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April 2, 2003
L-03-057

U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, DC 20555-0001

Subject: **Beaver Valley Power Station, Unit No. 1**
BV-1 Docket No. 50-334, License No. DPR-66
Reply to Request for Additional Information Regarding
Order EA-03-009 Relaxation Request

On March 27, 2003, the FirstEnergy Nuclear Operating Company (FENOC) submitted a relaxation request to NRC Order EA-03-009, "Issuance of Order Establishing Interim Inspection Requirements for Reactor Pressure Vessel Heads at Pressurized Water Reactors," dated February 11, 2003. In that submittal, relaxation was requested from parts IV.C.(1)(b)(i) and IV.C.(1)(b)(ii) of the Order, as they relate to ultrasonic, eddy current, and dye penetrant testing of limited portions of the bottom of the Reactor Pressure Vessel penetration nozzles. The portions of interest are not part of the pressure boundary.

Following an initial review of the FENOC March 27, 2003 submittal, the NRC provided five questions regarding the FENOC relaxation request. The five questions, and their responses, are provided in the enclosure to this letter.

There are no new commitments contained in this letter. If there are any questions concerning this matter, please contact Mr. Larry R. Freeland, Manager, Regulatory Affairs/Performance Improvement at 724-682-5284.

Sincerely,

Mark B. Bezilla

Enclosure

A101

c: Mr. T. G. Colburn, NRR Senior Project Manager
Mr. D. M. Kern, NRC Sr. Resident Inspector
Mr. H. J. Miller, NRC Region I Administrator

Enclosure to L-03-057

Responses to NRC Questions
Regarding Beaver Valley Power Station (BVPS) Unit 1
Order EA-03-009 Relaxation Request

Question 1. ***What is the minimum distance from the bottom of the weld to the point where data will not be acquired in the lower portion of the nozzle in accordance with the relaxation request?***

Response to Question 1:

The minimum examination distance below the weld varies due to the weld configuration and nozzle location. The examination coverage from the bottom of the J-groove weld is a minimum of at least 1 inch. The most limiting penetrations are near the outside perimeter. As noted in the original relaxation request (Ref. L-03-053 dated March 27, 2003), BVPS Unit 1 is inspecting all areas of the CRDM nozzle that can be inspected given the limitations of the examination equipment and the nozzle geometry.

Question 2. ***The request states that, "The magnitude of the stresses in these portions of the nozzles is low based on information from other plants of similar design and construction." Discuss how this information is applicable to your plant. Provide tabular listings of the maximum stress in the cross-section from the top of the J-groove weld region to the area covered by your relaxation request.***

Response to Question 2:

References:

1. CE Drawing No. 233-723, Control Rod Mechanism Housing Details, Revision 3.
2. CE Drawing No. 233-718, Closure Head Forming & Welding, Revision 2.
3. PWR Materials Reliability Program Response to NRC Bulletin 2001-01 (MRP-48), TP-1006284

The information is obtained from the finite element stress analysis results of the Control Rod Drive Mechanism (CRDM) penetration nozzles performed by our vendor (Westinghouse) for a 3-Loop plant of similar design and construction as BVPS Unit 1. The following summarizes a comparison of the geometry for the vessel head, CRDM nozzles, as well as the vessel head temperature.

	Reference Plant	BVPS Unit 1
RPV Head Inner Radius	79.094 inches	79.094 inches (Ref. 2)
RPV Head Thickness	6.188 inches	6.188 inches (Ref. 2)
CRDM Nozzle OD	4.000 inches	4.000 inches (Ref. 1)
CRDM Nozzle ID	2.750 inches	2.750 inches (Ref. 1)
RPV Head Op. Temp.	597°F	595°F (Ref. 3)

The arrangement of the penetration nozzles on the Beaver Valley Power Station (BVPS) Unit 1 vessel head is identical to that in the reference plant. In addition, the BVPS Unit 1 vessel head temperature is lower than that for the reference plant. Based on the above comparison, it is concluded that the information from the reference plant is applicable to BVPS Unit 1.

The hoop stress distributions as a function of distance from the bottom of the weld for a range of penetration nozzles located at the center of the vessel head to the outermost nozzles are provided in Figures 1 to 9. The expected "inspection zone" is also identified in each figure. This information is provided in graphical versus tabular format. As shown in Figures 1 to 9, the magnitude of the stresses in the unexamined portion of the nozzles is low. See response to Question 3 for further information.

Figure 1
Hoop Stress Vs Distance from Bottom of Weld
0° CRDM Penetration Nozzle – Uphill and Downhill

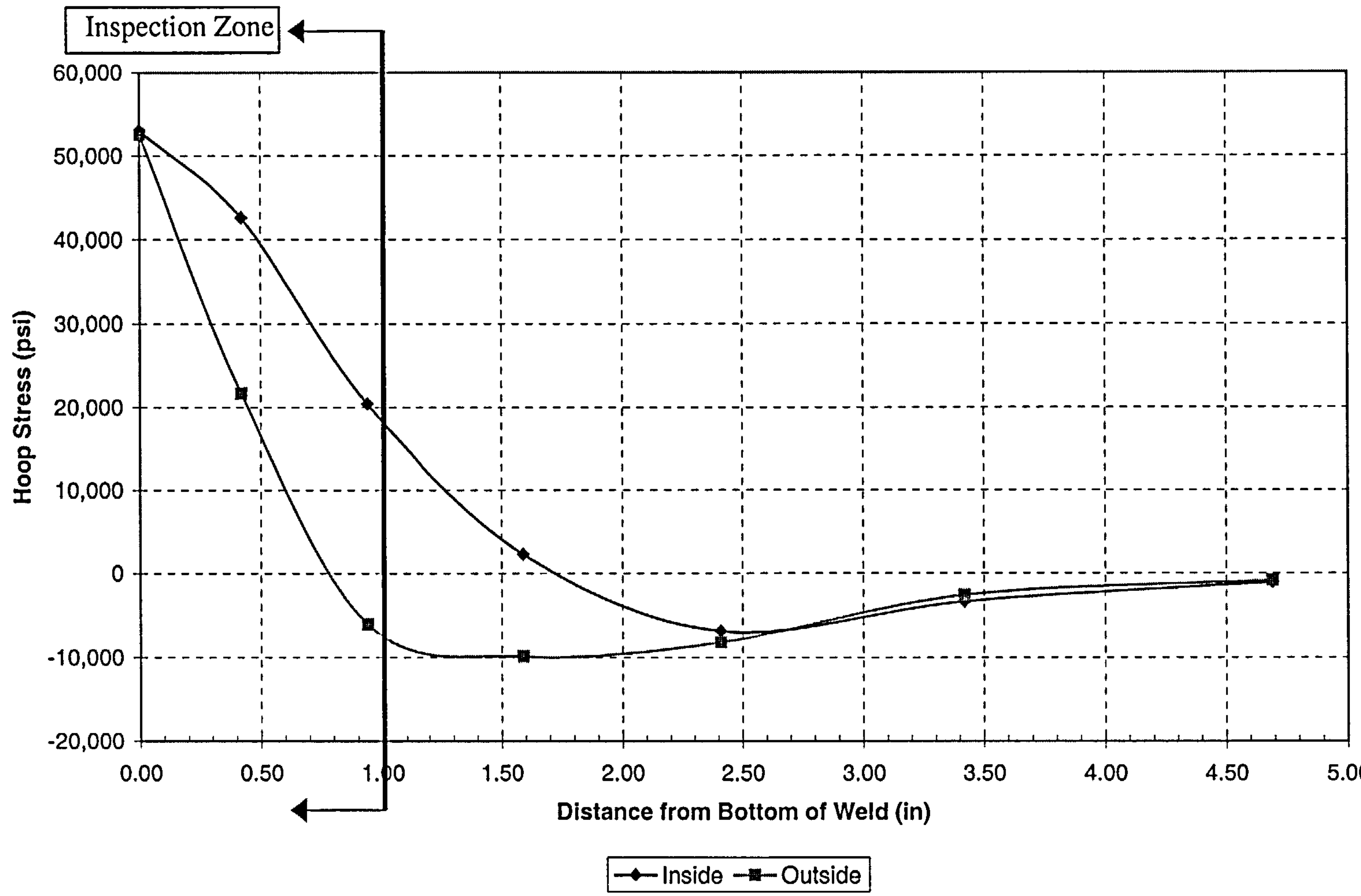


Figure 2
Hoop Stress Vs Distance from Bottom of Weld
28.6° CRDM Penetration Nozzle – Downhill

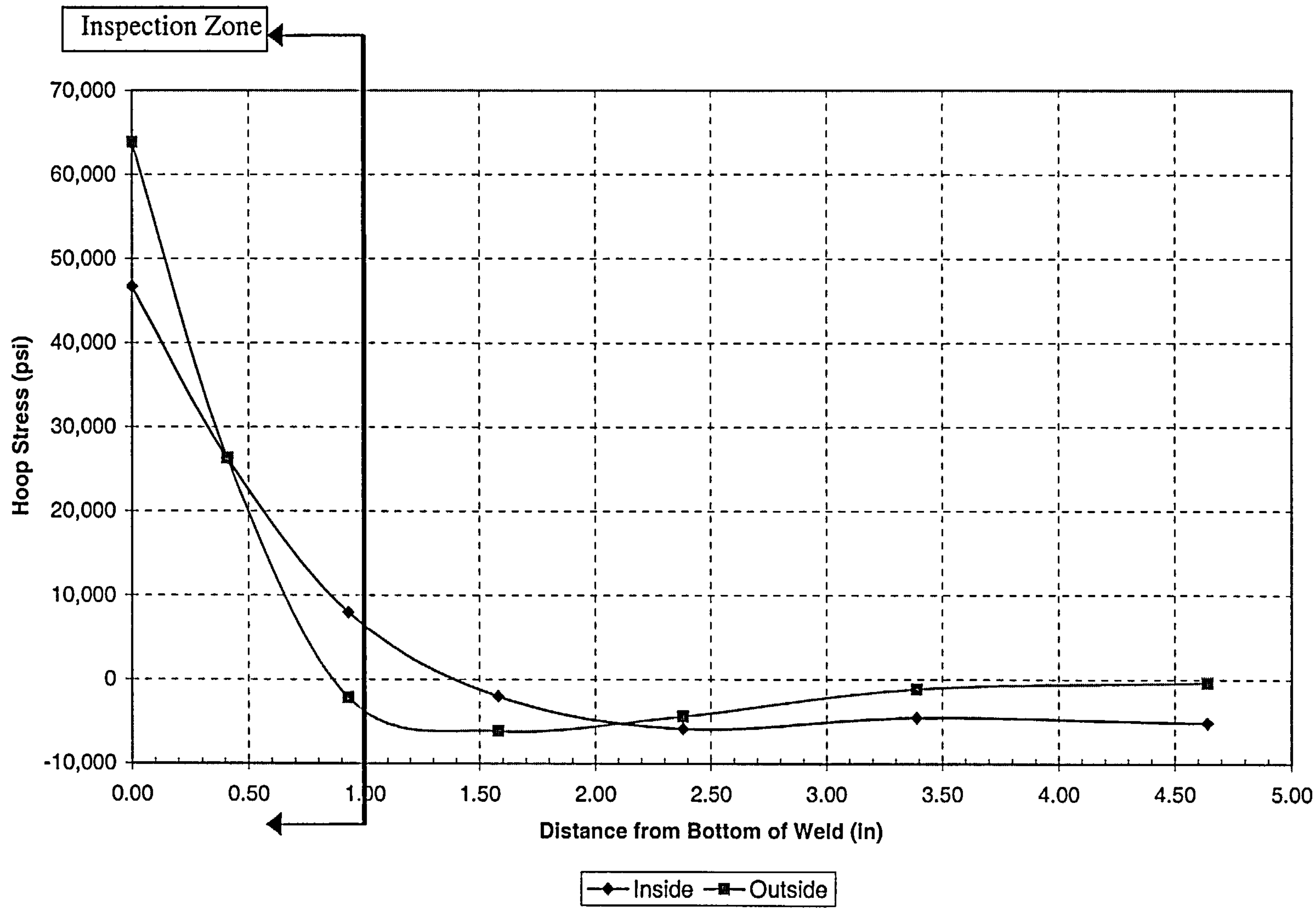


Figure 3
Hoop Stress Vs Distance from Bottom of Weld
28.6° CRDM Penetration Nozzle – Uphill

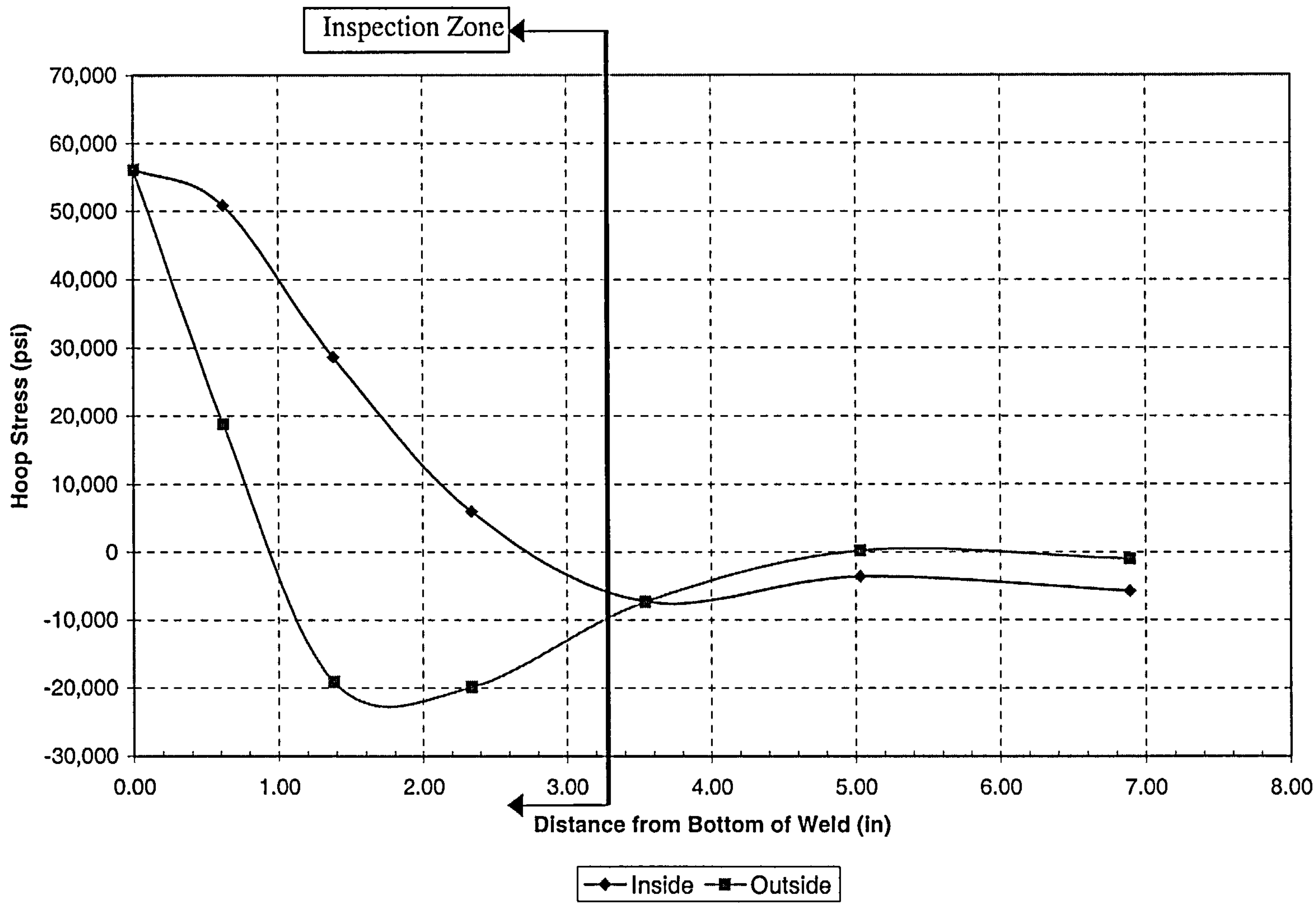


Figure 4
Hoop Stress Vs Distance from Bottom of Weld
38.6° CRDM Penetration Nozzle –Downhill

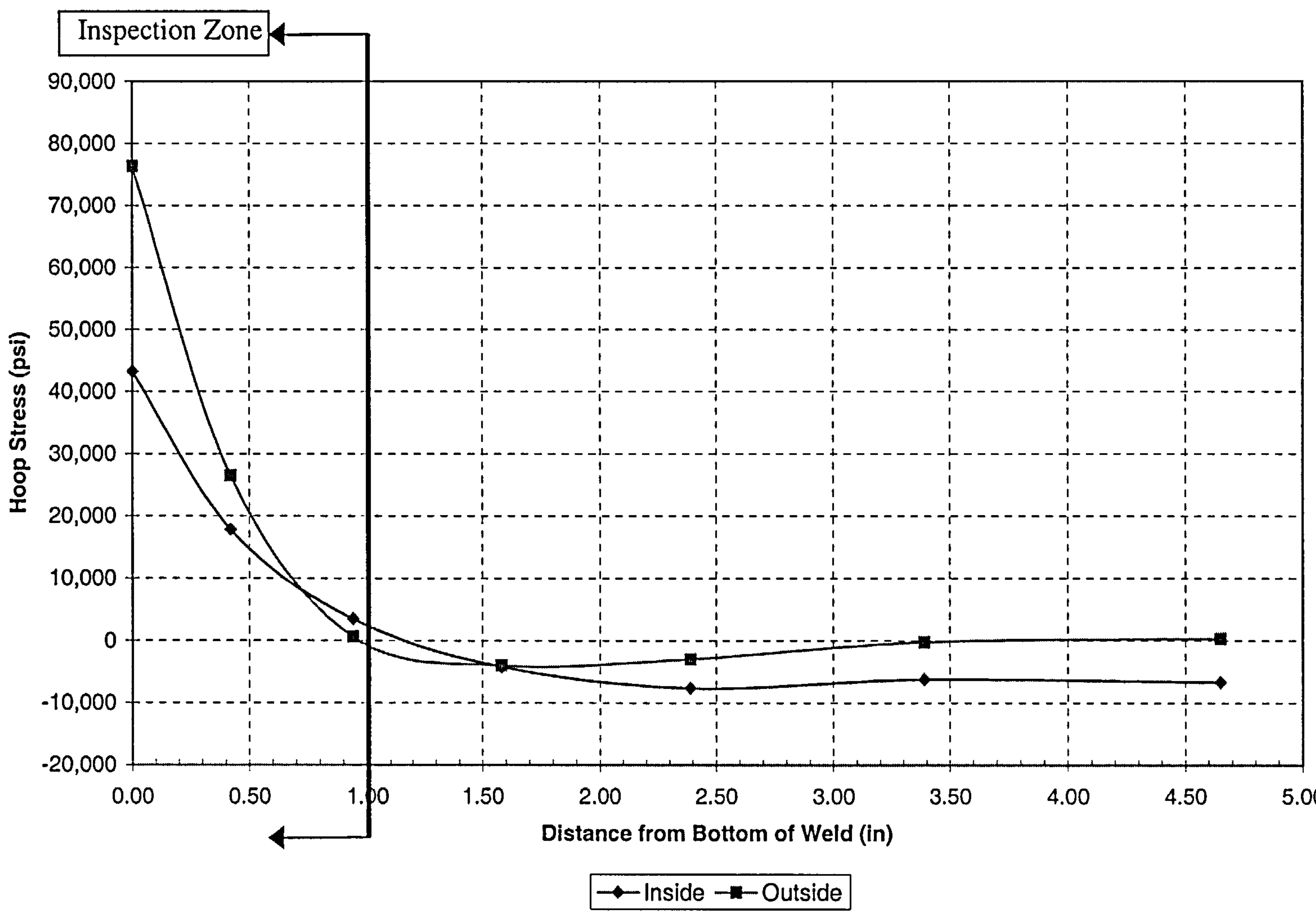


Figure 5
Hoop Stress Vs Distance from Bottom of Weld
38.6° CRDM Penetration Nozzle –Uphill

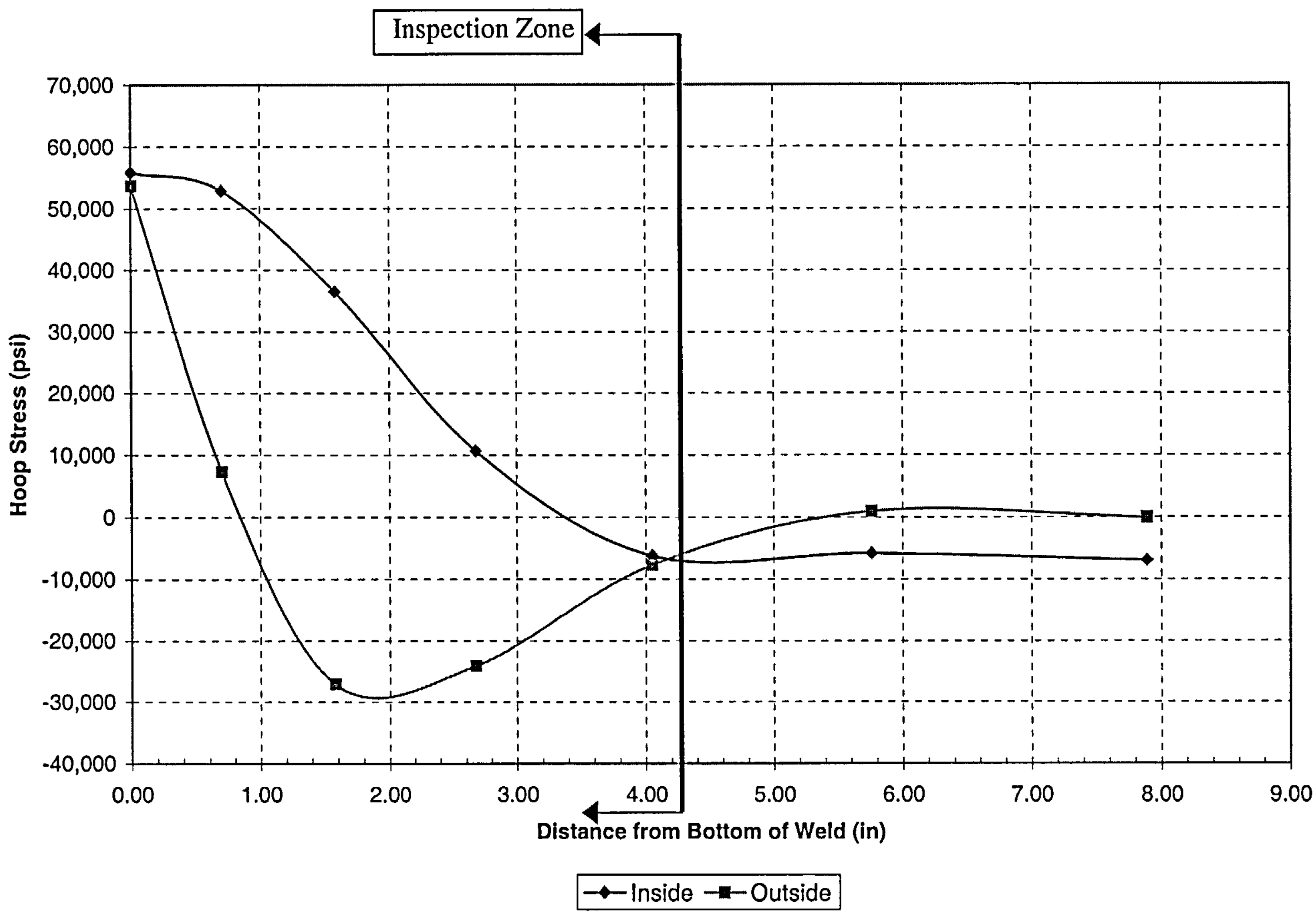


Figure 6
Hoop Stress Vs Distance from Bottom of Weld
40.0° CRDM Penetration Nozzle –Downhill

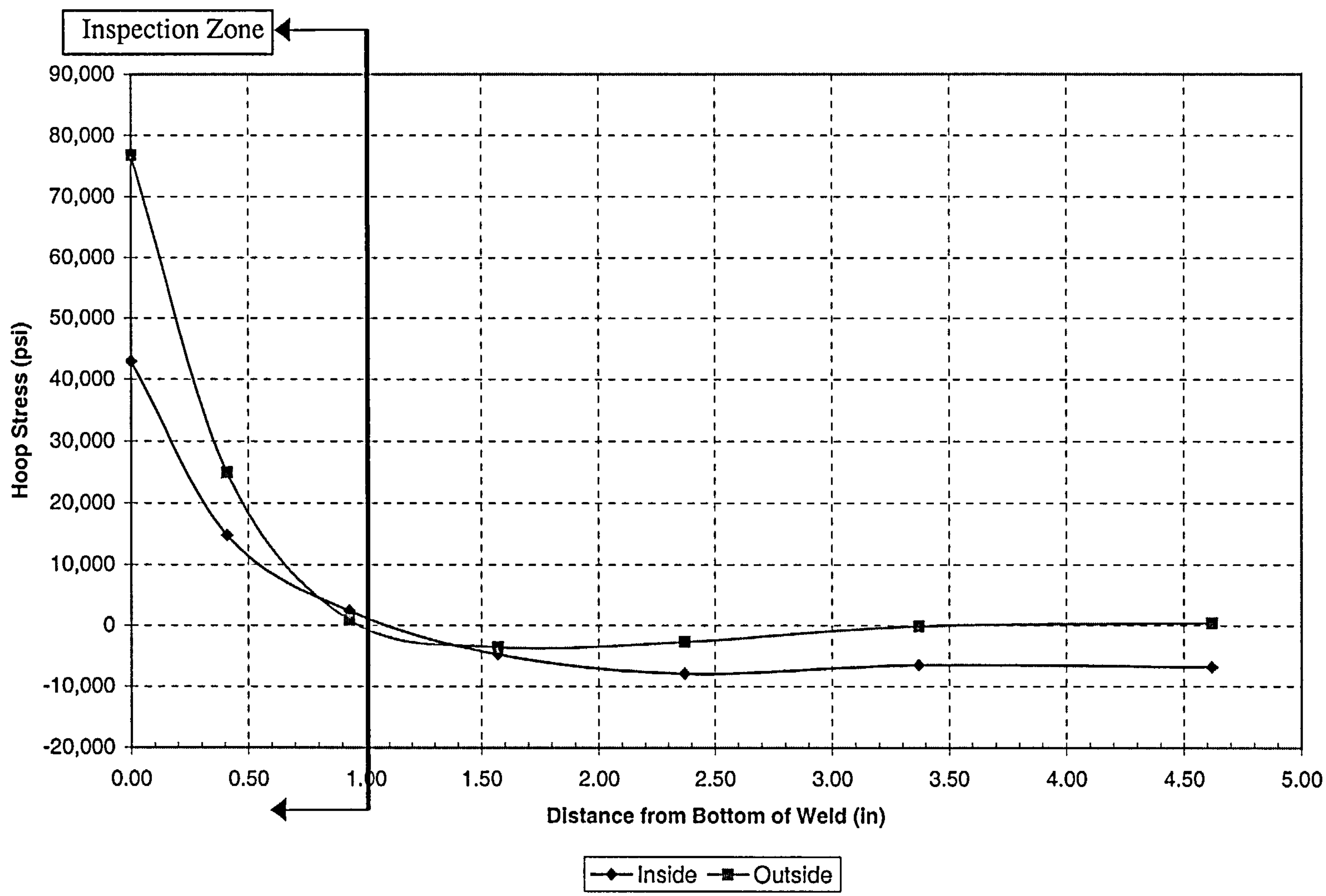


Figure 7
Hoop Stress Vs Distance from Bottom of Weld
40.0° CRDM Penetration Nozzle –Uphill

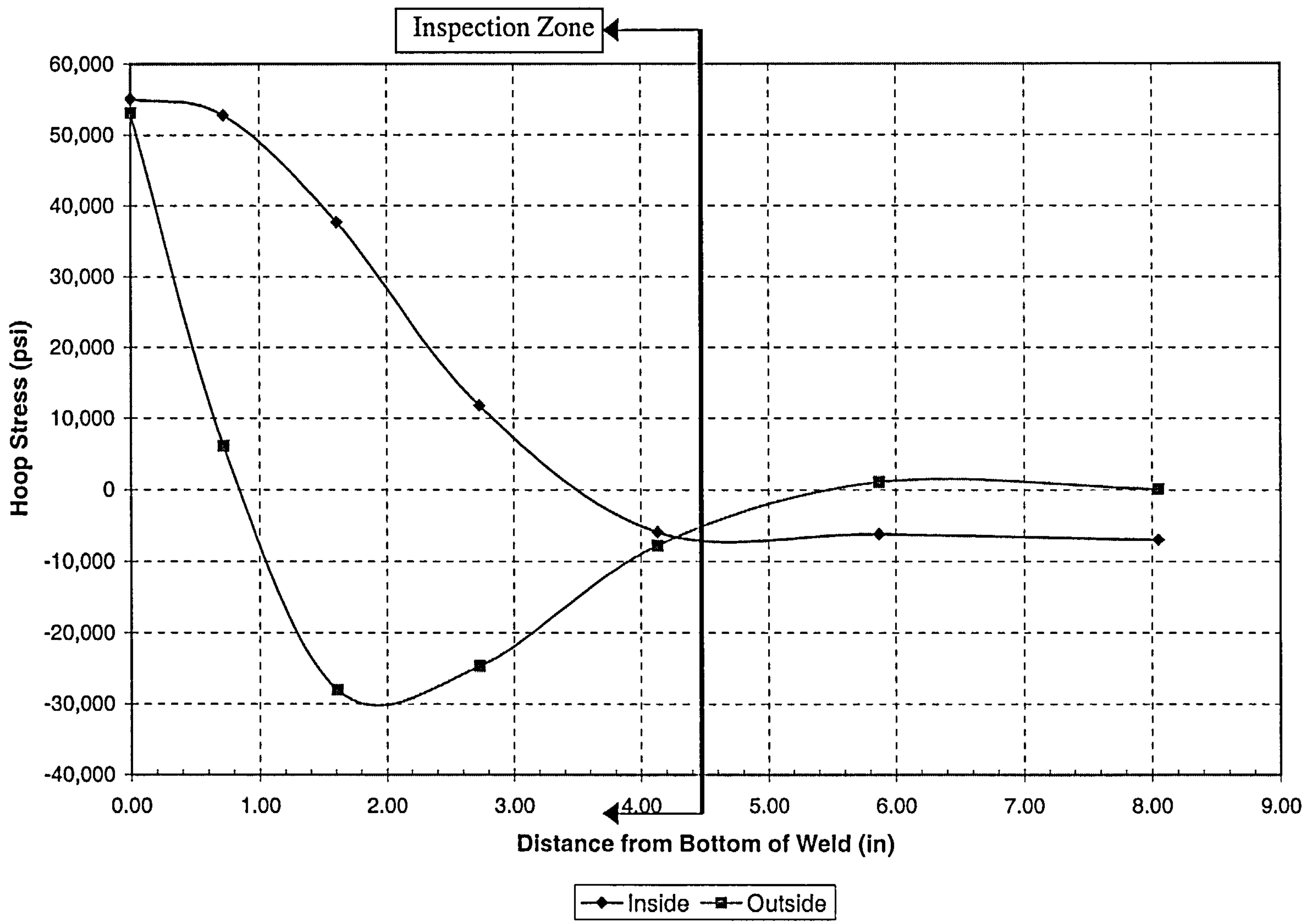


Figure 8
Hoop Stress Vs Distance from Bottom of Weld
42.6° CRDM Penetration Nozzle –Downhill

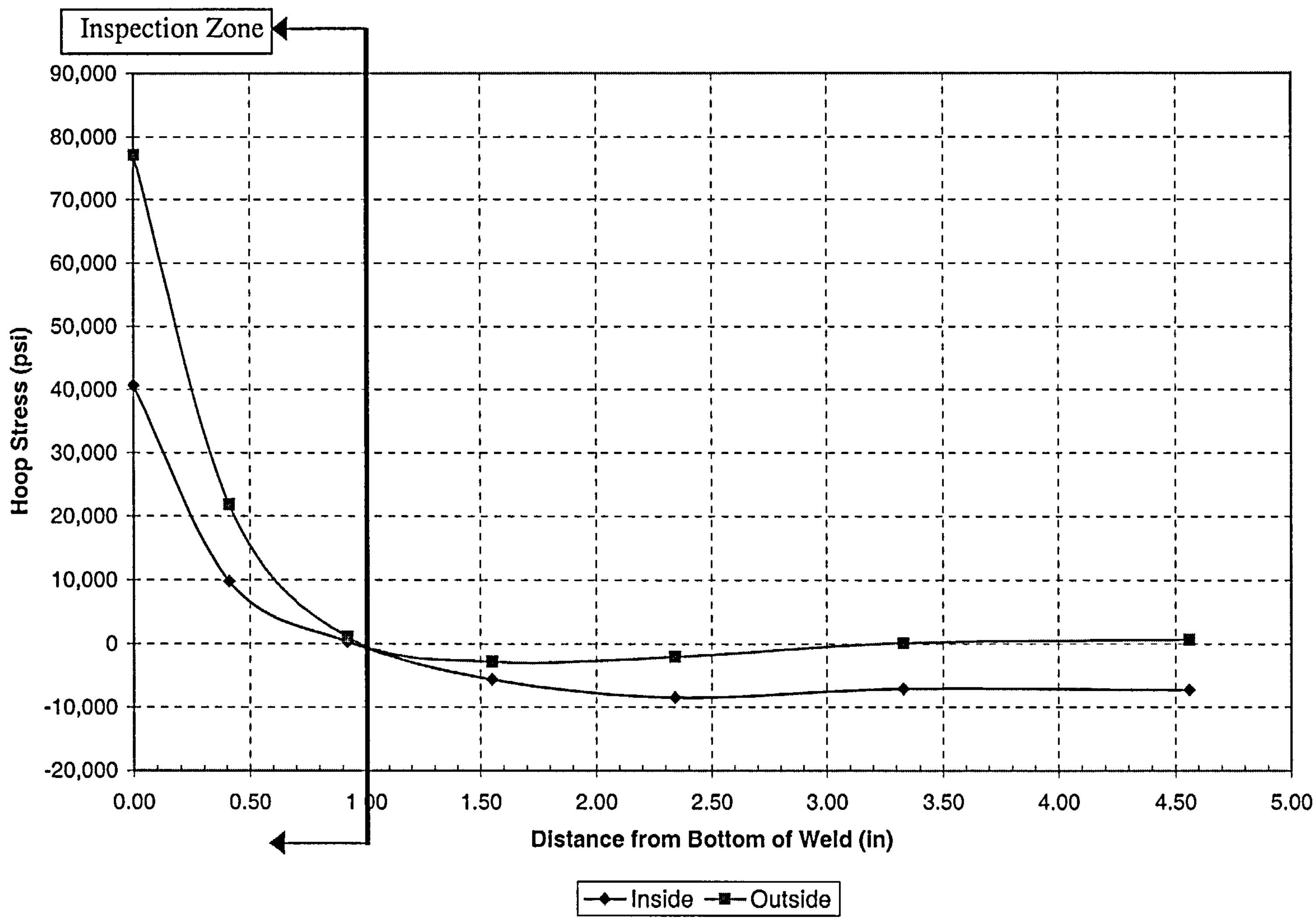
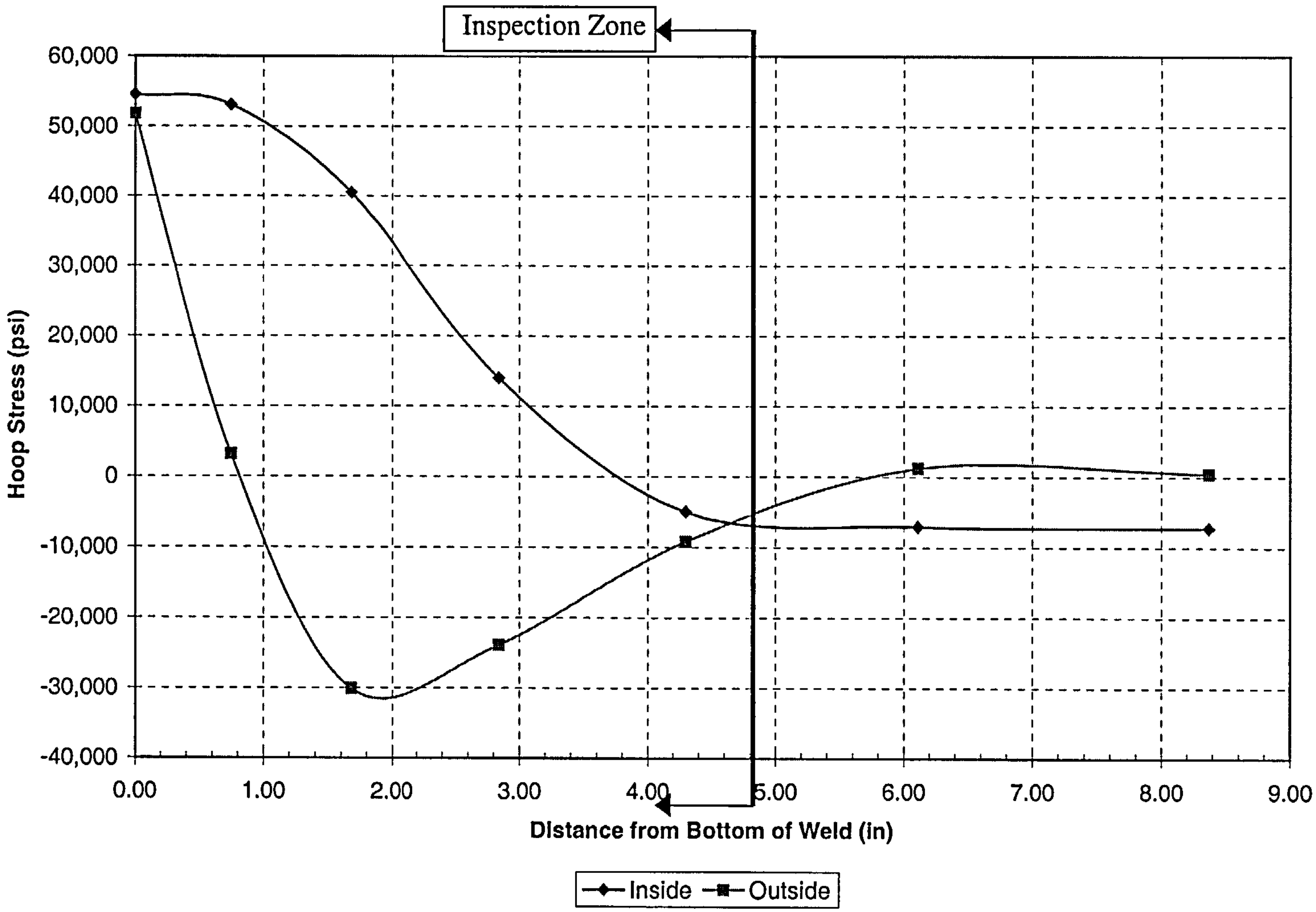


Figure 9
Hoop Stress Vs Distance from Bottom of Weld
42.6° CRDM Penetration Nozzle –Uphill



Question 3. ***The request also states that, "there are no concerns with the structural integrity of the vessel head penetration nozzles from the unexamined bottom portions of the nozzles addressed in this request." Provide the technical basis, such as an analysis or an evaluation to show that cracks initiated from the unexamined area will not propagate into the pressure boundary and exceed the Code allowable crack sizes within one operating cycle, based on a conservative crack growth rate from the industry operating experience.***

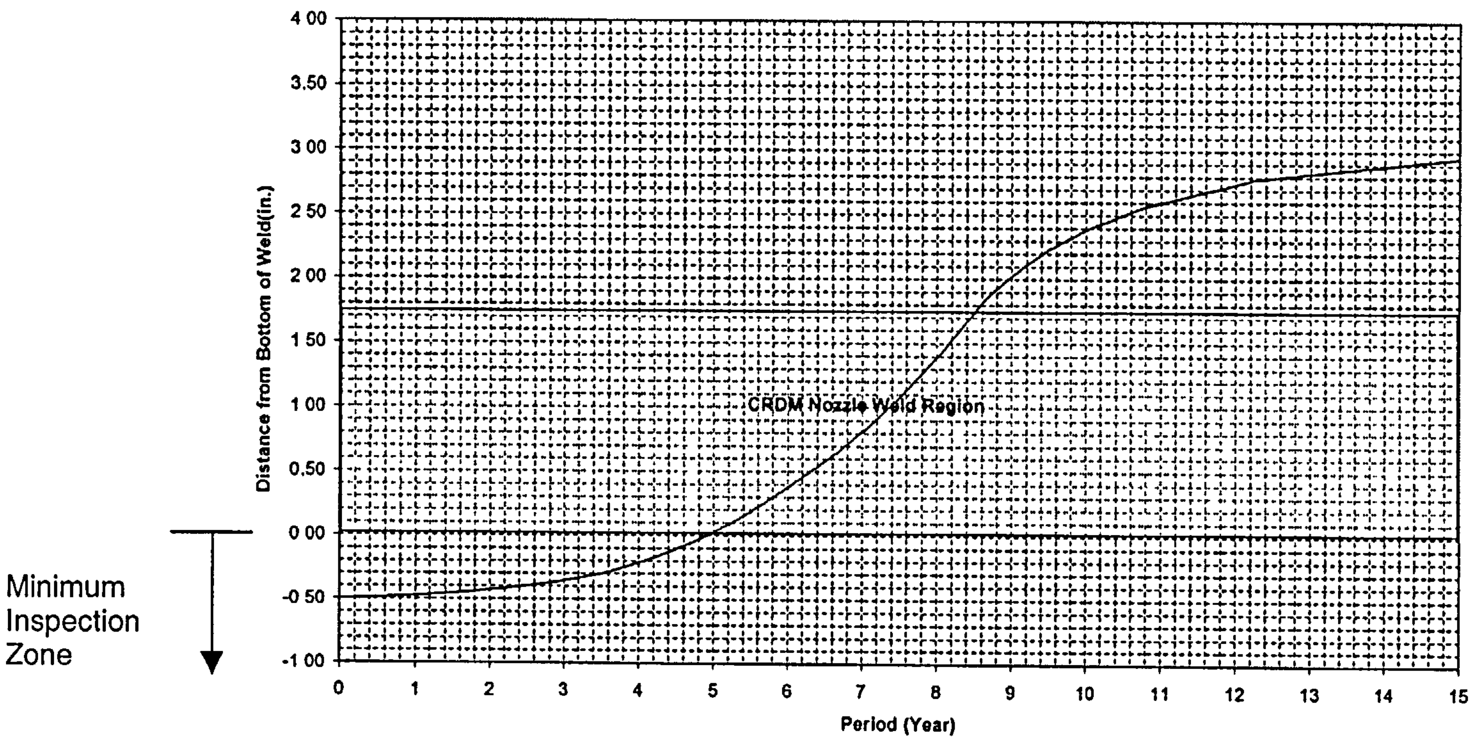
Response to Question 3:

The relaxation request involves only non-destructive examination (NDE) of the penetration nozzles below the J-groove weld that attaches the nozzle to the vessel head. Axial flaws located in the unexamined non-pressure boundary nozzle base material below the weld are of no structural significance based on the following information.

The examination coverage from the bottom of the J-groove weld towards the bottom of the nozzle is expected to be a minimum of 1.0 inch. To determine the significance of such an axial flaw located more than 1.0 inch below the weld, a flaw tolerance approach is used. The flaw evaluation results obtained from a plant of similar design and construction as BVPS Unit 1 were used. See response to Question 2. The evaluation postulated an axial flaw in the unexamined area below the weld. The evaluations performed are based on a methodology consistent with the recently approved Section XI flaw evaluation approach, with a Primary Water Stress Corrosion Cracking (PWSCC) crack growth rate that is consistent with the MRP-55 Rev. 1 report. A through wall axial flaw was postulated in the nozzle material growing upwards towards the bottom of the weld. Since the stresses for the portion of the nozzle more than 1.0" below the weld are too low to propagate an axial flaw, the flaw evaluations start at 0.5" below the weld and 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) was determined. Assuming a through wall flaw below the weld, with the flaw end located at 0.5" below the weld (which is in the area of complete examination coverage), an axial flaw would take approximately 5 years of operation to grow to the point of contact with the weld, and even longer for it to grow from the bottom of the weld upwards through the pressure boundary. This time period is significantly greater than the current inspection frequency of every refueling cycle (approximately 18 months for BVPS Unit 1) identified in NRC Order EA-03-009.

Figure 10 provides a graphical presentation of the above flaw evaluation discussion for the limiting penetration location. Based on the crack growth results shown in Figure 10, there are no concerns with the structural integrity of the reactor vessel head penetration nozzles that could be caused by axial cracking in the unexamined non-pressure boundary portion of the nozzle material for a period of approximately 5 years of operation.

Figure 10
Through-Wall Axial Flaws Located in the 28.6 Degree Row of Penetrations, Uphill Side - Crack Growth Predictions



Question 4. You indicated that contact was lost at the bottom of the nozzle due to using a probe arrangement for circumferential cracking detection. Since the licensees and NDE vendors have qualified their UT systems to find both circumferential and axial cracking with one scan and either probe arrangement, please discuss why an axial probe arrangement is not being attempted for the bottom portion of the tube.

Response to Question 4:

The ultrasonic blade probe utilized by our inspection vendor for these examinations, a PCS24 TOFD UT probe, has the transducers oriented in the vertical direction. This probe has been demonstrated through the EPRI-MRP protocol to be effective for the detection of circumferential and axial degradation on the inside and outside diameter surfaces of the tube. The transducers are configured to optimize the inspection in the circumferential direction. Circumferential flaws are the flaws of greatest concern relative to the potential for CRDM nozzle ejection. Given the vertical orientation of the probe, and the geometry of the bottom portion of the nozzle, there is a loss of inspection capability when the leading transducer reaches the bottom of the nozzles. As discussed in our response to questions 2 and 3 of this enclosure, flaws in the unexamined bottom portion of the nozzles are of no structural or safety significance prior to our next scheduled refueling outage.

Question 5. The licensee's basis does not discuss why no dye penetrant test (PT) of this area is acceptable. However, paragraph 4d. of the licensee's March 27 letter states: ...... "Performing PT in lieu of eddy current testing (ET) or ultrasonic testing (UT) would result in significant radiation exposure to personnel without a compensating increase in the level of quality or safety." Please provide a basis for this statement by quantifying the hardship as it relates quality/safety for PT testing versus ET and UT testing. Dose, time, capabilities, etc., should be addressed.

Response to Question 5:

Dye penetrant testing of the nozzles may require removal of approximately 25% of the thermal sleeves and funnels to provide physical access to all of the nozzles. It is estimated that the total additional dose associated with dye penetrant testing would be in excess of 100 man-rem. The estimated duration for this effort would be in excess of 15 days. As discussed in our response to questions 2 and 3 of this enclosure, flaws in the unexamined bottom portion of the nozzles are of no structural or safety significance prior to our next scheduled refueling outage.