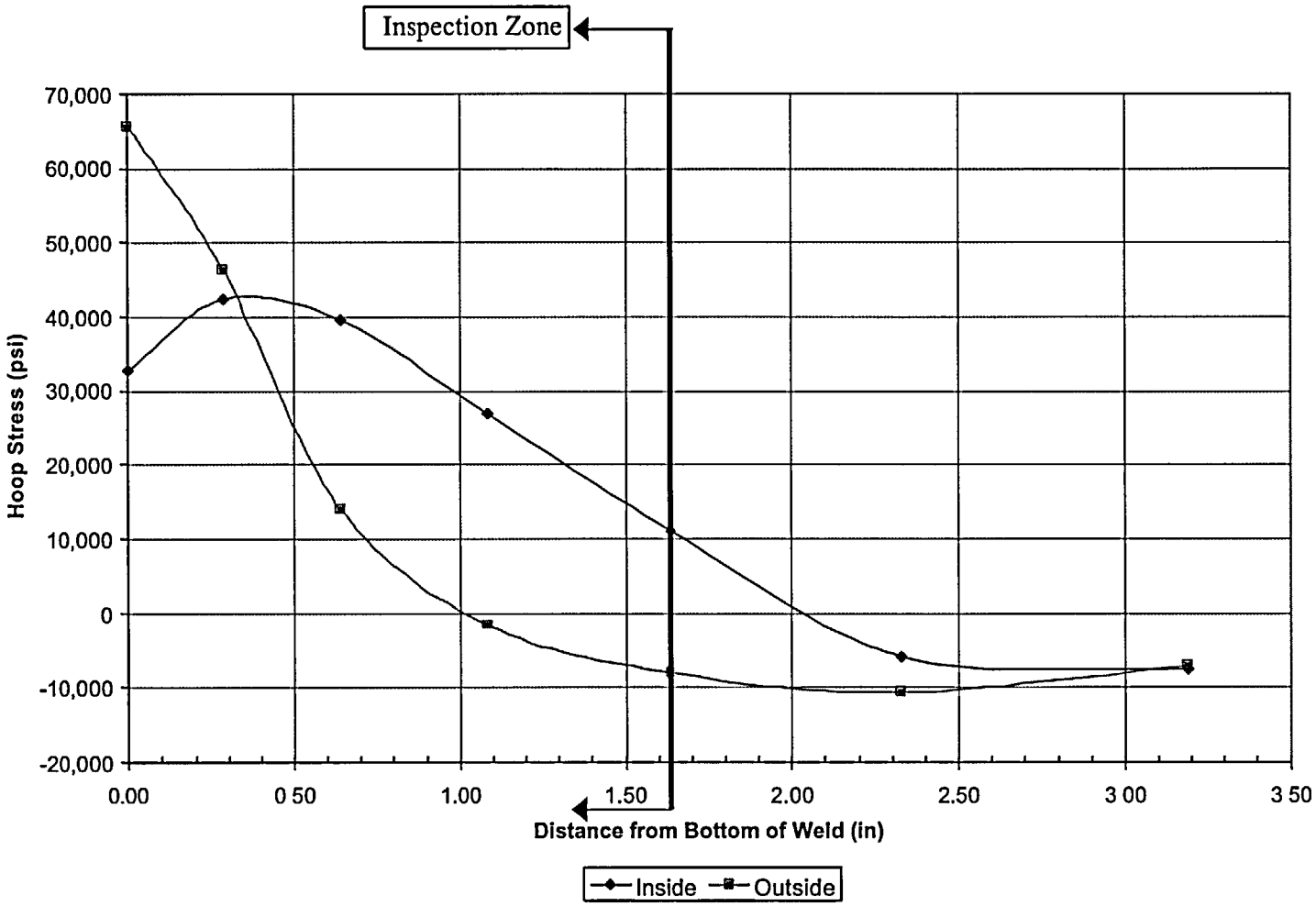

Figure 5: Hoop Stress Vs Distance from Bottom of Weld Plot for the 7.8 Degrees Row of Penetration, Uphill Side

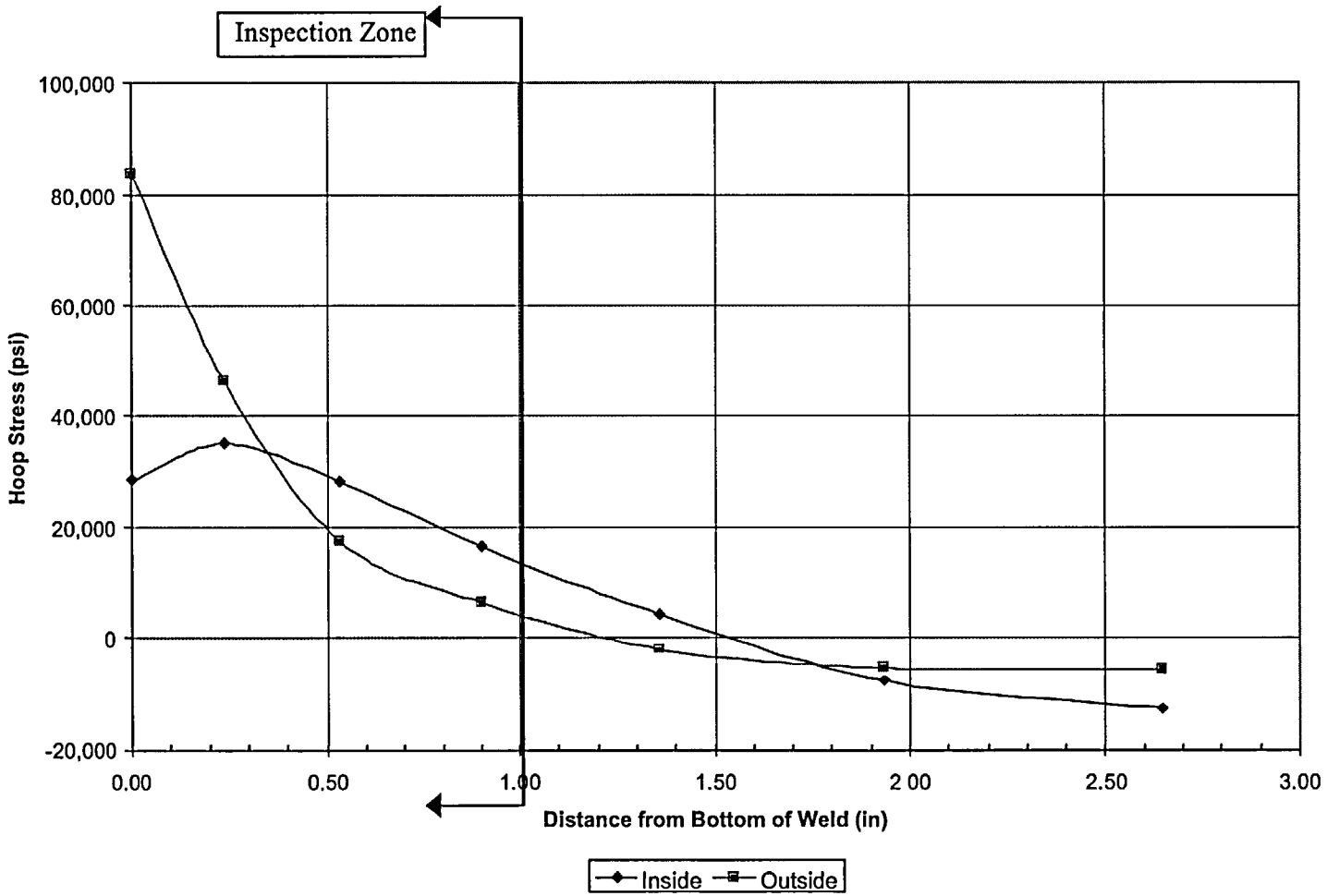

Figure 6:Hoop Stress Vs Distance from Bottom of Weld Plot for the 29.1 Degrees Row of Penetration, Downhill Side

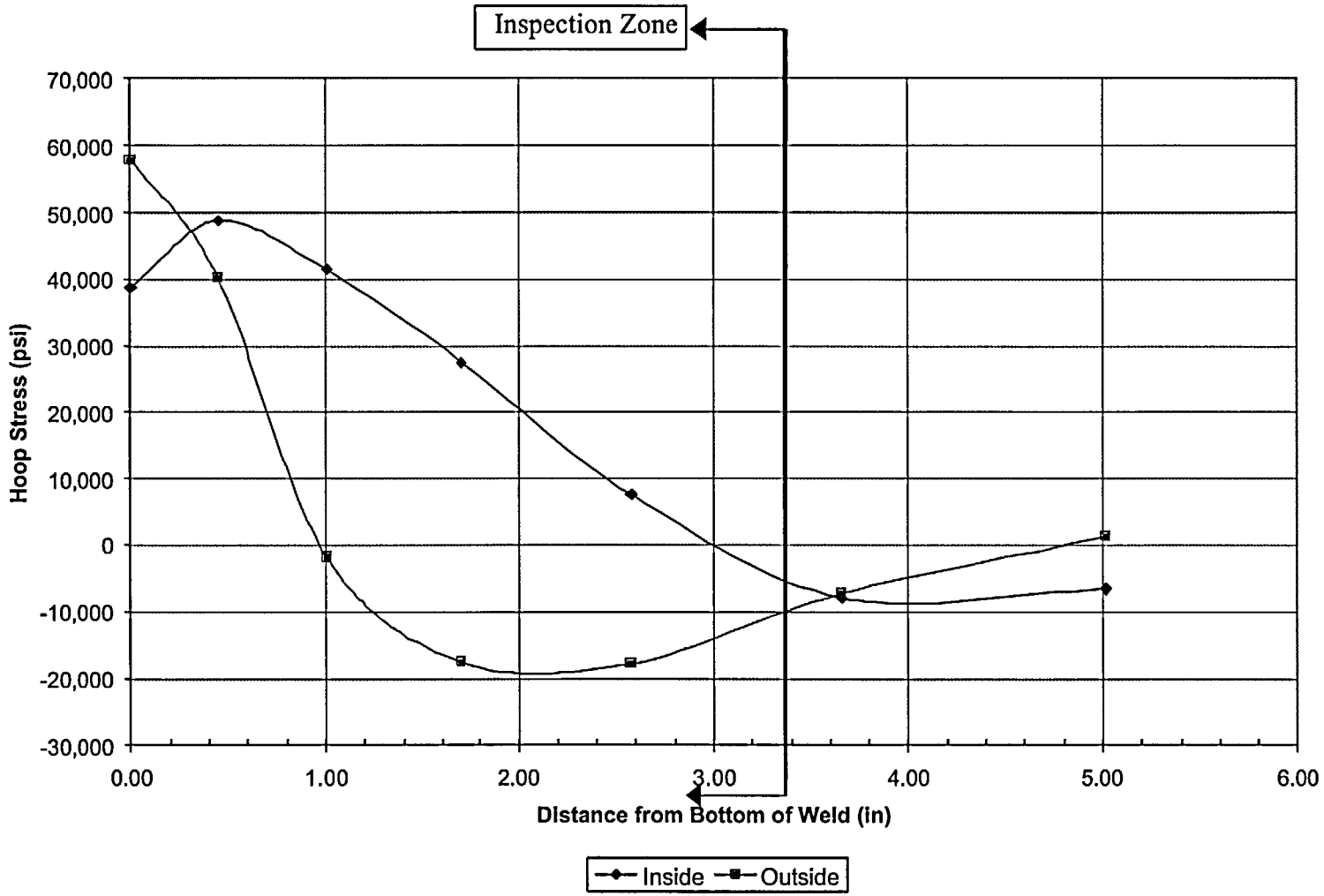

Figure 7:Hoop Stress Vs Distance from Bottom of Weld Plot for the 29.1 Degrees Row of Penetration, Uphill Side

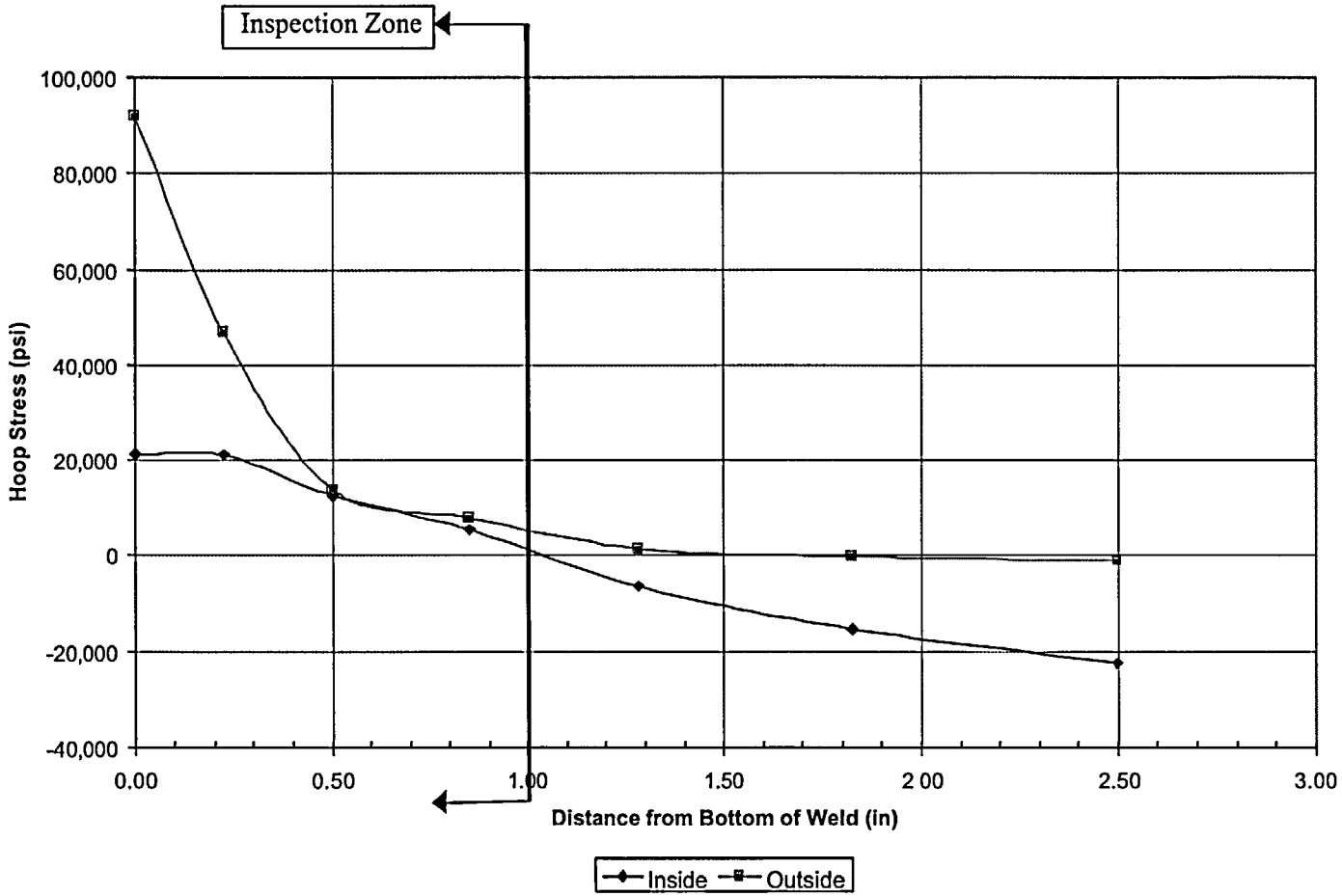

Figure 8: Hoop Stress Vs Distance from Bottom of Weld Plot for the 49.7 Degrees Row of Penetration, Downhill Side

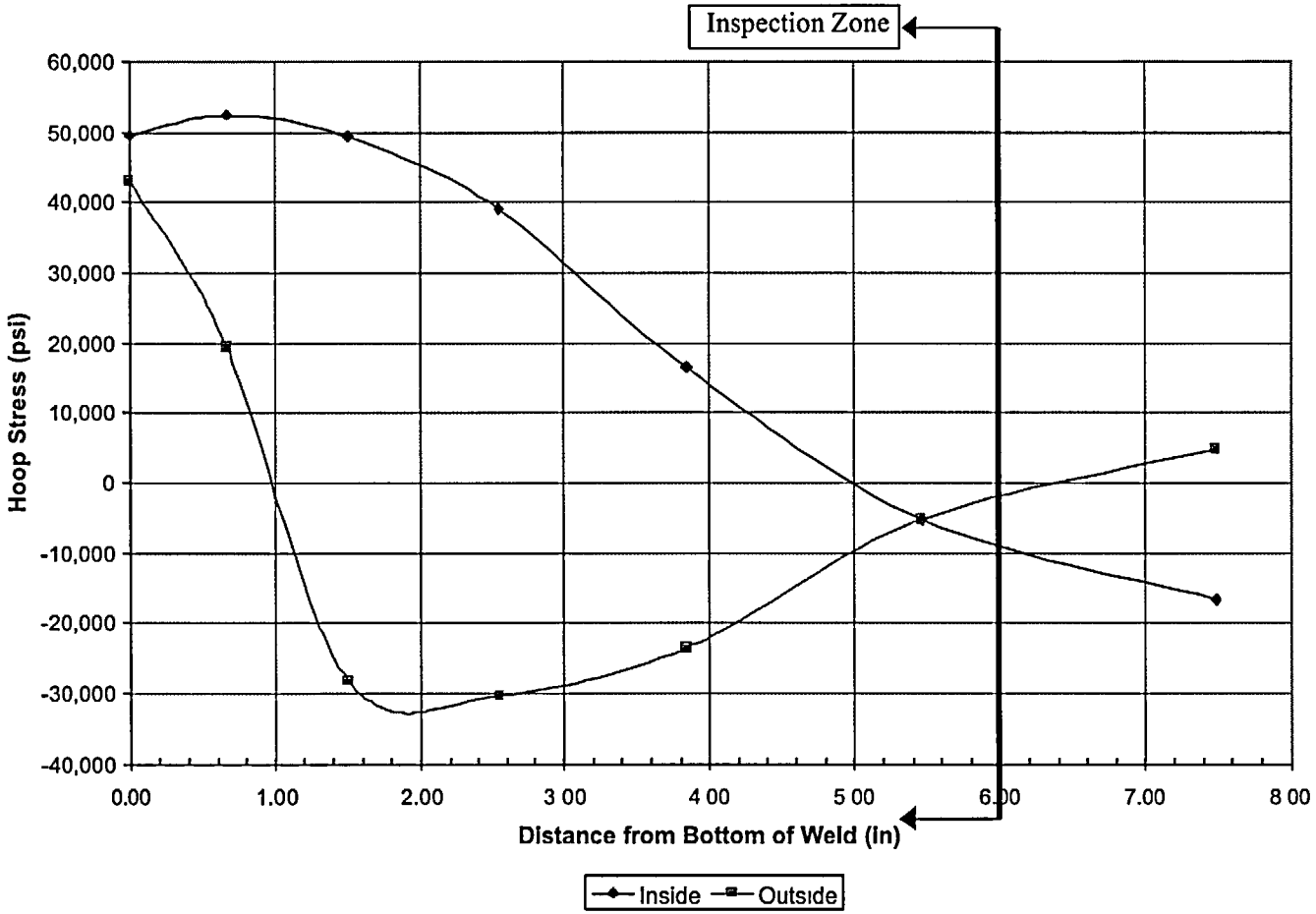

Figure 9: Hoop Stress Vs Distance from Bottom of Weld Plot for the 49.7 Degrees Row of Penetration, Uphill Side

ST. LUCIE UNIT 2 RELAXATION REQUEST NO. 2 FROM US NRC 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 2 has 102 ASME Class 1 reactor pressure vessel (RPV) head penetrations (including the vent).

The St. Lucie Unit 2 Order Inspection Category in accordance with Section (IV.A.) is currently determined as "high" based on 14.0 EDY at this refueling outage[1] (RFO).

FPL Drawing No. 2998-1714, Rev. 3
FPL Drawing No. 2998-4331, Rev. 2
FPL Drawing No. 2998-4318, Rev. 2
FPL Drawing No. 2998-4319, Rev. 3
FPL Drawing No. 2998-4332, Rev. 2

2. US NRC ORDER EA-03-009 APPLICABLE EXAMINATION REQUIREMENTS:

The NRC issued an Order[2] on Februay 11, 2003 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 techniques and frequencies:

(1) For those plants in the high category, RPV head and head penetration nozzle inspections shall be performed using the following techniques every refueling outage

(a) Bare metal visual examination of 100% of the RPV head surface (including 360° around each RPV head penetration nozzle), and

(b) Either:

(i) Ultrasonic testing of each RPV head penetration nozzle (i.e., nozzle base material) from two inches above the J-groove weld to

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[1] FPL letter L-2002-185, "St. Lucie Units 1 and 2, Docket Nos. 50-335, 50-389, Turkey Point Units 3 and 4, Docket Nos. 50-250 and 50-251, Response to NRC Bulletin 2002-02, Reactor Pressure Vessel Head Penetration Nozzle Inspection Programs," R. S. Kundalkar to NRC, September 11, 2002.

[2] US NRC Letter EA-03-009, *Issuance Of Order Establishing Interim Inspection Requirements For Reactor Pressure Vessel Heads At Pressurized Water Reactors*, from Samuel J. Collins (NRC) to all Pressurized Water Reactor Licensees, Dated February 11, 2003.

the bottom of the nozzle and an assessment to determine if leakage has occurred into the interference fit zone, or

(ii) Eddy current testing or dye penetrant testing of the wetted surface of each J-Groove weld and RPV head penetration nozzle base material to at least two inches above the J-groove weld.

Relaxation is requested from part IV.C.(1)(a) of the Order to perform "bare metal visual examination of 100% of the RPV head surface (including 360° around each RPV head penetration nozzle)" at St. Lucie Unit 2. Specifically, FPL is unable to completely comply with this requirement due to inaccessibility of a portion of the RPV head surface for inspection, where the shroud support ring and vertical panels of reflective metal insulation (RMI) inside the shroud meet the RPV head and the horizontal RMI support legs are positioned.

3. REASON FOR REQUEST:

Pursuant to Order Section IV.F "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 2. FPL is unable to comply with the requirement for 100% visual examination coverage due to lack of access and proposes that the requirement is unnecessary in that the inaccessibility of a small percentage of the head surface due to the vertical RMI panels, horizontal panel support legs, and shroud ring do not preclude performance of an effective bare metal visual examination of the RPV head to identify evidence of wastage. A side view of the RPV head showing the shroud ring location and RMI is shown in Figure 1 and Figure 2.

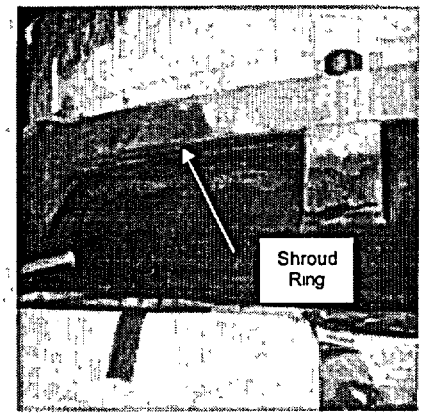

Figure 1: Picture showing Shroud Support Ring Location

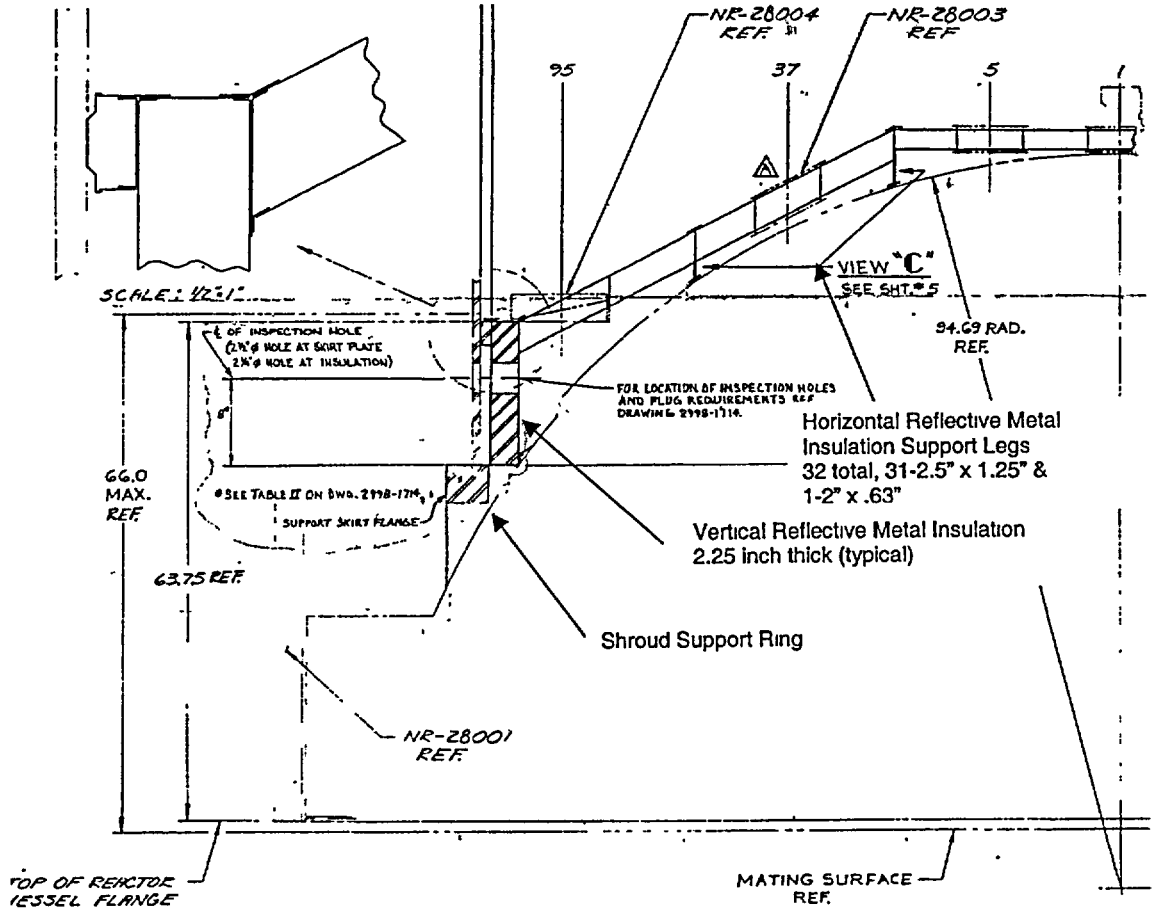

Figure 2: RPV Head Side View showing Insulation Panel Location

4. PROPOSED ALTERNATIVE AND BASIS FOR USE:

FPL proposes to achieve substantial compliance with the 100% requirement by conducting a bare metal visual examination of the RPV head surface to the extent practical, excluding the inside of the 54 RPV stud holes. Specifically, the examination will include a visual examination of 360° around each RPV head penetration nozzle for evidence of leakage and examination of the bare head surface within the vertical RMI panels and outside of the shroud ring for evidence of wastage.

BASIS FOR RELAXATION:

The scope of the examination is to perform a bare metal visual examination of 100% of the RPV head surface (including 360° around each RPV head penetration nozzle). The St. Lucie Unit 2 RPV top head surface has areas of inaccessibility due to the presence of the shroud ring and the vertical panels of RMI inside the shroud coming in contact with the RPV head, and horizontal RMI support legs. Improving access to these inaccessible areas, including removal of the horizontal panel support legs, for visual examination would require major disassembly of the CEDM coil stacks and lifting of the shroud and shroud ring to allow access for the destructive RMI removal causing a substantial increase in radiation dose and the potential for damage to removed components. The performance of this disassembly is not practical and does not enhance the quality of the examination because the RPV head penetration nozzles, where leakage would originate, are not located in or adjacent to the inaccessible area: the required 360° visual examination around each RPV head penetration nozzle is unaffected by the this limitation. Also, the head surface immediately uphill and downhill of the inaccessible area will be examined for evidence of boric acid leakage under the RMI or shroud support structure.

In November 2001, FPL performed a bare metal visual examination of the accessible portions of the RPV head inside the RMI, including 360° visual examination around each RPV head penetration nozzle, to identify any evidence of leakage from the 102 penetrations. There were no indications of staining leading downhill on the head surface or evidence of leakage identified around the 102 penetrations.

It can be concluded that a hardship or unusual difficulty without a compensating increase in level of quality or safety would result if physical modifications were performed to achieve the complete coverage of the RPV head base material required by the Order. These modifications would include coil stack disassembly, to accommodate lifting of the shroud ring, and removal of the vertical RMI panels to permit examination.

This conclusion is based on the following results:

- Visual examination during SL2-14 of the base material adjacent to the penetrations for evidence of leakage will be performed (360° coverage will be obtained).
- Visual examination during SL2-14 of the RPV head base material adjacent to the interior of the RMI and exterior of the shroud ring will be performed for evidence of staining and material wastage.
- An assessment during SL2-14 to determine if leakage has occurred into the interference fit zone will be performed.
- A UT inspection during the SL2-14 of the nozzle base material of the 102 penetrations will be performed as part of the UT inspection.
- The previous bare head visual examination SL2-13, including 360° around each RPV head penetration nozzle, identified no evidence of leakage, or staining leading downhill toward the RMI.

5. DURATION OF PROPOSED ALTERNATIVE:

This relaxation is applicable to the April/May 2003 refueling outage (SL2-14) for PSL-2.