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United States Nuclear Regulatory Commission
ATTN: Document Control Desk
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Rockville, Maryland 20852

Byron Station, Unit 2
Facility Operating License No. NPF-66
NRC Docket No. 50-455

Subject: Relaxation Request From First Revised NRC Order EA-03-009 Establishing Interim Inspection Requirements for Reactor Pressure Vessel Heads at Pressurized Water Reactors

Reference: Letter from David M. Hoots (Exelon Generation Company, LLC) to NRC, "Byron Station, Unit 2, 60-Day Response to First Revised NRC Order 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,'" dated June 20, 2007

On February 11, 2003, the NRC issued Order EA-03-009 for interim inspection requirements for reactor pressure vessel (RPV) heads at pressurized water reactor (PWR) facilities. On February 20, 2004, the NRC issued the First Revised Order EA-03-009 (the Order), which superseded Order EA-03-009. Revision 1 of the Order modified the requirements regarding nondestructive examination of the penetration nozzles.

During the Byron Station Unit 2 Spring 2007 refueling outage (B2R13), Exelon Generation Company (EGC) completed nondestructive examinations (NDE) of the RPV head penetrations in accordance with the Order. As described in the referenced submittal, these examinations were performed to meet the order requirements due, February 11, 2008, for those RPV heads categorized as "low susceptibility" in accordance with Section IV.A and IV.B of the Order. During B2R13, Byron Station identified an indication on Control Rod Drive Mechanism (CRDM) Nozzle # 68. The discovery of this indication and the attribution of this indication to PWSCC required that Byron Station re-categorize the head to "High Susceptibility" in accordance with the NRC Order, EA-03-009.

EGC has determined that because of the physical configuration of Byron Station Unit 2 RPV nozzles, the required coverage specified in Section IV.C.(5)(b)(i) of the Order could not be met for 16 of the 78 CRDM nozzles (vent nozzle not included) and therefore in accordance with Section IV.F.(2) of the Order, relaxation is requested because compliance with the Order would result in a hardship or unusual difficulty without a compensating increase in the level of quality and safety.

Specifically, for 16 Byron Station Unit 2 RPV penetration nozzles, EGC is requesting relaxation from the Order by proposing to redefine the Section IV.C.(5)(b)(i) inspection area as "the volume of the penetration tube extending from two inches above the J-groove weld down to the lowest elevation that can be practically inspected." The details of the Byron Station Unit 2 Relaxation Request are contained in Attachment 1.

The technical justification for the Byron Station Unit 2 relaxation requests is provided in Attachment 1 which references "WCAP-16394-P, Revision 0, 'Structural Integrity Evaluation of Reactor Vessel Upper Head Penetrations to Support Continued Operation: Byron and Braidwood Units 1 and 2.'"

Attachment 1 contains Westinghouse proprietary information, as previously supported by an affidavit signed by Westinghouse, the owner of the information. The affidavit set forth the basis on which the information may be withheld from public disclosure by the Commission and addresses with specificity the considerations listed in paragraph (b)(4) of 10CFR 2.390. Accordingly, it is respectfully requested that the information that is proprietary to Westinghouse be withheld from public disclosure in accordance with 10CFR 2.390 of the Commission's regulations.

Correspondence with respect to the copyright or proprietary aspects of the items listed above, or the supporting Westinghouse affidavit, should reference CAW-05-2070 and should be addressed to B. F. Maurer, Acting Manager, Regulatory Compliance and Plant Licensing, Westinghouse Electric Company LLC, P.O. Box 355, Pittsburgh, Pennsylvania 15230-0355.

The attached Relaxation Request is specific to Byron Station Unit 2. The previous submittal for Braidwood Unit 2 and Byron Unit 1 was placed on the dockets for all 4 Braidwood Station and Byron Station units since the supporting Westinghouse WCAP-16349 report is applicable to all 4 units.

EGC is formally committing to the following actions as a condition of the "Proposed Alternative and Basis for Use" statements proposed in Attachment 1 of the Submittal. If the NRC finds that the crack-growth formula in industry report MRP-55 is unacceptable, then EGC will revise its analysis that justifies relaxation of the Order within 30 days after the NRC notifies EGC by written correspondence of an NRC-approved crack-growth formula. If the EGC revised analysis for Byron Station Unit 2 shows that the crack-growth acceptance criteria is exceeded prior to the end of the current operating cycle, the relaxation request will be rescinded and the EGC will, within 72 hours, submit to the NRC written justification for continued operation.

If the revised analysis shows that the crack-growth acceptance criteria are exceeded during the subsequent operating cycle, EGC will, within 30 days, submit the revised analysis for NRC review. If the revised analysis shows that the crack-growth acceptance criteria are not exceeded during either the current operating cycle or the subsequent operating cycle, EGC will, within 30 days, submit a letter to the NRC confirming that its analysis has been revised. Any future crack-growth analyses performed for this and future cycles for RPV head penetrations must be based on an acceptable crack-growth rate formula. These commitments are detailed in Attachment 2.

EGC requests that the review and approval of these relaxation requests be completed by February 11, 2008. If you have any questions regarding this letter, please contact William Grundmann at (815) 406-2800.

Respectfully,

David M. Hoots
Site Vice President
Byron Nuclear Generating Station

Attachments:

1. Relaxation Request From NRC Order EA-03-009 Section IV, Paragraph C(5)(b)(i) – Byron Station, Unit 2

2. Byron Station Unit 2 – List of Commitments Regarding First Revised Order EA-03-009 Relaxation Request

Attachment 1

Relaxation Request From NRC Order EA-03-009
Section IV, Paragraph C(5)(b)(i)

Byron Station, Unit 2

Component

Byron Station Unit 2 has seventy-nine (79) reactor pressure vessel (RPV) head penetration nozzles comprised of fifty-five (55) penetration tubes with thermal sleeves, twenty-three (23) locations without thermal sleeves, and one (1) vent penetration nozzle.

In accordance with Section IV.A of the First Revised NRC Order EA-03-009 (hereafter referred to as the Order), the Byron Station Unit 2 susceptibility category is classified as "low" based on a calculated value of less than eight effective degradation years (EDY) and no previous inspection findings prior to the Spring 2007 refueling outage (B2R13). Results of this examination were previously submitted by letter dated June 20, 2007 (Reference 1).

During B2R13, Byron Station identified a flaw on CRDM Nozzle # 68. The discovery of this indication and the attribution of this indication to PWSCC required that Byron Station to re-categorize the head to "High Susceptibility" in accordance with the NRC Order, EA-03-009. Results of this examination were previously submitted by letter dated June 20, 2007 (Reference 1)

NRC Order EA-03-009 Applicable Examination Requirements

The non-visual NDE examinations (ultrasonic and eddy current) performed on the Byron Station Unit 2 RPV head during the Spring 2007 refueling outage are specified in the Order, Section IV, paragraphs C.(3) and C.(5)(b).

Paragraph IV.C.(3) of the Order states in part:

> *"... The requirements of paragraph IV.C.(5)(b) must be completed at least once prior to February 11, 2008, and thereafter, at least every four refueling outages or every 7 years, whichever occurs first."*

Paragraph IV.C.(5)(b) of the Order states:

> *"For each penetration, perform a nonvisual 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 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."*

Requirement from Which Relaxation is Requested

In accordance with Section IV.F.(2) of the Order, relaxation from the above requirements is requested since compliance with the Order would result in a hardship or unusual difficulty without a compensating increase in the level of quality and safety.

Relaxation is requested from Section IV.C.(5)(b)(i) of the Order to perform ultrasonic testing (UT) of the RPV head penetrations inside the tube from 2 inches above the J-groove weld to:

- two inches below the lowest point of the toe of the J-groove weld (or the bottom of the nozzle if less than two inches) OR
- one inch below the lowest point of the toe of the J-groove weld and including all RPV head penetration nozzle surfaces below the J-groove weld that have an operating stress level of 20 ksi tension and greater.

Based on the physical configuration of the nozzles and the limitations of the test equipment at Byron Station Unit 2, it is not possible to achieve the inspection coverage specified in Section IV.C.(5)(b)(i) of the Order for sixteen RPV penetration nozzles on Byron Station Unit 2.

Relaxation is requested to redefine the inspection area for the affected penetrations as *"the volume of the penetration tube extending from 2" above the J-groove weld down to the lowest elevation that can be practically inspected."*

Reason for Request

The Byron Station Unit 2 RPV head penetration non-visual examinations were performed during the Spring 2007 (B2R13) refuel outage. The examinations were performed using Westinghouse/WesDyne equipment and procedures demonstrated through the Electric Power Research Institute (EPRI) Materials Reliability Project. Due to physical limitations and interferences associated with some of the penetrations, the full examination volume required by Section IV.C.(5)(b)(i) of the Order cannot be achieved for sixteen RPV penetration nozzles.

The nozzle inspections of the volume from the J-groove weld root up to 2 inches above the weld and the leakage assessments required under Section IV, Paragraph C.(5)(b)(i) of the Order were satisfied for all penetrations. The lower nozzle inspection volume (1.0-inch below the lowest point at the toe of the J-groove weld including all RPV head penetration nozzle surfaces of 20 ksi tension and greater) required under Section IV, Paragraph C.(5)(b)(i) of the Order were satisfied for all but sixteen penetrations. For the lower portion of the penetration defined in Figure IV-2 of the Order, required coverage one inch below the lowest point of the J-groove weld toe could not be achieved for sixteen penetrations (numbers 33, 34, 39, 42, 44, 45, 51, 52, 53, 55, 56, 58, 63, 68, 69 and 71).

Component Geometry

For Byron Station Unit 2, the bottom of each RPV head penetration nozzle includes a threaded region approximately 1.00 inch long on the outside diameter along with a chamfered area at the inside diameter which extends approximately 0.76 inches from the bottom of the penetration tube (see Figure 1). The chamfered surface is machined at a 20° angle.

The distance from the top of the thread relief to the bottom of the fillet of the J-groove weld, identified as "A" in Figure 1, varies based on location of the penetration in the RPV head. These distances are generally longer for penetrations at "inboard" locations and become progressively shorter for penetrations located farther away from the center of the RPV head. At the sixteen subject penetration nozzles (i.e. numbers 33, 34, 39, 42, 44, 45, 51, 52, 53, 55, 56, 58, 63, 68, 69 and 71) the configuration is such that the distance from the lowest point at the toe of the J-groove weld to the bottom of the scanned region is less than the one inch lower boundary limit specified in Section IV, Paragraph C.5(b)(i) of the Order.

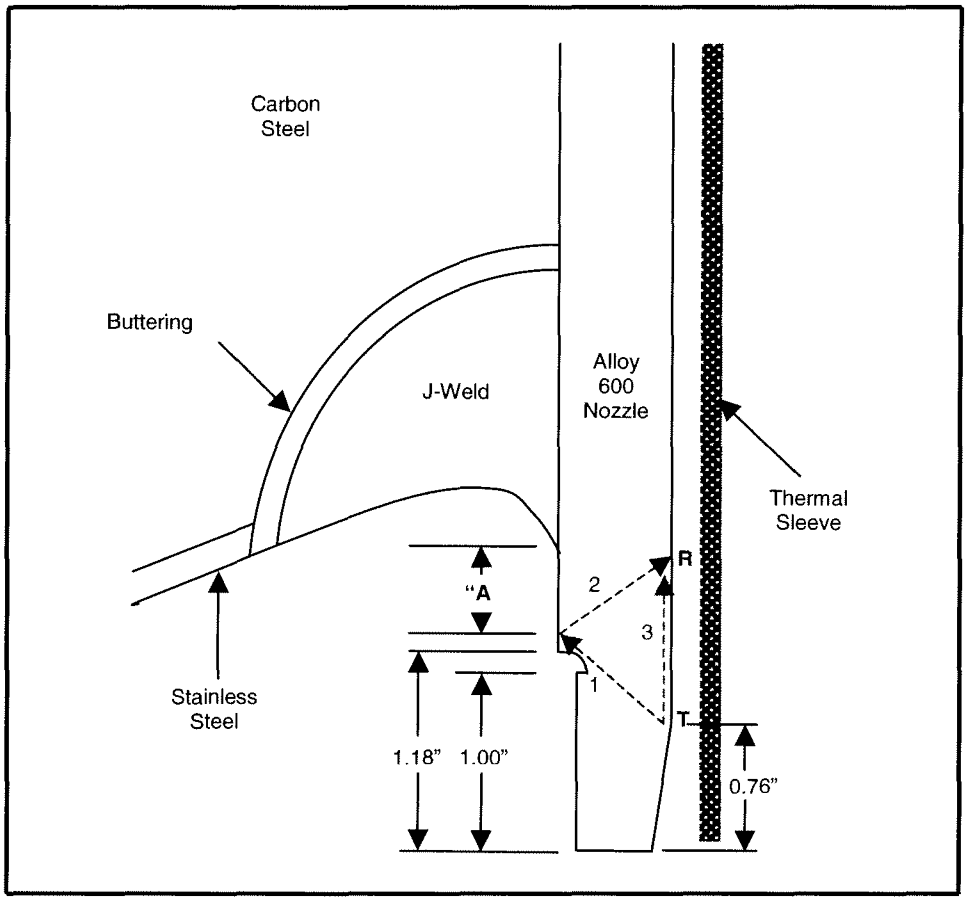

Figure 1
Illustration of Axially Oriented TOFD Examination Coverage on Byron Station Unit 2 Penetration Geometry (Including General Dimensions) at 0 Degrees

Examination Details

The inspection system used for Byron Station Unit 2 consisted of two probes to perform UT inspection of the penetration nozzles. The first probe type (Trinity Probe) was used to inspect nozzles that contained thermal sleeves (55 total). The second probe type (Open Housing Probe) was used to inspect nozzles without thermal sleeves (23 total). Both probes use axially oriented time-of-flight tip diffraction (TOFD) as the primary crack detection method. The vent line examination (1 total) is not included in the discussion as this examination area has a different geometry that was not limited.

The TOFD technique is a "pitch/catch" ultrasonic method, which uses two transducers (one a transmitter, and one a receiver) oriented along the vertical axis of the probe. The focus point of the TOFD beam is at the midpoint between the upper and lower transducers. Longitudinal waves are transmitted into the tube at an angle by the transmitter (T) and reflect off the backside of the tube to a receiver (R), as shown in path "1-2" in Figure 1. A lateral wave also travels on the tube inside diameter (ID) surface between the transmitter and receiver as shown in path "3". The transmitting and receiving elements are mounted on a "shoe" with a probe center spacing of 0.925 inches. ID TOFD coverage is provided by the lateral wave to the elevation of the chamfer of the tube on the ID surface. With an axially oriented TOFD transducer pair in the Trinity probe, outside diameter (OD) coverage becomes completely effective at an elevation just above the top of the thread relief. The presence of the thread relief results in a slight masking of the ultrasound to the OD surface to an elevation conservatively estimated at 0.20 inches above the thread relief. In this area however, OD initiated degradation would be detected once the depth of the degradation exceeded the depth of the masked area. With a circumferentially oriented TOFD transducer pair, included in the Open Housing Scanner, OD coverage is extended to the elevation of the top of the chamfer, approximately 0.76 inches above the bottom of the tube. In the threaded region, cracks extending deeper than the threads will be detected.

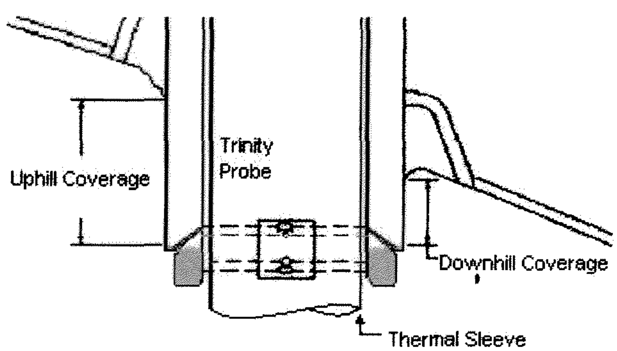

Figure 2
Trinity Probe Inspection Circumferential UT Coverage

The Open Housing Probe has a transducer pair with a 55-degree angle of refraction. The Trinity Probe (Figure 2) has a transducer pair with a 44-degree angle of refraction. Since the Trinity Probe transducers are a smaller size and spacing is less than that of the Open Housing Probe, the focus point of the Trinity Probe transducers are at a lower elevation (closer to the bottom of the tube) than the Open Housing Probe focus point when the probes reach the top of the ID chamfer. However, due to the difference in the refracted angles, the thread relief on the outside diameter (OD) of the tube interferes with the TOFD beam for the Trinity Probe. Due to this interference, there is a small area above the thread relief where the Trinity Probe cannot inspect. Figure 3 shows the lower transducer at the top of the ID chamfer and the OD thread relief interference with the TOFD beam. Figure 4 shows the probe at the minimum (higher) elevation where the TOFD beam is not interrupted by the thread relief.

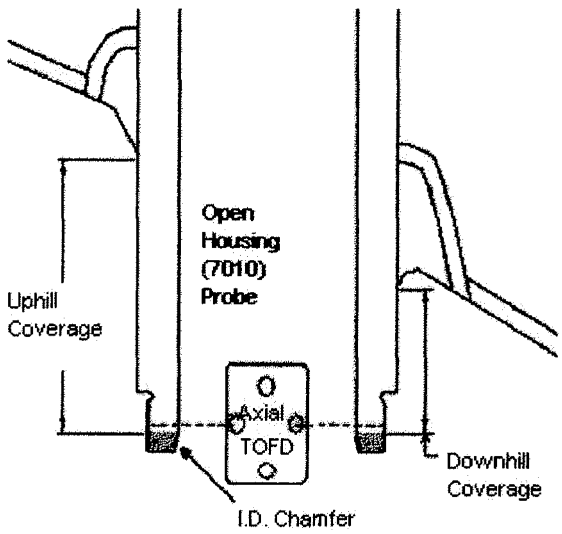

Figure 3
Open Housing Probe Circumferential UT Coverage

The shaded areas from both Figures 3 and 4 make up the total portion of the tube that cannot be inspected. The dimensions listed in Table 1 are based on the maximum coverage limitation of 1.18 inches shown in Figures 1 and 4.

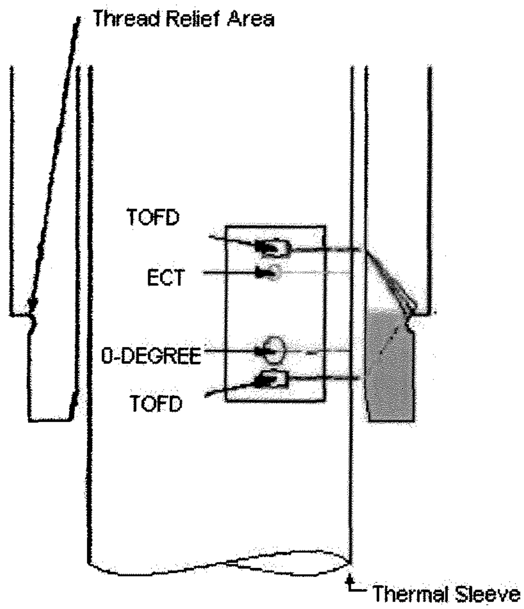

Figure 4
Trinity Probe – Lower TOFD Transducer to Top of Chamfer

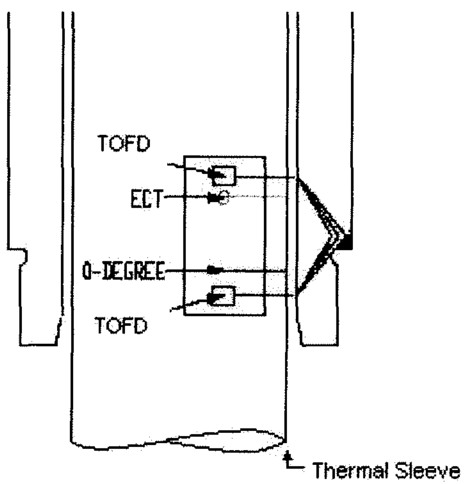

Figure 5
Trinity Probe – TOFD Beam Uninterrupted by Thread Relief

In addition to the axially oriented TOFD transducers (Figures 5), the Open Housing Probe has circumferentially oriented TOFD transducers that the Trinity Probe does not have. This circumferentially oriented TOFD signal allows the Open Housing Probe to inspect the tube down to the top of the ID chamfer. Also, with the Open Housing Probe's circumferentially oriented transducers, the TOFD beam is not interrupted by the OD thread relief. The dimensions listed in Table 1 reflect the circumferential TOFD transducer coverage limitation of 0.76 inches due to the chamfered region. This is why the Open Housing Probe coverage is consistently greater than the Trinity Probe coverage. Figure 6 shows both the axial and circumferential Open Housing Probe TOFD coverage limitations. The shaded areas indicate the portions of the tube that cannot be inspected.

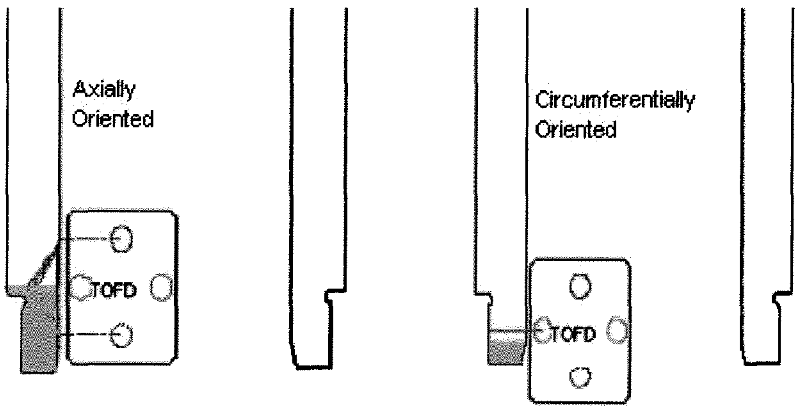

Figure 6
Open Housing Probe Coverage Limitations

The Order allows provisions for dye penetrant inspection. However, dye penetrant inspection would require extensive work under and around the RPV head. Based on electronic dosimetry readings from the examiner performing the vent nozzle manual inspection, the general area radiation levels under the Unit 2 head during B2R13 ranged from 1.7 R/hr at one foot off the floor to 6.3 R/hr near the funnels. General contact readings at the nozzles for Byron Station Unit 2 are historically 8 to 10 R/hr. Section IV.C.5(b)(iii)1 of the Order requires penetrant inspection on both the inside and outside diameter surfaces in order to be considered an acceptable substitution for ultrasonic examination. The threaded region on the outside diameter of the penetration tubes makes a dye penetrant examination on the lower section of the tube impractical. Therefore, performing manual dye penetrant inspections on the bottom nozzle area would result in significant radiation exposure to personnel without a compensating increase in the level of quality or safety.

Table 1 contains information specific to the sixteen penetrations for which relaxation is being requested. The values for Control Rod Drive Housing (CRDM) penetration hoop stress distributions at a point where the operating stress levels are less than 20 ksi tension (i.e., 20 ksi Line) were extrapolated from the associated graphs contained in Figures 10 through 15, which are also contained in Appendix A of Topical Report WCAP-16394-P, Revision 0, "Structural Integrity Evaluation of Reactor Vessel Upper Head Penetrations to Support Continued Operation: Byron and Braidwood Units 1 and 2," dated February 2005 (previously submitted as Attachment 4 to the submittal from J. A. Bauer (Exelon Generation Company, LLC) to NRC, "Relaxation Request for First Revised Order EA-03-009 Establishing Interim Inspection Requirements for Reactor Pressure Vessel Heads at Pressurized Water Reactors" dated March 31, 2006, (ADAMS Assession Number 061510660).

NOTE: Flaw Tolerance charts (crack growth projections) and hoop stress distribution curves were not completed for all nozzle angles. Nozzle angle nearest to the specific nozzle were applied.

Table 1
Penetrations with Limited Examination Volume
(Shaded Areas Do Not Meet Order Requirements)

Penetration Number	Angle (Degrees)	B2R13 Inspection Coverage (Inches Below Weld)	20 Ksi line (Inches below J-Groove Weld)				Inspection Method
			Uphill Side		Downhill Side		
			ID	OD	ID	OD	
33	29.3	0.920	1.85	.61	.45	.92	Trinity
34	29.3	0.880	1.85	.61	.45	.92	Trinity
39	32.9	0.800	1.85	.61	.45	.92	Trinity
42	34.1	0.880	2.9	.62	.62	.46	Trinity
44	34.1	0.840	2.9	.62	.62	.46	Trinity
45	34.1	0.800	2.9	.62	.62	.46	Trinity
51	35.2	0.960	2.9	.62	.62	.46	Trinity
52	35.2	0.880	2.9	.62	.62	.46	Trinity
53	35.2	0.880	2.9	.62	.62	.46	Trinity
55	37.4	0.920	2.9	.62	.62	.46	Trinity
56	37.4	0.640	2.9	.62	.62	.46	Trinity
58	37.4	0.840	2.9	.62	.62	.46	Trinity
63	42.8	0.760	2.9	.62	.62	.46	Trinity
68	43.8	0.800	3.0	.60	.60	.46	Trinity
69	43.8	0.800	3.0	.60	.60	.46	Trinity
71	43.8	0.960	3.0	.60	.60	.46	Trinity

Proposed Alternative and Basis for Use

EGC proposes to define the lower boundary of the inspection volume for the affected RPV head penetration nozzles as: *"the volume of the penetration tube extending from 2" above the J-groove weld down to the lowest elevation that can be practically inspected."*

EGC performed UT examinations to the maximum extent possible and, for Byron Station Unit 2, meets all requirements of the Order with the exception of the sixteen penetration tubes previously noted.

EGC was unable to completely comply with the requirements of the Order for UT inspection for 16 RPV penetration nozzles below the J-groove weld, due to the physical configuration of the nozzles and the limitations of the test equipment. The bottom ends of these nozzles are externally threaded and internally tapered. Loss of UT probe coupling due to the internal taper and/or disruption of the UT signal due to the external thread prevented UT data acquisition in a zone extending to approximately one-inch above the bottom of each nozzle

Testing of portions of the nozzle significantly below the J-groove weld is not significant to the phenomena of concern. The phenomena that are of concern are leakage through the J-groove weld and circumferential cracking in the nozzle above the J-groove weld. This is appropriately reflected in the requirements of the Order (as stated previously) that the testing extend to two inches above the J-groove weld. However, the Order also requires that testing be extended to:

- two inches below the lowest point of the toe of the J-groove weld (or the bottom of the nozzle if less than two inches) OR
- one inch below the lowest point at the toe of the J-groove weld and including all RPV head penetration nozzle surfaces below the J-groove weld that have an operating stress level of 20 ksi tension or greater.

The nozzle is essentially an open-ended tube and the nozzle wall below the J-groove weld is not part of the reactor coolant system pressure boundary.

The proposed inspection coverage is adequate because the cited inspection limitation for the RPV head penetration nozzles does not preclude full UT examination coverage of the portions of these nozzles that are of primary interest.

This can be assumed because:

- UT 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 this limitation, and cracks initiating in the unexamined bottom portion (non-pressure 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, any cracks would have to grow through a significant examined portion of the tube to reach the pressure boundary.

This proposed alternative is consistent with the analysis submitted in the industry topical report MRP-95, "Materials Reliability Program: Generic Evaluation of Examination Coverage Requirements for Reactor Pressure Vessel Head Penetration Nozzles," and the site-specific analysis in WCAP-16394-P. The zones of inspection selected are such that the stresses in the remaining uninspected zones are at levels for which Primary Water Stress Corrosion Cracking (PWSCC) is considered highly unlikely.

The major inherent conservatisms in WCAP-16394-P are summarized below:

Conservatism in Assumed Crack Geometry

It is understood that high stresses, on the order of the material yield strength, are necessary to initiate PWSCC. There is no known case of PWSCC of Alloy 600 below the yield stress. The yield strengths for wrought Alloy 600 head penetration nozzles are in the range of 37 ksi to 65 ksi. Weld metal yield strengths are generally higher. The yield strength of the head penetration nozzles for Byron Station Unit 2 varies from 36.5 ksi to 60.5 ksi. The stress level of 20 ksi is a conservative value below which PWSCC initiation is extremely unlikely.

Therefore, the assumption of any PWSCC crack initiation in the region of the penetration nozzle with a stress level of 20 ksi or less is conservative. The assumption of a through-wall flaw in these unlikely PWSCC crack initiation regions of the head penetration is an important additional conservatism, since the penetration tubes were inspected with maximum achievable coverage on the tube ID.

Flaw Propagation Calculations and Examination Coverage

A structural integrity evaluation was performed for the Byron and Braidwood Stations Unit 2 and Unit 2 reactor vessel head penetrations under WCAP-16394-P. The basis of this analysis is a detailed three-dimensional elastic-plastic finite element stress analysis of several penetration locations, which considers all the pertinent loadings on the penetration, and a fracture analysis using the crack growth rates recommended by the EPRI Topical Report "Materials Reliability Program (MRP) Crack Growth Rates for Evaluating Primary Water Stress Corrosion Cracking (PWSCC) of Thick Wall Alloy 600 Material (MRP-55) Revision 1". A series of crack growth calculations were performed presuming a flaw where the lower extremity of this initial through-wall flaw is conservatively postulated to be located on the penetration nozzle where either the inside or outside surface hoop stress drops below 0 ksi. The results of these calculations provided the estimated remaining operating cycles that would elapse before a postulated flaw in the unexamined area of the penetration nozzle would propagate into the pressure boundary formed by the J-groove weld.

The postulated flaw at the lower extent of coverage was located on the flaw growth curve associated with the penetration angle. For those penetrations that do not have a flaw growth curve specific to the actual tube penetration angle, a conservative curve (nearest the nearest penetration angle) was used. The time it would take for the postulated flaws to intersect the weld metal for the minimum coverage achieved was then determined.

Byron Station Unit 2 was re-categorized as a "High Susceptibility" plant due to the discovery of PWSCC on Penetration 68. This re-categorization to High requires the bare metal visual of 100 percent of the RPV head surface and non-visual NDE examinations be performed every outage. The next examination is currently scheduled for B2R14 in the Fall of 2008.

Byron Station Unit 2 past operating cycles has been approximately 18 months (1.5 calendar years or an average of 1.47 Effective Full Power Years (EFPY) per cycle based on historical data). Byron Unit 2 will remain on 18-month cycles based on the current long-term schedule. Conservatively using 1.5 EFPY, for the remaining operating cycle until the next required examination, there is only 1.5 EFPY between the B2R13 examinations and the next scheduled examination required by the Order. In accordance with the current Order requirements, the next inspection for the Byron Station Unit 2 RPV penetrations must be completed by the B2R14 outage, which is currently scheduled in Fall of 2008.

Based on B2R13 examination results (see Table 1), the worst-case minimum distance below the J-groove weld to the top of the zone that could not be inspected was determined to be 0.640 inches on the downhill side of the penetration nozzle #56. To account for the inspection tolerance of the inspection equipment (0.04 inches), an axial through-wall flaw was conservatively postulated to be located at 0.60 inches below the J-groove weld in the crack propagation calculation for the downhill side of the penetration nozzle. Using the applicable crack growth rate for the penetration (Figure 8), crack growth would not occur at this location. The current frequency of examination (approximately every 18 months or if even performed at the previous frequency of every 6 years) any possible cracks or crack growth for the postulated flaw to propagate from that location to the bottom of the J-groove weld, which would occur after the next scheduled inspection. Note that the normal instrument data acquisition resolution (tolerance) used during the CRDM volumetric examinations is 0.04 inches. This is the standard examination tolerance and has been used by Braidwood Station and Byron Station to determine the final examination coverage values.

For the subject penetrations that EGC is seeking relaxation, Figures 7 through 9 (WCAP-16394-P, Figures 6-13 through 6-15) provide results of the calculation. The results of the flaw propagation calculation indicate that, even if a flaw were to occur in the region of the penetration nozzle not being inspected, there would be adequate opportunity for detection prior to the crack reaching the reactor coolant system pressure boundary (J-groove weld). The results demonstrate that the extent of the proposed inspection coverage would provide reasonable assurance of the structural integrity of the Unit 2 RPV head penetration nozzles and the J-groove welds.

Conclusion

In all cases, the measured coverage is adequate to allow Byron Station Unit 2 to continue to operate prior to the hypothetical flaws reaching the J-groove weld. In accordance with the current Order requirements, the next examination required for the Byron Station Unit 2 RPV penetrations would be completed prior to flaw propagation into J-groove welds.

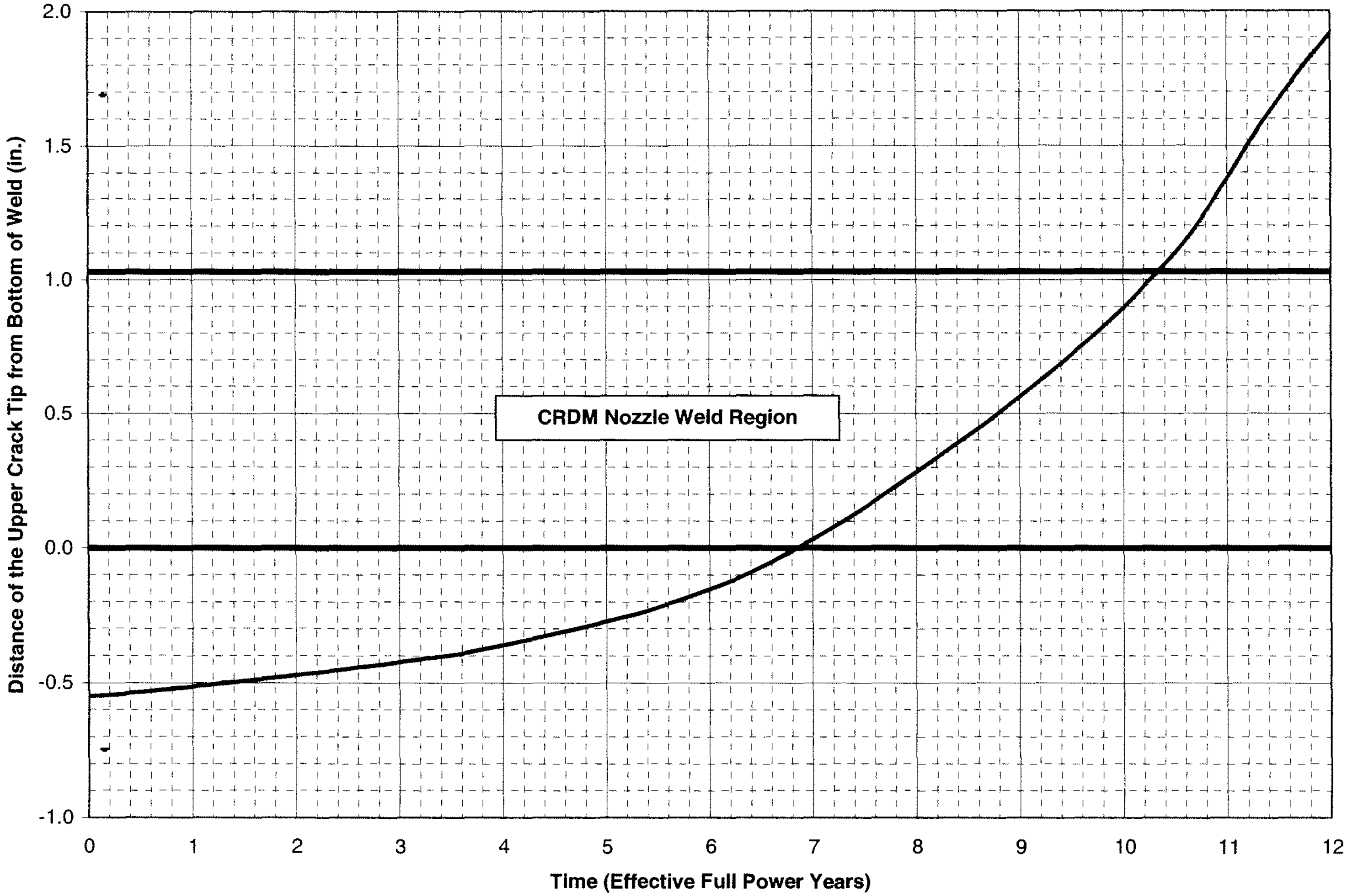

Figure 7
Through -Wall Longitudinal Flaw in the 25.4 Degree CRDM Row Downhill Side - Crack Growth Prediction
(Applies to Penetration 33, 34 and 39)

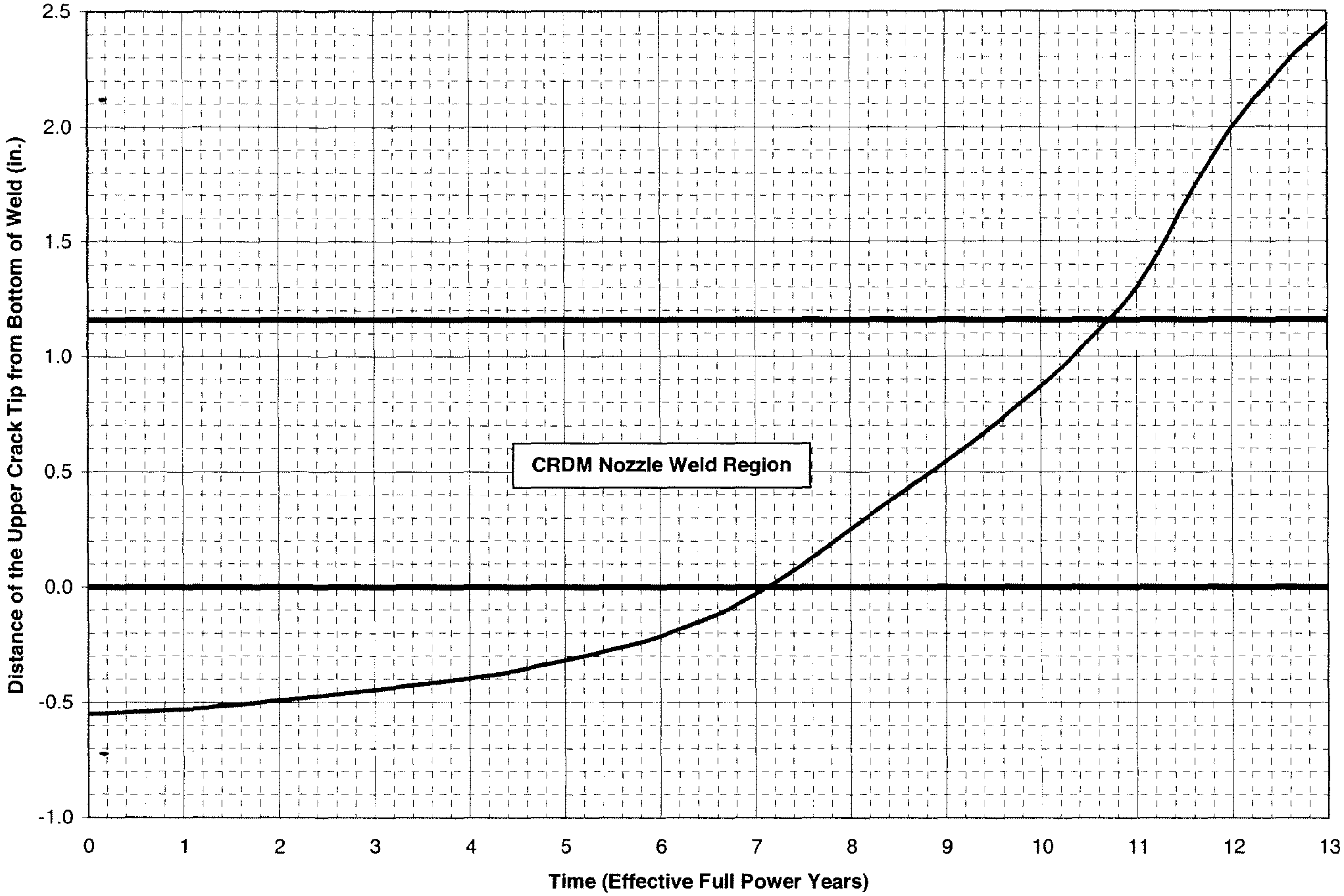

Figure 8
Through -Wall Longitudinal Flaw in the 42.8 Degree CRDM Row Downhill Side - Crack Growth Prediction
(Applies to Penetration 42, 44, 45, 51, 52, 53, 55, 56, 58 and 63)

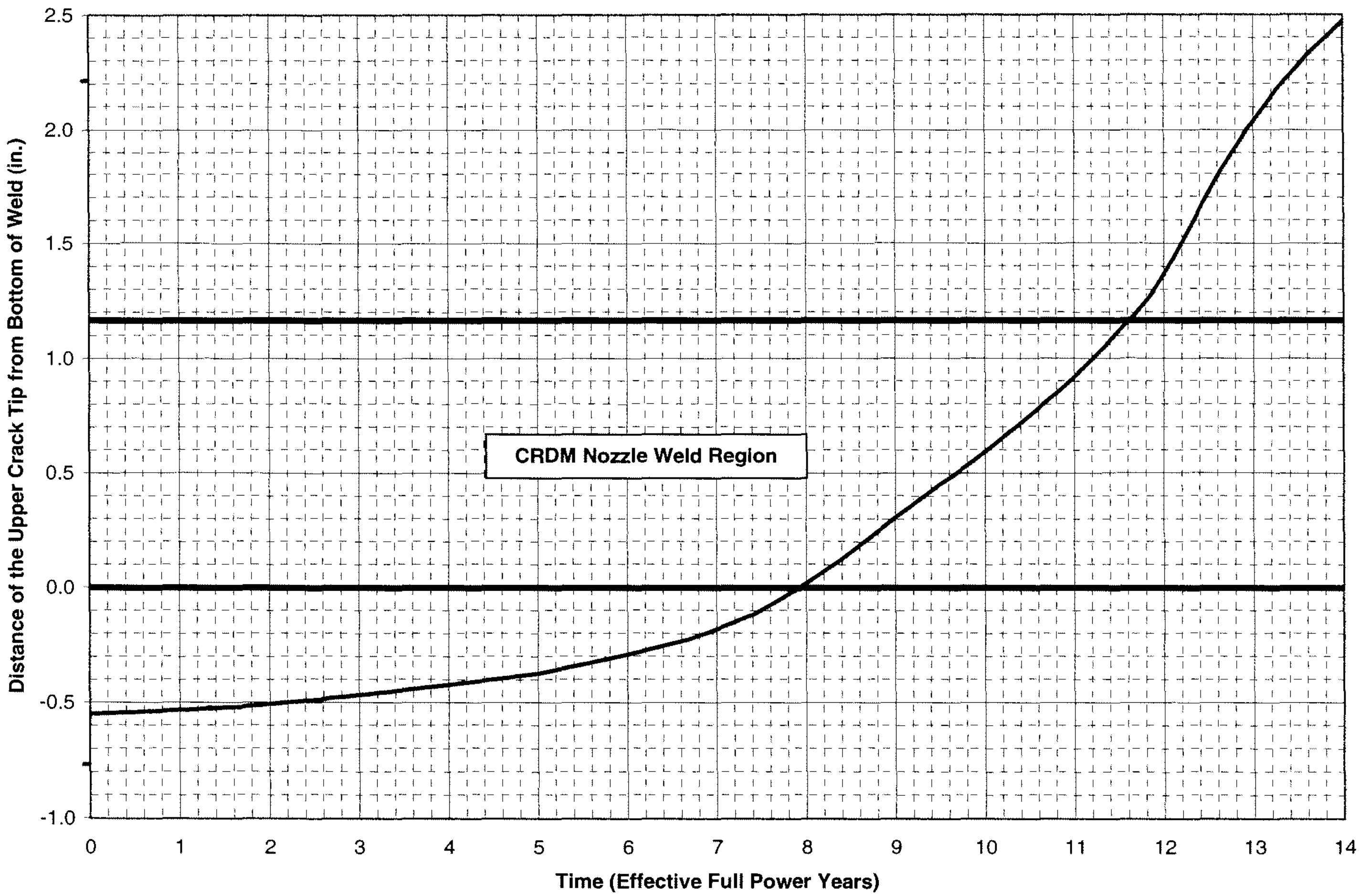

Figure 9
Through -Wall Longitudinal Flaw in the 43.8 Degree CRDM Row Downhill Side - Crack Growth Prediction
(Applies to Penetrations 68, 69, and 71)

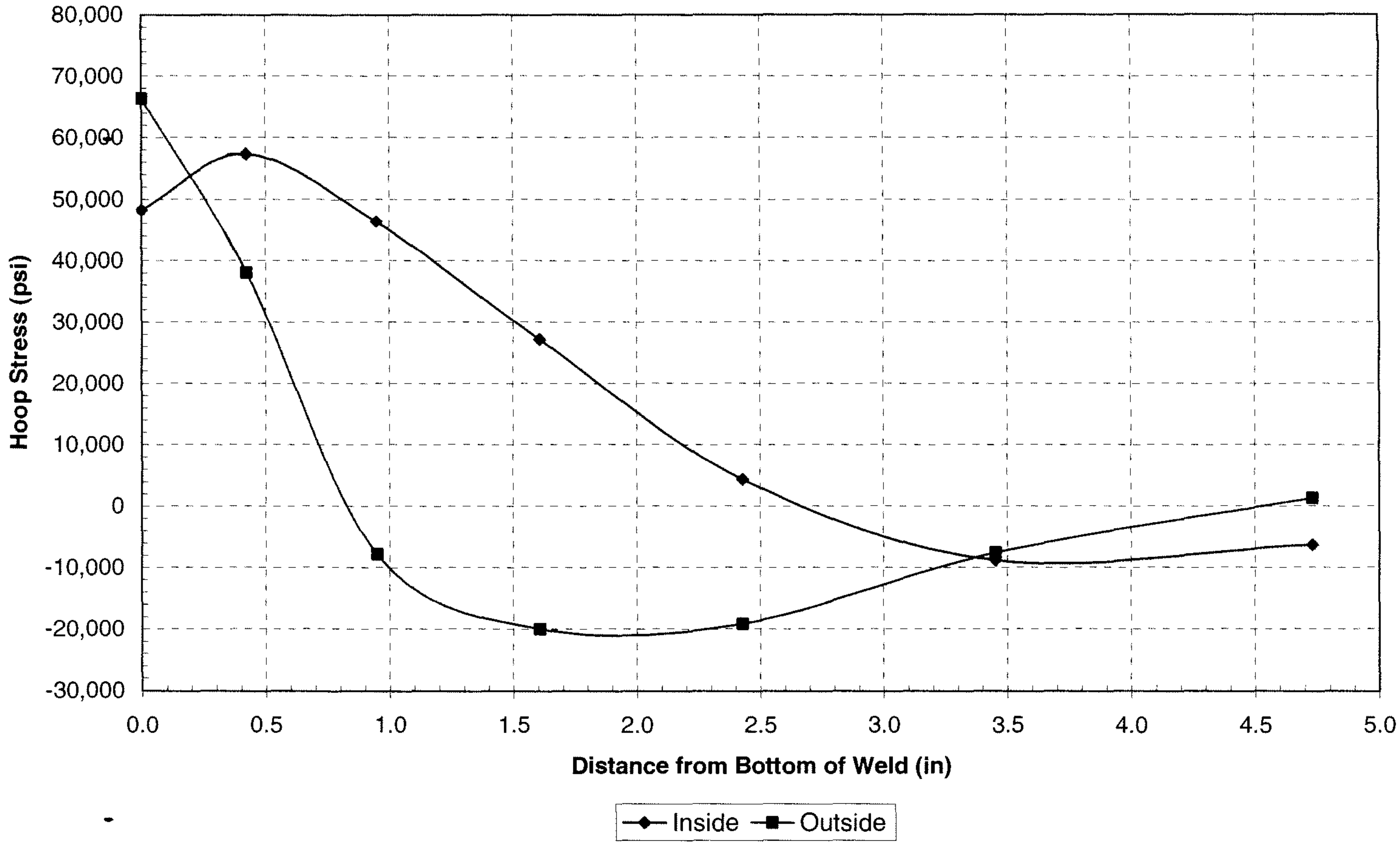

Figure 10
Hoop Stress Distribution Uphill Side
(25.4 Degree CRDM Penetration Nozzle)

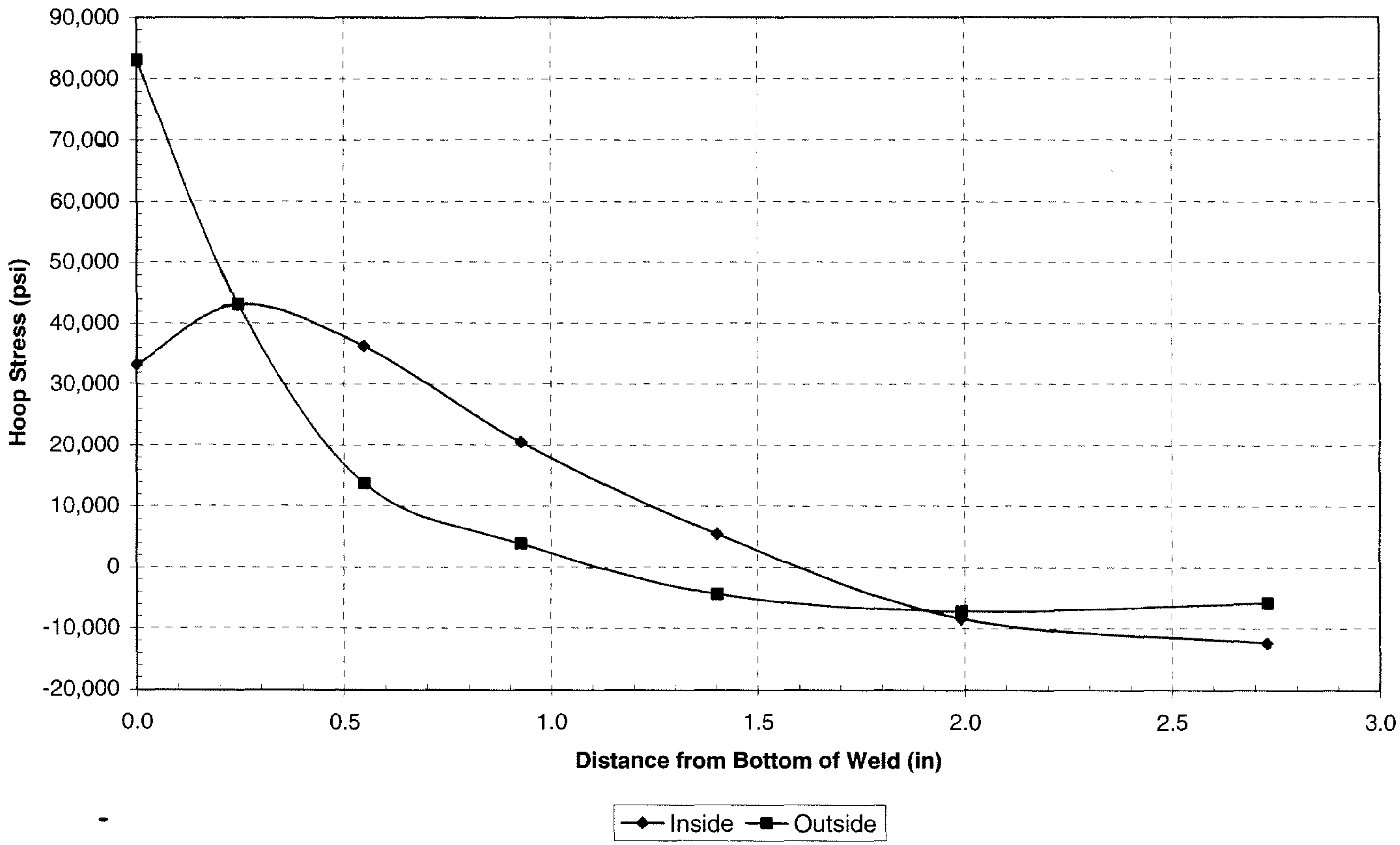

Figure 11
Hoop Stress Distribution Downhill Side
(25.4 Degree CRDM Penetration Nozzle

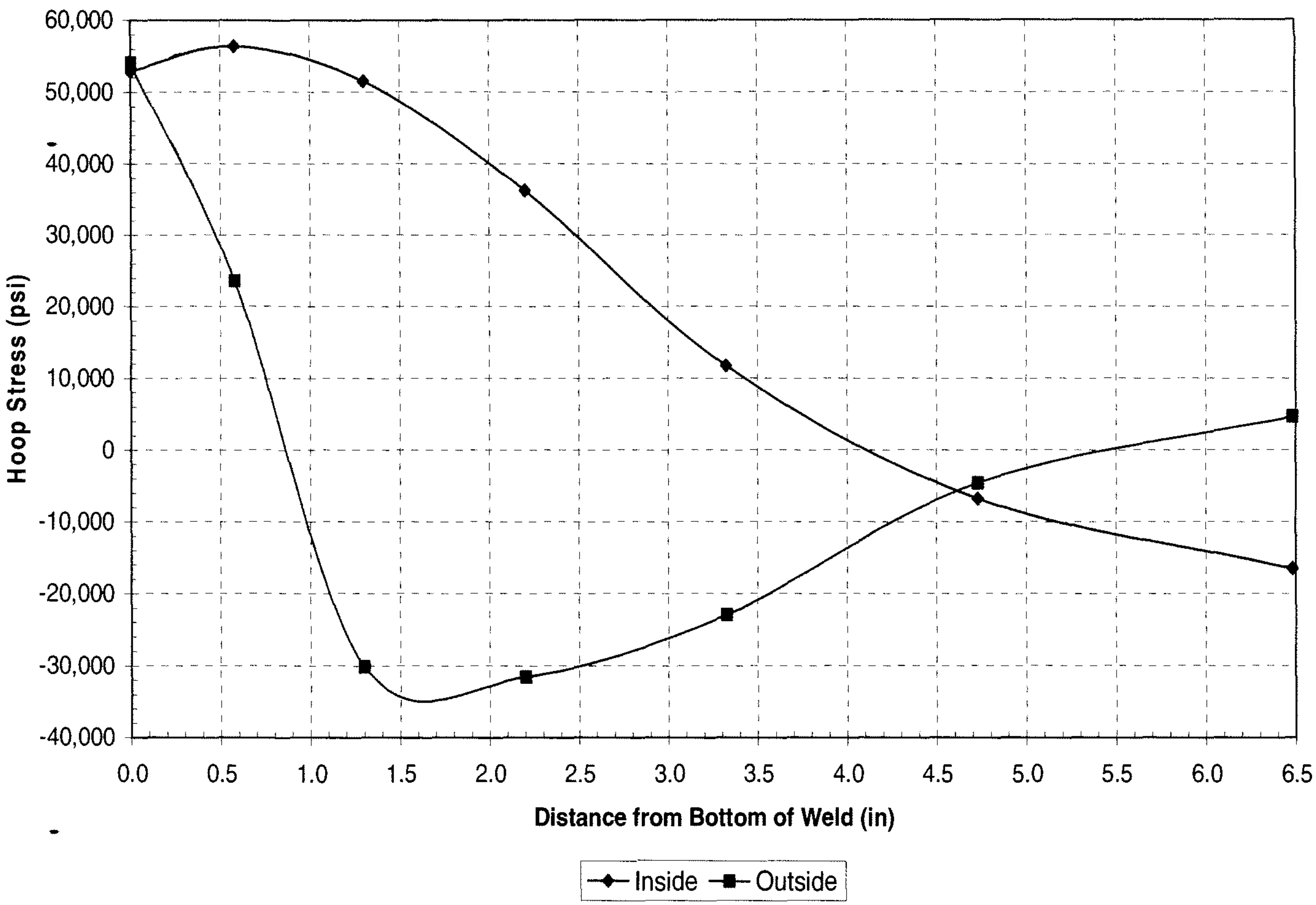

Figure 12
Hoop Stress Distribution Uphill Side
(42.8 Degree CRDM Penetration Nozzle)

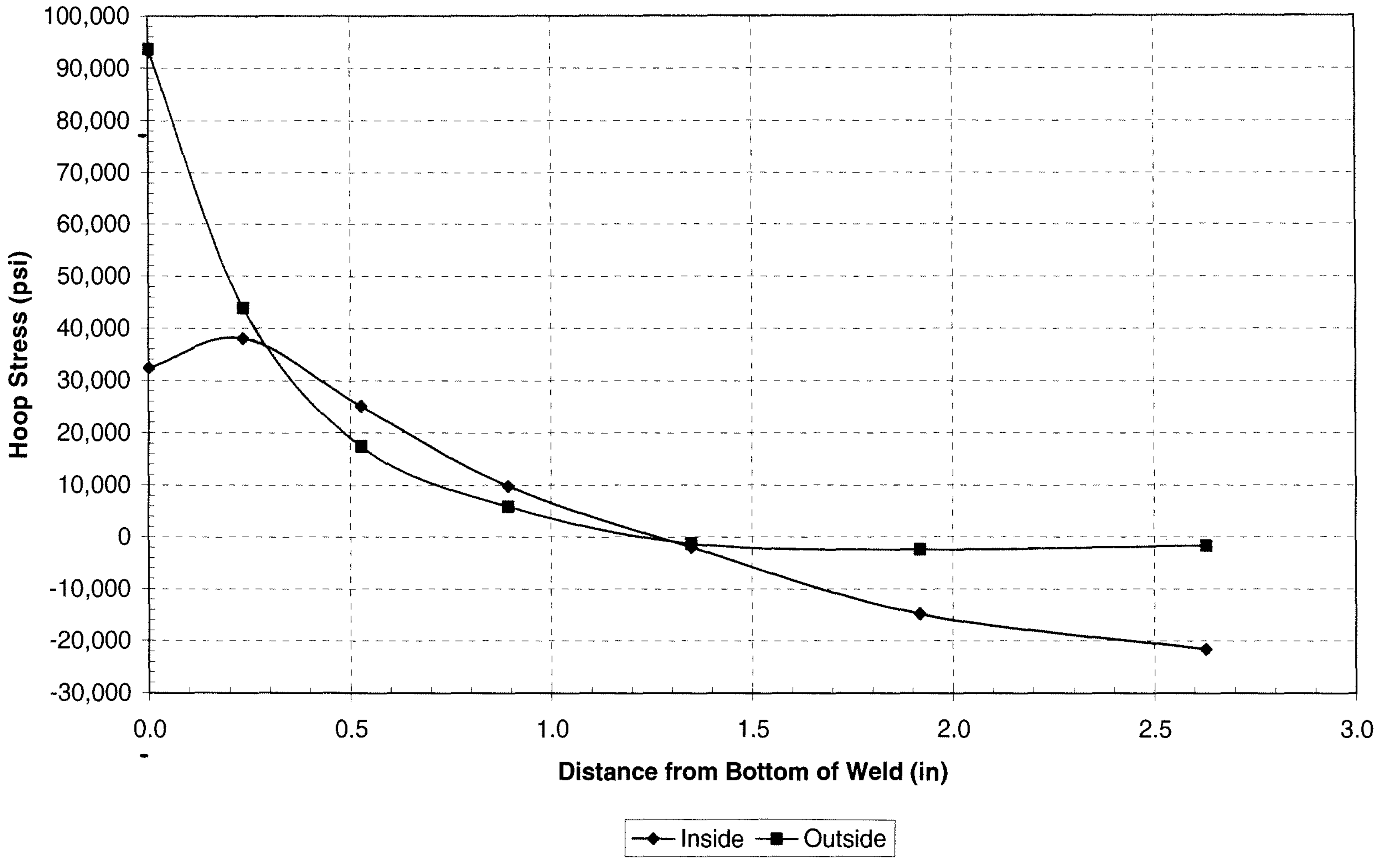

Figure 13
Hoop Stress Distribution Downhill Side
(42.8 Degree CRDM Penetration Nozzle)

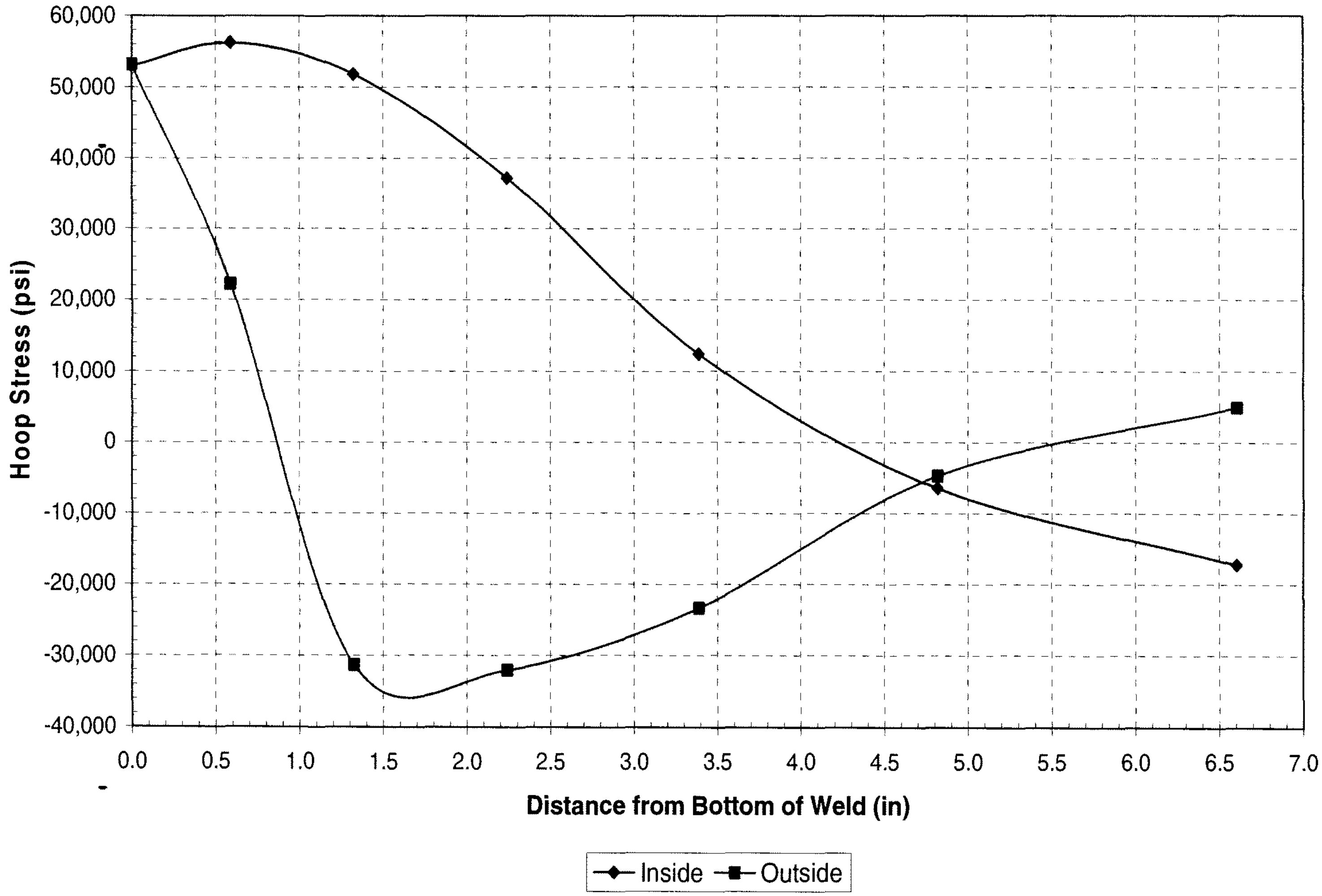

Figure 14
Hoop Stress Distribution Uphill Side
(43.8 Degree CRDM Penetration Nozzle)

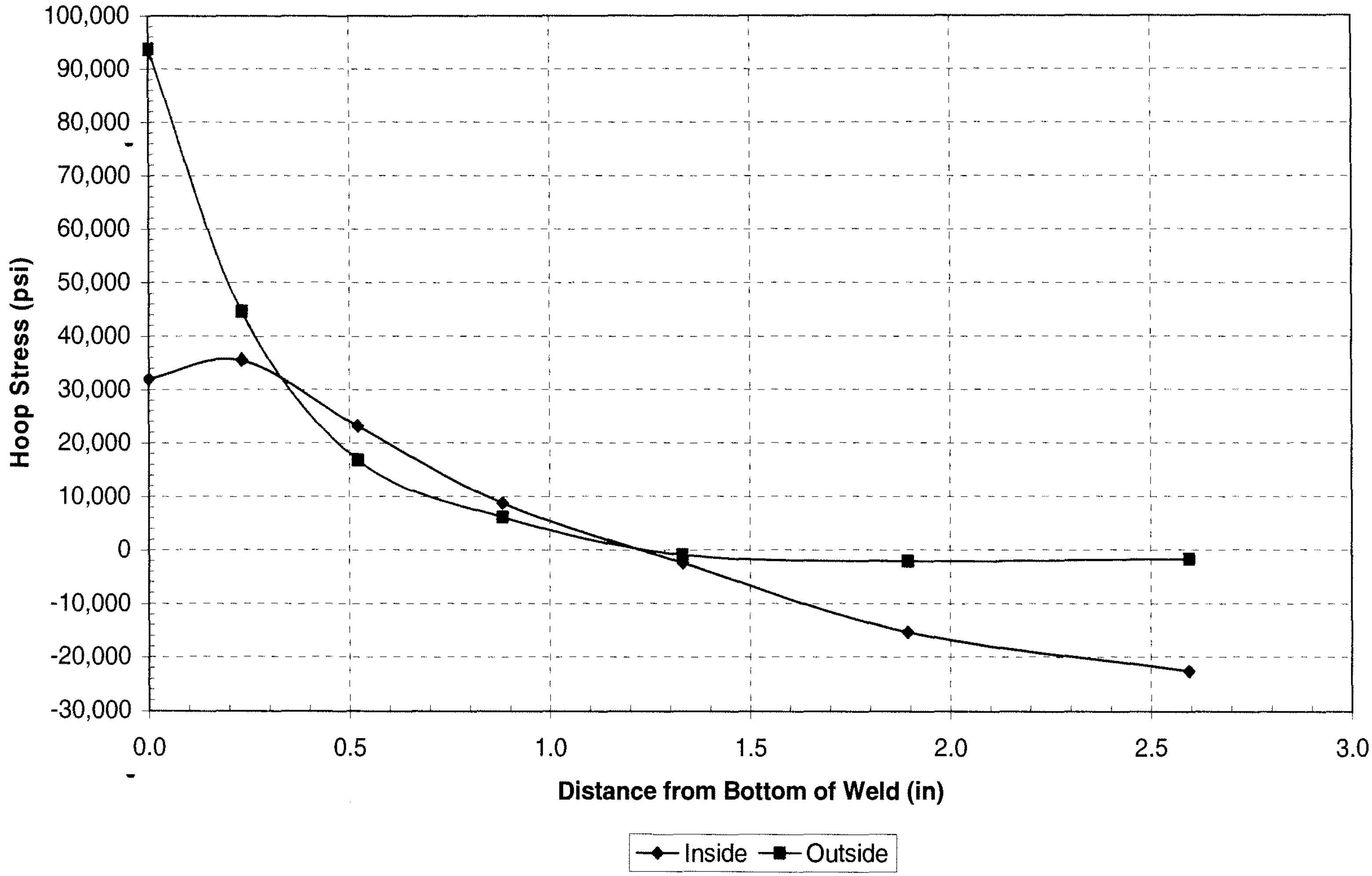

Figure 15
Hoop Stress Distribution Downhill Side
(43.8 Degree CRDM Penetration Nozzle)

Attachment 2

Byron Station Unit 2 – List of Commitments Regarding
First Revised Order EA-03-009 Relaxation Request

Byron Station Unit 2

COMMITMENT	COMMITTED DATE OR "OUTAGE"	COMMITMENT TYPE	
		ONE-TIME ACTION (Yes/No)	PROGRAMMATIC (Yes/No)
If the NRC finds that the crack-growth formula in industry report MRP-55 is unacceptable, then EGC will revise its analysis for Byron Station Unit 2 that justifies relaxation of the Order using the new NRC-approved crack-growth formula.	Within 30 days after the NRC notifies EGC by written correspondence of an NRC-approved crack-growth formula.	Yes	No
If the EGC revised analysis for Byron Station Unit 2 shows that the crack-growth acceptance criteria are exceeded prior to the end of the current operating cycle, the relaxation request will be rescinded and EGC will submit to the NRC written justification for continued operation of Byron Station Unit 2.	Within 72 hours of determining that the crack growth acceptance criteria are exceeded prior to the end of the current Byron Station Unit 2 operating cycle.	Yes	No
If the EGC revised analysis for Byron Station Unit 2 shows that the crack-growth acceptance criteria, while acceptable for the current operating cycle, are exceeded during the subsequent operating cycle, EGC will submit the revised analysis for NRC review.	Within 30 days of determining that the crack growth acceptance criteria are exceeded during the subsequent Byron Station Unit 2 operating cycle.	Yes	No
If the EGC revised analysis shows that the crack-growth acceptance criteria are not exceeded during either the current operating cycle or the subsequent operating cycle for Byron Station Unit 2, EGC will submit a letter to the NRC confirming that its analysis has been revised.	Within 30 days of the approval of the EGC revised analysis for Byron Station Unit 2.	Yes	No
Any future crack-growth analyses performed for this and future cycles for Byron Station Unit 2 RPV head penetrations must be based on an acceptable crack-growth rate formula.	Whenever crack-growth analyses for Byron Station Unit 2 RPV head penetrations are revised.	No	Yes

Note: The term "current operating cycle" refers to the Byron Station Unit 2 operating cycle in effect when the NRC notifies EGC by written correspondence that the flaw-growth rate formula in industry report MRP-55 is no longer acceptable and an alternate NRC-approved crack-growth formula is to be used.