NMC
Committed to Nuclear Excellence

Point Beach Nuclear Plant
Operated by Nuclear Management Company, LLC

May 14, 2004

NRC 2004-0052
10 CFR 50.55a(a)(3)

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

Point Beach Nuclear Plant, Unit 1
Docket 50-266
License No. DPR-24
NRC Order EA-03-009 Relaxation Request Supplement

Reference: 1) NRC Order EA-03-009, "Issuance of First Revised Order Establishing Interim Inspection Requirements for Reactor Pressure Vessel Heads at Pressurized Water Reactors," dated February 20, 2004
2) Letter from NMC to NRC dated March 30, 2004 (NRC 2004-0031)

In reference 2, Nuclear Management Company, LLC (NMC), requested a review for approval of relaxation from certain requirements of Nuclear Regulatory Commission (NRC) Order EA-03-009 (reference 1), for the Point Beach Nuclear Plant, Unit 1. That request was conditioned on a possibility that inspection of certain nozzles in accordance with the requirements of the Order may be unduly difficult.

As discussed during a conference call between NMC representatives and NRC staff on April 29, 2004, some specific limitations in inspection coverage of certain nozzles were experienced. Physical limitations preclude full compliance with paragraph IV.C.(5)(b) of Order EA-03-009 during the April 2004 refueling outage of Point Beach Unit 1. NMC believes that an alternative to the requirements of the order is appropriate. Therefore, NMC hereby requests relaxation from certain requirements of reference 1.

Enclosure I contains the basis for relaxation, which states that the proposed alternative for inspection of specific nozzles provides an acceptable level of quality and safety. NMC proposes an alternative to the requirements specified in Order EA-03-009, in accordance with paragraph IV.F.(1), pursuant to 10 CFR 50.55a(a)(3).

Enclosure I also includes submittal of as-found detailed inspection results and its specific analyses and supporting calculations. NMC is providing NRC staff with detailed information regarding the extent of inspection coverage to confirm that it is bounded by the analysis provided in Enclosure I.

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6590 Nuclear Road • Two Rivers, Wisconsin 54241
Telephone: 920.755.2321

MAY 21 2004

This letter contains no new commitments and no revisions to existing commitments.

Gary D. Van Middlesworth
Site Vice-President, Point Beach Nuclear Plant
Nuclear Management Company, LLC

Enclosures:
- I Justification for Relaxation
- II Unit 1 Reactor Vessel Closure Head Inspection Results
- III Illustrations of the Initial UT Scans of Nozzles 32 and 33
- IV Assessment of Nozzle Stresses

cc: Regional Administrator, Region III, USNRC
Project Manager, Point Beach Nuclear Plant, NRR, USNRC
NRC Resident Inspector - Point Beach Nuclear Plant
PSCW

ENCLOSURE I

NRC ORDER EA-03-009 RELAXATION REQUEST SUPPLEMENT

JUSTIFICATION FOR RELAXATION

POINT BEACH NUCLEAR PLANT, UNIT 1

INTRODUCTION

Nuclear Management Company, LLC (NMC) requests a review for approval of relaxation from certain requirements of Nuclear Regulatory Commission (NRC) Order EA-03-009, for the Point Beach Nuclear Plant, Unit 1. NMC proposes an alternative to the requirements specified in Order EA-03-009, in accordance with section IV.F.(1), pursuant to 10 CFR 50.55a(a)(3). This alternative includes use of deterministic structural integrity evaluations and probabilistic models to demonstrate the acceptability of limited non-destructive examinations (NDE).

In addition to a bare-metal visual exam, NMC attempted a 100% ultrasonic testing (UT) examination of the CRDM nozzles during the current Point Beach Unit 1 refueling outage (U1R28). However, some limitations in inspection coverage were experienced. The steep curvature of the reactor pressure vessel (RPV) at the outer row of control rod drive mechanism (CRDM) nozzles resulted in an inability to obtain complete coverage with the NDE equipment. Circumferential coverage limitations were found on two nozzles. Additionally, NMC was unable to scan one (1) inch below the CRDM J-groove weld of several of the nozzles.

Limitations in inspection coverage were also experienced during the previous Unit 1 inspection in 2002. During that inspection, thermal sleeves were removed from several nozzles to allow full access for material inspection with a rotating UT probe instead of a blade UT probe. This process of thermal sleeve removal and reattachment expended a large amount of personnel dose (approximately 3 rem/nozzle).

Following the previous Unit 1 inspection, NDE equipment was modified and full coverage was achieved on a subsequent inspection of the Point Beach Unit 2 CRDM nozzles. However, it appears that unit-specific differences between the two vessel heads prevented achieving similar results on the Unit 1 vessel head.

The information contained in this relaxation request supplements the information provided in reference 2 to include submittal of as-found inspection results and its specific analyses. These two submittals form the basis for specific relaxation of the requirements of NRC Order EA-03-09.

COMPONENT IDENTIFICATION

The affected components are the Point Beach Nuclear Plant Unit 1 reactor pressure vessel (RPV) head penetration nozzles.

APPLICABLE DOCUMENT

The applicable document is Order EA-03-009, "Issuance of First Revised Order Establishing Interim Inspection Requirements for Reactor Pressure Vessel Heads at Pressurized Water Reactors," dated February 20, 2004.

APPLICABLE REQUIREMENT

Order EA-03-009 established interim inspection requirements for RPV head penetration nozzles, depending on their susceptibility to primary stress corrosion cracking. The Point Beach Unit 1 RPV head is currently in the high susceptibility category.

Order EA-03-009 specifies the requirements governing inspection of RPV heads in the high susceptibility categories in section IV.C.(1), using the techniques of paragraphs IV.C.(5)(a) and IV.C.(5)(b). If ultrasonic testing is selected as the method of nondestructive examination (NDE), the following is required for each penetration.

> 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); **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. 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.

BASIS FOR RELAXATION REQUEST

NMC requires relaxation from paragraph IV.C.(5)(b) of Order EA-03-009, from the requirement to perform nonvisual NDE on the entire prescribed region of each of the RPV head penetration nozzles at Point Beach Unit 1. The justification for this relaxation request is based on the methodologies contained in Structural Integrity Associates Report SIR-04-032 (Enclosure II to reference 2), and WCAP-14000, Revision 1, "Structural Integrity Evaluation of Reactor Vessel Head Penetrations to Support Continued Operation: Point Beach Units 1 & 2". These documents were provided to the NRC on March 30, 2004 and September 27, 2002, respectively. The final basis for

relaxation from the Order is the analyses of as-found inspection results using these methodologies.

These analytical methods were discussed with NRC staff during public meetings on October 6, 2003 and February 19, 2004.

INSPECTION RESULTS

Enclosure II contains the detailed results of the reactor vessel closure head (RVCH) inspection. Table 1, below, summarizes these results and identifies where relaxation of NRC Order EA-03-09 is needed. No unacceptable defects were identified during the RVCH inspection other than in Nozzle 26, which is being repaired.

An above-head bare-metal visual examination will be performed on greater than 95% of the surface area surrounding the PBNP Unit 1 vessel head penetrations (VHP). The primary inspection area around each of the CRDM penetrations is complete. The examination resulted in an effective visual examination that revealed no evidence of boric acid deposition or wastage. All RPV head penetrations were examined with no limitations. The surface area outside the vessel shroud has yet to be inspected. This area does not contain any penetrations.

Table 1
RVCH Inspection Summary

Penetration(s)	Coverage	Description
6-9, 34-37, 42-49, & vent	100%	Inspection coverage satisfies NRC Order. Rotating probed used. No restrictions or limitations.
32	100%	Inspection coverage satisfies NRC Order. A combination of blade probe and manual UT was performed.
1-3, 5, 10, 14, 17, 21, 23, & 38-41	<100%	Full coverage obtained except for 0.4" at OD of tube bottom. Greater than 1" of coverage was obtained below the toe of the J-groove weld. Stresses are < 20 ksi in unexamined area. Inspection coverage satisfies NRC Order. Stress curves are provided in Enclosure IV
4, 11-13, 15-16, 18-20, 22, 24-25, & 27-31	<100%	**Relaxation of NRC Order is requested**. Full coverage obtained except for 0.4" at OD of tube bottom. However, less than 1" of coverage was obtained below the toe of the J-groove weld. Deterministic fracture mechanics was used to justify coverage.
33	83%	**Relaxation of NRC Order is requested**. A combination of blade probe and manual UT was performed. A 60° coverage limitation exists in and above the J-groove weld region. Deterministic fracture mechanics accompanied by probabilistic analysis was used to justify coverage.
26	100%	Nozzle 26 repair. Full coverage obtained.

Nozzle 26 – Examinations and Repair

During the performance of UT examinations, large indications were seen at the weld root of nozzle 26 (downhill location – 180°). The indications were initially declared crack-like in appearance. Further review of the UT data and previous inspection reports determined that the indications were likely a result of a fabrication-related defect in the nozzle.

A series of manual liquid dye-penetrant (PT) examinations were performed on the nozzle J-groove weld. The results of these examinations revealed surface defects. Excavation of the defects was performed by manual grinding of the J-groove surface. The flaws were not removed after grinding to a depth of approximately 3/16 inch.

Due to the high dose involved with further grinding, as well as industry experience with these types of defects, a conservative decision was made to repair nozzle 26 using the Areva ID Temperbead (IDTB) repair process. A revised relief request was submitted by NMC on May 13, 2004, to the NRC to conduct this repair.

Nozzles 32 and 33 – Additional UT Examinations

As shown in Enclosure II, nozzles 32 and 33 received a UT examination of less than 100% coverage. The lack of full coverage was due to weld distortion in the nozzle. This weld distortion made blade probe access very difficult, resulting in coverage limitations. Enclosure III contains illustrations of the initial UT scans of nozzles 32 and 33.

Similar coverage limitations were experienced during the previous Unit 1 refueling outage in fall 2002 (U1R27). The nozzle 32 and 33 thermal sleeves were removed during that outage to allow use of a rotating UT probe. 100% inspection coverage was obtained with at least one transducer of the rotating UT probe. No flaws were detected. Replacement thermal sleeves were installed. A radiation dose of approximately 3 rem per nozzle was incurred during the thermal sleeve removal and installation processes.

Due to the placement of the thermal sleeve reattachment weld, an additional removal and reattachment of the nozzle 32 and 33 thermal sleeve would be very difficult. Dose estimates for this work are 3 rem per nozzle or greater. Based on this concern, an alternative to removal of the thermal sleeves was pursued.

NMC has therefore performed manual UT examinations of the CRDM 32 and 33 nozzle material below the J-groove weld. This manual UT process has been demonstrated on Materials Reliability Program (MRP) mockups at the EPRI NDE Center and is approved for use at PBNP. No indications were detected on either nozzle during this exam.

The combination of remote and manual UT examinations of nozzle 32 provided 100% coverage. Therefore, no relaxation from NRC Order EA-03-09 is needed for this nozzle.

The combination of remote and manual UT examinations of nozzle 33 provided 83% coverage of that nozzle. The only unexamined area is a 60° vertical area in the J-groove weld and above. Relaxation from NRC Order EA-03-09 is requested for nozzle 33 as discussed below.

Nozzle 33 – Specific Information

As shown in Enclosures II & III, NMC was unable to examine a 60° area in the J-groove weld and above on nozzle 33. Therefore, **relaxation from the inspection requirements of NRC Order EA-03-09 is requested for nozzle 33.** This relaxation is justified by a combination of deterministic flaw tolerance evaluations and probabilistic evaluations. Similar deterministic flaw tolerance evaluations were used to evaluate coverage limitations during the Unit 1 fall 2002 refueling outage. Those evaluations were provided to the NRC in PBNP Unit 1 Thirty-day Response to NRC Bulletins 2001-01, 2001-01, and 2002-02 for Reactor Vessel Head and Vessel Head Penetration Nozzle Inspection Findings, dated November 15, 2002.

Figure 2 illustrates the coverage achieved on nozzle 33.

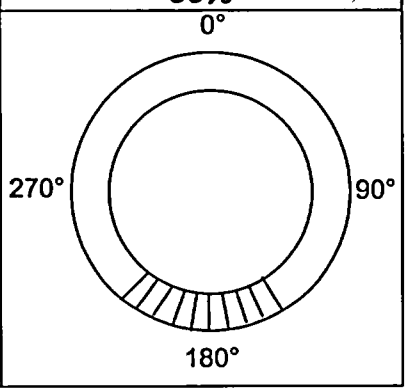
Nozzle	***Area***	***Circ Length***	***Axial Length***	***Examination Percentage 83%***
33	Area of Interest	0-360°	2.57" above weld	
	Area Examined	0-142° & 204-360°		
	Area Not Examined	143-203°		

Figure 2 – Nozzle 33 UT Exam Coverage

Circumferential cracks that may be located in the nozzle material are the area of prime interest due to the safety concern arising from nozzle ejection and loss of coolant accident (LOCA). Therefore, a deterministic flaw tolerance evaluation was performed postulating a circumferential flaw in the area not covered by the UT exam. The assumed flaw in this evaluation was the maximum circumferential length in the area not covered by the UT exam (60° - reference Enclosures II, III, and figure 2). Figure 3 illustrates the time required for the postulated 60° flaw to grow to a point of structural significance (330°) to be approximately 30 years of operation. Figure 3 is plotted as half the length of the circumferential flaw to account for both ends of the flaw growing equally. The evaluation uses plant specific stresses, operating temperature, and the

crack growth rate predictions in EPRI MRP-55, "Materials Reliability Program (MRP) Crack Growth Rates for Evaluating Primary Water Stress Corrosion Cracking (PWSCC) of Thick-Wall Alloy 600 Material." Based on the UT inspection results and this evaluation, there are no concerns with the structural integrity of nozzle 33 from a postulated circumferential crack in the non-inspected area over the next operating cycle. This flaw tolerance evaluation is documented in WCAP-14000, Revision 1 "Structural Integrity Evaluation of Reactor Vessel Upper Head Penetrations to Support Continued Operation: Point Beach Units 1 and 2 (Proprietary)". This report was transmitted to the NRC by Westinghouse Electric Company on September 27, 2002.

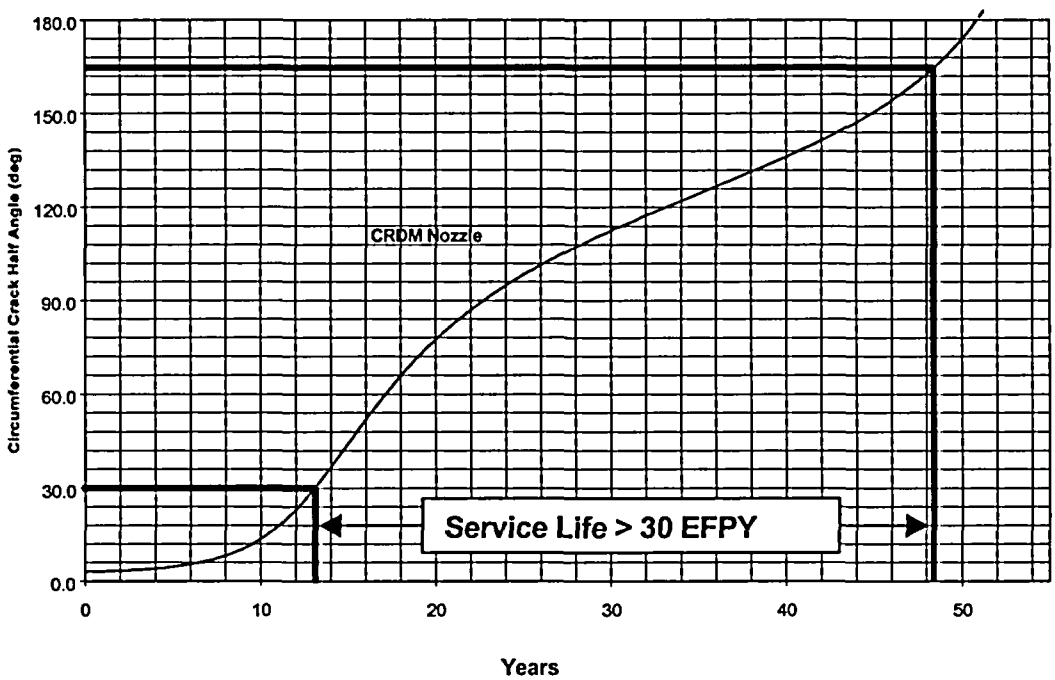


Figure 3 - Crack Growth Predictions for Circumferential Through-Wall Cracks

In addition to the work described above, a probabilistic fracture mechanics (PFM) evaluation was performed based on the PBNP-1 RPV inspections. The PFM tool was developed by the PWR Materials Reliability Program (MRP). The PFM evaluation was provided to NRC as Enclosure II to reference 2. The evaluation used plant-specific parameters such as head geometry, number of nozzles, head temperature, plant operating time, and inspection history to determine probability of nozzle leakage.

The PFM analysis conservatively assumed only 90% coverage during the spring 2004 Unit 1 refueling outage. Actual UT coverage exceeded 95%. Figure 4 illustrates the results of the analysis.

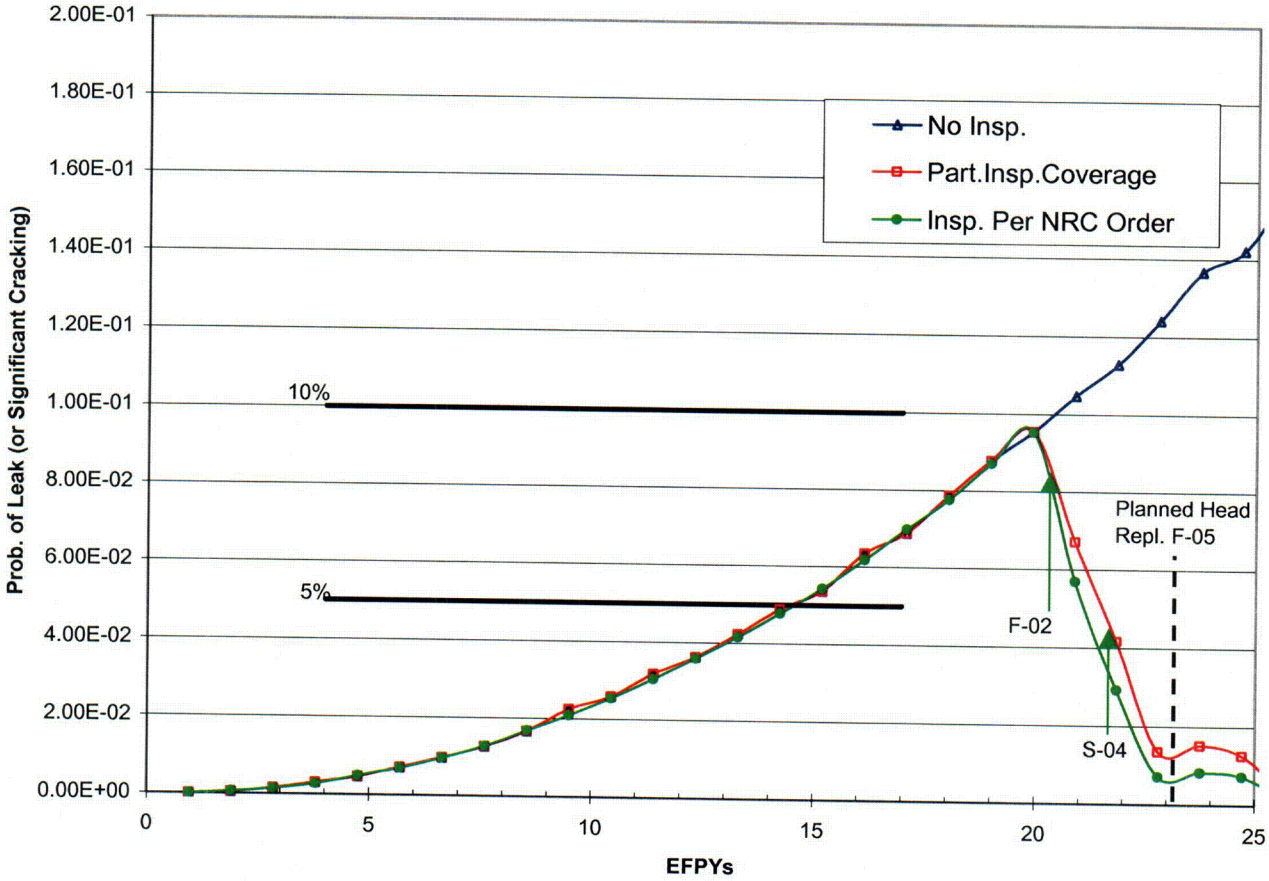


Figure 4 – Probabilistic Comparison of 100% and 90% Coverage During U1R28

The results indicate only a small difference in the probabilities of leakage based on the inspection coverage achieved, as compared to full coverage inspections. Such small differences do not warrant the additional radiation exposure that would be incurred to remove the nozzle 33 thermal sleeve in order to achieve full inspection coverage. These results demonstrate that the inspection coverage achieved was acceptable.

Area Below the Toe of the J-groove Weld

As shown in Table 1 and Enclosure II, seventeen nozzles could not be examined one inch below the toe of the J-groove weld on the OD surface. The amount of unscanned area is a function of the Areva blade tool and not a result of PNBP-specific nozzle geometry. The ID surface was fully examined. Figure 5 illustrates the limitation in coverage.

C01

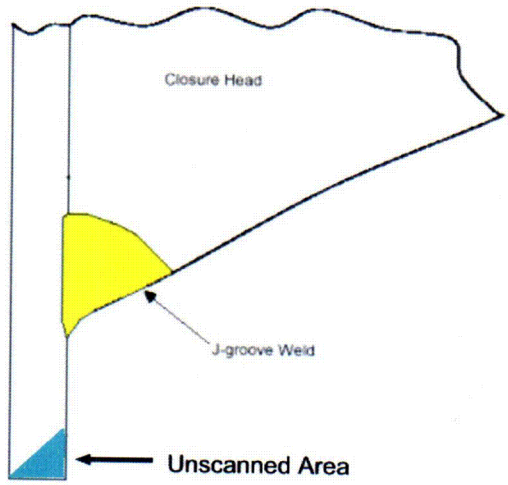


Figure 5 – Examination Limitation (OD Thermal Sleeve Locations)

A deterministic flaw tolerance evaluation was performed for the limiting nozzle (nozzle 20). The height in the unscanned area is 0.4 inches (L_{flaw}) and is a function of the design of the blade probes used in these examinations. Figure 6 illustrates this dimension.

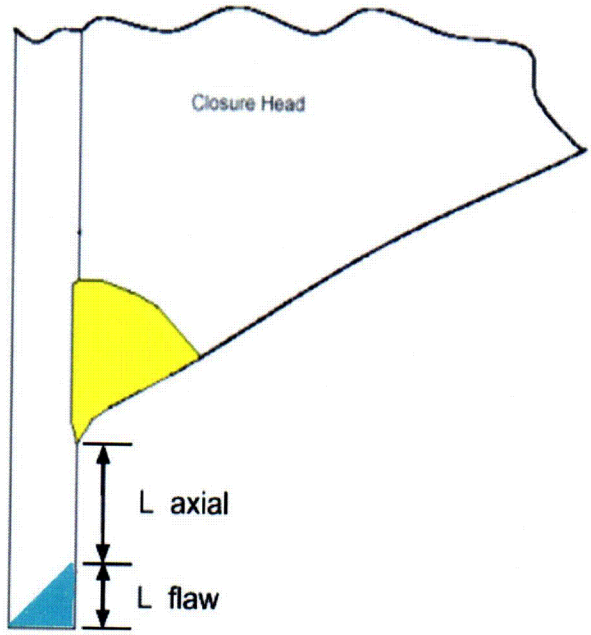


Figure 6 – Dimension Used in Flaw Evaluation

C02

L_{axial} is the worst-case OD distance below the weld achieved on the down-hill side during the examinations. As shown in Enclosure II, the minimum coverage distance observed was 0.44 inch (nozzle 20). Accounting for instrument uncertainty (± 0.03 inch), this worst-case dimension is 0.41 inch (L_{axial}).

Postulating a thru-wall flaw in the unexamined area L_{flaw} and calculating the time required for the flaw to travel through a distance of L_{axial} demonstrates the acceptability of this condition. This assures that no leakage could result from the unexamined area.

Plant specific MRP-55 crack growth rate (CGR) data of 1.98×10^{-03} $(K-K_{th})^{1.16}$ inch per year. Using a conservative value of 55 ksi-$(in)^{0.5}$ for $K-K_{th}$, yields a crack growth rate of 0.207 inch/year and is used in the calculation. This CGR is documented in Structural Integrity Associates (SIA) Calculation PBCH-09Q-302. This calculation was provided to the NRC as Enclosure III to a letter from NMC to NRC dated May 13, 2004.

The following formula is used to calculate flaw propagation time.

$$\text{Time} = L_{axial} / \text{CGR}$$

The time for a worst-case flaw to travel through a distance of L_{axial} is therefore calculated as 2.0 EPFY. PBNP operates on an 18-month cycle and will be replacing the RPV head during the next refueling outage scheduled for Fall 2005.

PROPOSED ALTERNATE EXAMINATION

NMC proposes that the extent of ultrasonic testing required to be conducted on each RPV head penetration nozzle, in accordance with paragraph IV.C.(5)(b)(i) of Order EA-03-009, be modified based on the analyses of as-found inspection results.

The inspection coverage that was achieved, along with the corresponding justifications for coverage limitations as discussed in this submittal, provide an acceptable level of quality and safety. Additionally, compliance with the Order for the specific nozzles on which coverage was limited, would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

Therefore, NMC requests that Order EA-03-009 be relaxed for nozzles 4, 11-13, 15-16, 18-20, 22, 24-25, 27-31, and 33, to only require the examination coverage that was achieved as shown in Table 1.

CONCLUSION

In summary, NMC previously submitted the methodologies on which to base relaxation from paragraph IV.C.(5)(b) of Order EA-03-009, from the requirement to perform non-visual NDE on the entire prescribed region of each of the RPV head penetration nozzles at Point Beach Unit 1. Inspection limitations were found during the Unit 1 RPV head

inspection and NMC believes that an alternative to the requirements of the Order is appropriate. Therefore, detailed examination results and supporting calculations are being submitted to the NRC staff. Based on the information presented, and pursuant to 10 CFR 50.55a(a)(3)(i), NMC requests approval of the relaxation on the basis that the proposed alternative provides an acceptable level of quality and safety.

PERIOD FOR WHICH RELAXATION IS REQUESTED

The proposed alternative will apply only to the Point Beach Unit 1 inspections required by Order EA-03-009 for the spring 2004 refueling outage (U1R28).

ENCLOSURE II

NRC ORDER EA-03-009 RELAXATION REQUEST SUPPLEMENT

UNIT 1 REACTOR VESSEL CLOSURE HEAD INSPECTION RESULTS

AREVA

Point Beach Unit 1 (U1R28)

RVH			Extent of UT Coverage in RVHP Nozzle Material							
Pen #	Nozzle Degree	Ring	Min. Distance Above Up-Hill Weld Root	Coverage Above Weld Root (Theta)	Weld Region Coverage (Theta)	Below Weld Coverage (Theta)	Minimum ID Distance Below Weld Achieved on Down-Hill Side	Minimum OD Distance Below Weld Achieved on Down-Hill Side	Minimum OD Distance Below Weld Achieved on Down-Hill Side w/ inst uncertainty	If OD Distance is LESS than 1.0", what is circ Extent LESS than 1.0" (List start - end)
1	0.0	0	3.11	360	360	360	1.514	1.120	1.090	1.0" obtained
2	19.4	3	3.80	360	360	360	1.504	1.110	1.080	1.0" obtained
3	19.4	3	3.48	360	360	360	1.594	1.200	1.170	1.0" obtained
4	19.4	3	3.68	360	360	360	1.394	1.000	0.970	1.0" obtained
5	19.4	3	3.59	360	360	360	1.594	1.200	1.170	1.0" obtained
6	13.6	2	7.45	360	360	360	*Data Collected using Rotating Probe -- Full Coverage Obtained*			
7	13.6	2	7.40	360	360	360	*Data Collected using Rotating Probe -- Full Coverage Obtained*			
8	13.6	2	7.30	360	360	360	*Data Collected using Rotating Probe -- Full Coverage Obtained*			
9	13.6	2	7.30	360	360	360	*Data Collected using Rotating Probe -- Full Coverage Obtained*			
10	28.1	5	3.51	360	360	360	1.654	1.260	1.230	1.0" obtained
11	28.1	5	3.20	360	360	360	1.394	1.000	0.970	1.0" obtained
12	28.1	5	3.60	360	360	360	1.074	0.680	0.650	110
13	28.1	5	3.60	360	360	360	1.124	0.730	0.700	17
14	31.8	7	3.8	360	360	360	1.494	1.100	1.070	1.0" obtained
15	31.8	7	3.39	360	360	360	1.394	1.000	0.970	1.0" obtained
16	31.8	7	3.80	360	360	360	0.974	0.580	0.550	110
17	31.8	7	3.09	360	360	360	1.554	1.160	1.130	1.0" obtained
18	29.9	6	3.40	360	360	360	1.394	1.000	0.970	1.0" obtained
19	29.9	6	3.49	360	360	360	1.394	1.000	0.970	1.0" obtained
20	29.9	6	3.57	360	360	360	0.834	0.440	0.410	104
21	29.9	6	2.30	360	360	360	1.504	1.110	1.080	1.0" obtained
22	31.8	7	3.48	360	360	360	1.404	1.010	0.980	1.0" obtained
23	31.8	7	3.19	360	360	360	1.594	1.200	1.170	1.0" obtained
24	31.8	7	3.43	360	360	360	1.074	0.680	0.650	64
25	31.8	7	3.28	360	360	360	1.394	1.000	0.970	1.0" obtained
26	36.9	8	2.02	360	360	360	*Data Collected using Rotating Probe -- Full Coverage Obtained*			
27	36.9	8	2.90	360	360	360	1.344	0.950	0.920	50
28	36.9	8	3.01	360	360	360	0.924	0.530	0.500	95
29	36.9	8	3.85	360	360	360	1.164	0.770	0.740	99
30	36.9	8	3.24	360	360	360	1.174	0.780	0.750	100
31	36.9	8	2.89	360	360	360	1.134	0.740	0.710	70
32	36.9	8	3.81	360	360	99	*Percentages can't be determined due to lack of data on Down Hill Side*			

RVH			Extent of UT Coverage in RVHP Nozzle Material							
Pen #	Nozzle Degree	Ring	Min. Distance Above Up-Hill Weld Root	Coverage Above Weld Root (Theta)	Weld Region Coverage (Theta)	Below Weld Coverage (Theta)	Minimum ID Distance Below Weld Achieved on Down-Hill Side	Minimum OD Distance Below Weld Achieved on Down-Hill Side	Minimum OD Distance Below Weld Achieved on Down-Hill Side w/ inst uncertainty	If OD Distance is LESS than 1.0", what is circ Extent LESS than 1.0" (List start - end)
33	36.9	8	2.57	300	300	57	*Percentages can't be determined due to lack of data on Down Hill Side*			
34	43.3	9	4.10	360	360	360	*Data Collected using Rotating Probe -- Full Coverage Obtained*			
35	43.3	9	4.16	360	360	360	*Data Collected using Rotating Probe -- Full Coverage Obtained*			
36	43.3	9	4.60	360	360	360	*Data Collected using Rotating Probe -- Full Coverage Obtained*			
37	43.3	9	3.95	360	360	360	*Data Collected using Rotating Probe -- Full Coverage Obtained*			
38	9.6	1	3.38	360	360	360	1.694	1.300	1.270	1.0" obtained
39	9.6	1	3.24	360	360	360	2.064	1.670	1.640	1.0" obtained
40	9.6	1	3.40	360	360	360	1.494	1.100	1.070	1.0" obtained
41	9.6	1	3.15	360	360	360	1.694	1.300	1.270	1.0" obtained
42	21.8	4	6.54	360	360	360	*Data Collected using Rotating Probe -- Full Coverage Obtained*			
43	21.8	4	6.61	360	360	360	*Data Collected using Rotating Probe -- Full Coverage Obtained*			
44	21.8	4	6.69	360	360	360	*Data Collected using Rotating Probe -- Full Coverage Obtained*			
45	21.8	4	6.83	360	360	360	*Data Collected using Rotating Probe -- Full Coverage Obtained*			
46	21.8	4	7.10	360	360	360	*Data Collected using Rotating Probe -- Full Coverage Obtained*			
47	21.8	4	6.80	360	360	360	*Data Collected using Rotating Probe -- Full Coverage Obtained*			
48	21.8	4	6.60	360	360	360	*Data Collected using Rotating Probe -- Full Coverage Obtained*			
49	21.8	4	6.56	360	360	360	*Data Collected using Rotating Probe -- Full Coverage Obtained*			

AREVA

Point Beach Unit 1 (U1R28)

Extent of UT Coverage in RVHP Nozzle Material

Pen #	Nozzle Degree	Ring	Min. Distance Above Up-Hill Weld Root	Coverage Above Weld Root (Percentage)	Weld Region Coverage (Percentage)	Below Weld Coverage (Percentage)	Minimum ID Distance Below Weld Achieved on Down-Hill Side (Percentage)	Minimum OD Distance Below Weld Achieved on Down-Hill Side (Percentage)	If OD Distance is LESS than 1.0", what is circ Extent LESS than 1.0" (in Degrees)
1	0.0	n/a	3.11	100%	100%	100%	100%	100%	
38	9.6	1	3.38	100%	100%	100%	100%	100%	
39	9.6	1	3.24	100%	100%	100%	100%	100%	
40	9.6	1	3.40	100%	100%	100%	100%	100%	
41	9.6	1	3.15	100%	100%	100%	100%	100%	
			Ring Average:	*100%*	*100%*	*100%*	100%	100%	
6	13.6	2	7.45	100%	100%	100%	*Data Collected using Rotating Probe -- Full Covergae Obtained*		
7	13.6	2	7.40	100%	100%	100%	*Data Collected using Rotating Probe -- Full Covergae Obtained*		
8	13.6	2	7.30	100%	100%	100%	*Data Collected using Rotating Probe -- Full Covergae Obtained*		
9	13.6	2	7.30	100%	100%	100%	*Data Collected using Rotating Probe -- Full Covergae Obtained*		
			Ring Average:	*100%*	*100%*	*100%*	100%	100%	
2	19.4	3	3.80	100%	100%	100%	100%	100%	
3	19.4	3	3.48	100%	100%	100%	100%	100%	
4	19.4	3	3.68	100%	100%	100%	100%	100%	
5	19.4	3	3.59	100%	100%	100%	100%	100%	
			Ring Average:	*100%*	*100%*	*100%*	100%	100%	
42	21.8	4	6.54	100%	100%	100%	*Data Collected using Rotating Probe -- Full Covergae Obtained*		
43	21.8	4	6.61	100%	100%	100%	*Data Collected using Rotating Probe -- Full Covergae Obtained*		
44	21.8	4	6.69	100%	100%	100%	*Data Collected using Rotating Probe -- Full Covergae Obtained*		
45	21.8	4	6.83	100%	100%	100%	*Data Collected using Rotating Probe -- Full Covergae Obtained*		
46	21.8	4	7.10	100%	100%	100%	*Data Collected using Rotating Probe -- Full Covergae Obtained*		
47	21.8	4	6.80	100%	100%	100%	*Data Collected using Rotating Probe -- Full Covergae Obtained*		
48	21.8	4	6.60	100%	100%	100%	*Data Collected using Rotating Probe -- Full Covergae Obtained*		
49	21.8	4	6.56	100%	100%	100%	*Data Collected using Rotating Probe -- Full Covergae Obtained*		
			Ring Average:	*100%*	*100%*	*100%*	100%	100%	

Extent of UT Coverage in RVHP Nozzle Material

Pen #	Nozzle Degree	Ring	Min. Distance Above Up-Hill Weld Root	Coverage Above Weld Root (Percentage)	Weld Region Coverage (Percentage)	Below Weld Coverage (Percentage)	Minimum ID Distance Below Weld Achieved on Down-Hill Side (Percentage)	Minimum OD Distance Below Weld Achieved on Down-Hill Side (Percentage)	If OD Distance is LESS than 1.0", what is circ Extent LESS than 1.0" (in Degrees)
10	28.1	5	3.51	100%	100%	100%	100%	100%	
11	28.1	5	3.20	100%	100%	100%	100%	100%	
12	28.1	5	3.60	100%	100%	100%	100%	68%	110
13	28.1	5	3.60	100%	100%	100%	100%	73%	17
			Ring Average:	***100%***	***100%***	***100%***	***100%***	***85%***	
18	29.9	6	3.40	100%	100%	100%	100%	100%	
19	29.9	6	3.49	100%	100%	100%	100%	100%	
20	29.9	6	3.57	100%	100%	100%	83%	44%	104
21	29.9	6	2.30	100%	100%	100%	100%	100%	
			Ring Average:	***100%***	***100%***	***100%***	***96%***	***86%***	
14	31.8	7	3.8	100%	100%	100%	100%	100%	
15	31.8	7	3.39	100%	100%	100%	100%	100%	
16	31.8	7	3.80	100%	100%	100%	97%	58%	110
17	31.8	7	3.09	100%	100%	100%	100%	100%	
22	31.8	7	3.48	100%	100%	100%	100%	100%	
23	31.8	7	3.19	100%	100%	100%	100%	100%	
24	31.8	7	3.43	100%	100%	100%	100%	68%	64
25	31.8	7	3.28	100%	100%	100%	100%	100%	
			Ring Average:	***100%***	***100%***	***100%***	***100%***	***91%***	
26	36.9	8	2.02	100%	100%	100%	***Data Collected using Rotating Probe -- Full Covergae Obtained***		
27	36.9	8	2.90	100%	100%	100%	100%	95%	50
28	36.9	8	3.01	100%	100%	100%	92%	53%	95
29	36.9	8	3.85	100%	100%	100%	100%	77%	99
30	36.9	8	3.24	100%	100%	100%	100%	78%	100
31	36.9	8	2.89	100%	100%	100%	100%	74%	70
32	36.9	8	3.81	100%	100%	28%	***Percentages can't be determined due to lack of data on Down Hill Side***		
33	36.9	8	2.57	82%	83%	15%	***Percentages can't be determined due to lack of data on Down Hill Side***		
			Ring Average:	***98%***	***98%***	***80%***	***98%***	***75%***	***(Circ Blade Data only)***

Extent of UT Coverage in RVHP Nozzle Material

Pen #	Nozzle Degree	Ring	Min. Distance Above Up-Hill Weld Root	Coverage Above Weld Root (Percentage)	Weld Region Coverage (Percentage)	Below Weld Coverage (Percentage)	Minimum ID Distance Below Weld Achieved on Down-Hill Side (Percentage)	Minimum OD Distance Below Weld Achieved on Down-Hill Side (Percentage)	If OD Distance is LESS than 1.0", what is circ Extent LESS than 1.0" (in Degrees)
				98%	*98%*	*80%*	*99%*	*80%*	*(Circ Blade + Rotating data)*
34	43.3	9	4.10	100%	100%	100%	*Data Collected using Rotating Probe -- Full Covergae Obtained*		
35	43.3	9	4.16	100%	100%	100%	*Data Collected using Rotating Probe -- Full Covergae Obtained*		
36	43.3	9	4.60	100%	100%	100%	*Data Collected using Rotating Probe -- Full Covergae Obtained*		
37	43.3	9	3.95	100%	100%	100%	*Data Collected using Rotating Probe -- Full Covergae Obtained*		
			Ring Average:	*100%*	*100%*	*100%*	*100%*	*100%*	

ENCLOSURE III

NRC ORDER EA-03-009 RELAXATION REQUEST SUPPLEMENT

ILLUSTRATIONS OF THE INITIAL UT SCANS OF NOZZLES 32 AND 33

AREVA

BLADE PROBE / ROTATING UT DATA SHEET

RVH Penetration Number: 32	*RVH Penetration Type:* ☒-CRDM ☐-CEDM ☐-ICI ☐-Vent-Line

Utility : Nuclear Management Corporation **Plant:** Point Beach **Unit:** 1 **Outage:** U1R28

Procedure No: 54-ISI-100-11 **Procedure Title -** Remote Ultrasonic Examination of Reactor Vessel Head Penetrations

Essential Equipment Description

UT System Make / Model	S/N	VH#	Cal. Due Date	Remote Pulser / Receiver	
RD Tech / Micro-Tomo	63592	8168	01/16/2005	VH# N/A	Cal. Due: N/A

UT Cable Type / Length:	RG174 / 50 ft.	RG58 / 0 ft.	**No. of Connectors:** 2

UT Data Acquisition / Version : ACCUSONEX™ Data Acqusition / Calibration Version 6.5 / 6.5 (Acq. / Cal.)

UT Data Analysis / Version: ACCUSONEX™ Data Analysis Software / Version 3.13

Calibration or Nozzle Scan Information:

Scan File Information:	**Total Number of Files:** 4		
File Name(s):	D4119_12.23.58	D4119_13.29.54	
D4119_13.40.54	D4123_07.39.08		
Scan Start Θ	-5 °	**Scan End Θ**	+365 °
Scan Start "Z"	0.0 In.	**Scan End "Z"**	10,0 In.
Θ Increment:	3.0 °	**Sync. Value:**	0.05 °
Blade Probe Offset Value:	N/A		

Rotating / Blade Probe Calibration Information:

Calibration Setup No.:	3
Initial Calibration File:	A4119_01.32.40 (Blade 708)
Initial Calibration File:	A4123_04.40.42 (Balde 703)
Calibration Block ID:	02-5032568E01
Calibration Temperature:	N/A °F
RVH Examination Temp.:	N/A °F
Pyrometer S/N or VH No.:	N/A
Pyrometer Cal. Due Date:	N/A

Examination Coverage

Axial Extent Above Up-Hill Weld Root:	**3.81"**
Axial Extent Below Low-Hill Weld Toe[1]:	**N/A**
[1]If Axial Extent Below Low-Hill Weld Toe < 1.0", Number of Degrees this Condition Exists:	**N/A**
Up-Hill Weld Root to Interference Fit Region:	**N/A**

J-Groove Weld Search Unit Parameters

Transducer Manufacturer	Couplant
AREVA SAS	De-Mineralized Water

☐ Rotating Inspection Head ☒ Blade Probe TOFD

Chan.	Angle / Direction / Freq.	DB No. / Model
1	Circ. Blade TOFD / Axial / 5.0	SO708 / CN
1	Circ. Blade TOFD / Axial / 5.0	SO703 / CN
N/A	N/A	N/A N/A
N/A	N/A	N/A N/A
N/A	N/A	N/A N/A
N/A	N/A	N/A N/A
N/A	N/A	N/A / N/A
N/A	N/A	N/A / N/A

Examination Results

Data Sheet Intended For:

☒ ***UT Examination Data***
- ☒ No Flaws Detected
- ☐ Axial Flaws Detected
- ☐ Circ. Flaws Detected

☐ ***UT Calibration Data***
- ☐ Initial Calibration
- ☐ Calibration Verification
- ☐ Final Calibration

Leak Path Assessment Possible ☒ - Yes ☐ - No

☐ Leak Path Detected Flaw Report No. N/A

Remarks: Limited UT examination coverage;

- Above weld root coverage equals 100% (360°)
- Weld region coverage equials 100% (360°)
- Below weld region coverage equals 27.5% (99°)

Note 1: No final calibration performed due to blade probe failure; Probe function was acceptable prior to failure.

Analyzed By:	Pierre Wanders	**Level:**	II	**Date:**	05/02/2004
Reviewed By:	Kent C. Gebetsberger	**Level:**	III	**Date:**	05/02/2004

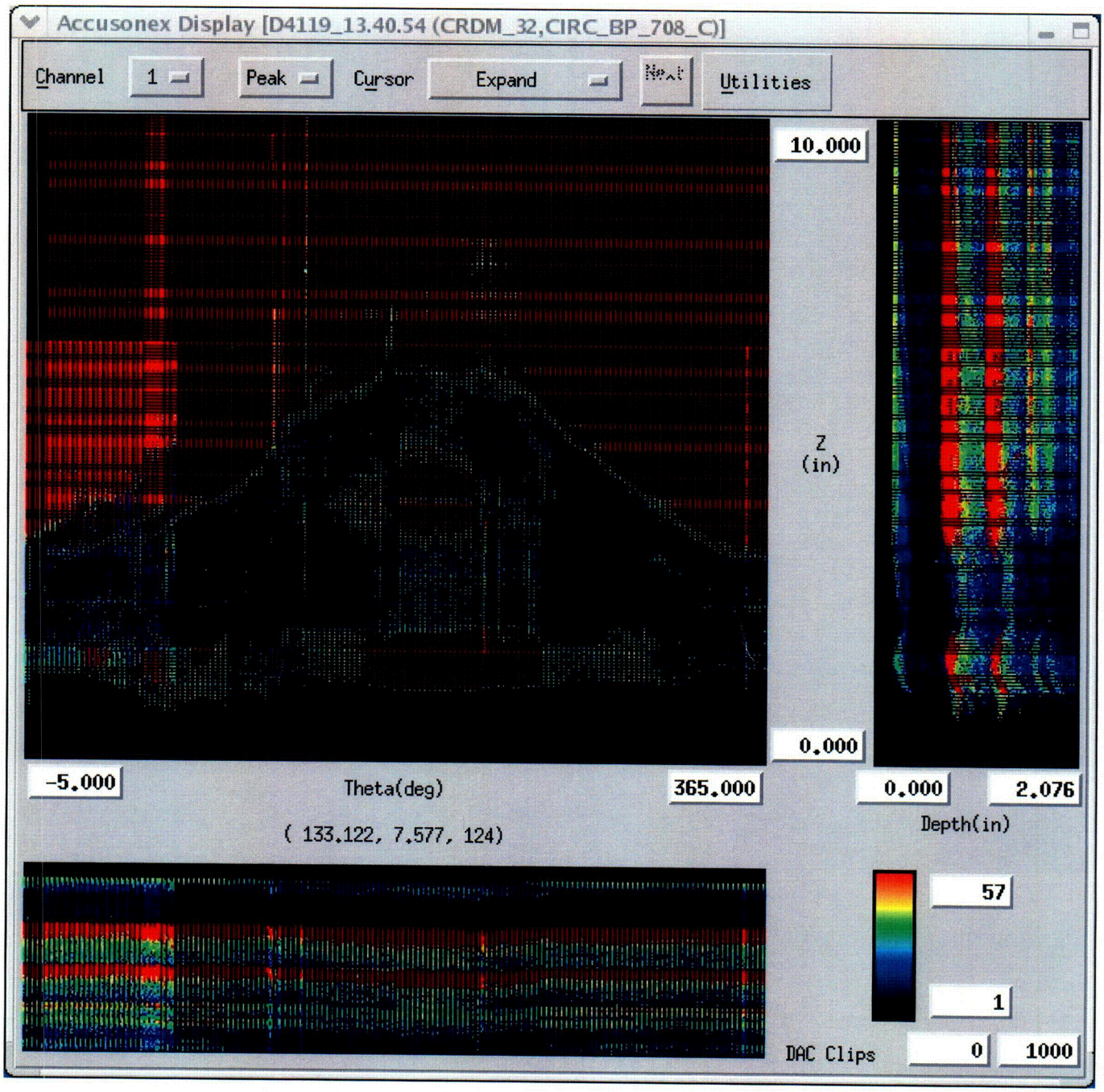
Examination & Calibration Hyperlinks (for electronic version only)

Examination:

Calibration:

AREVA

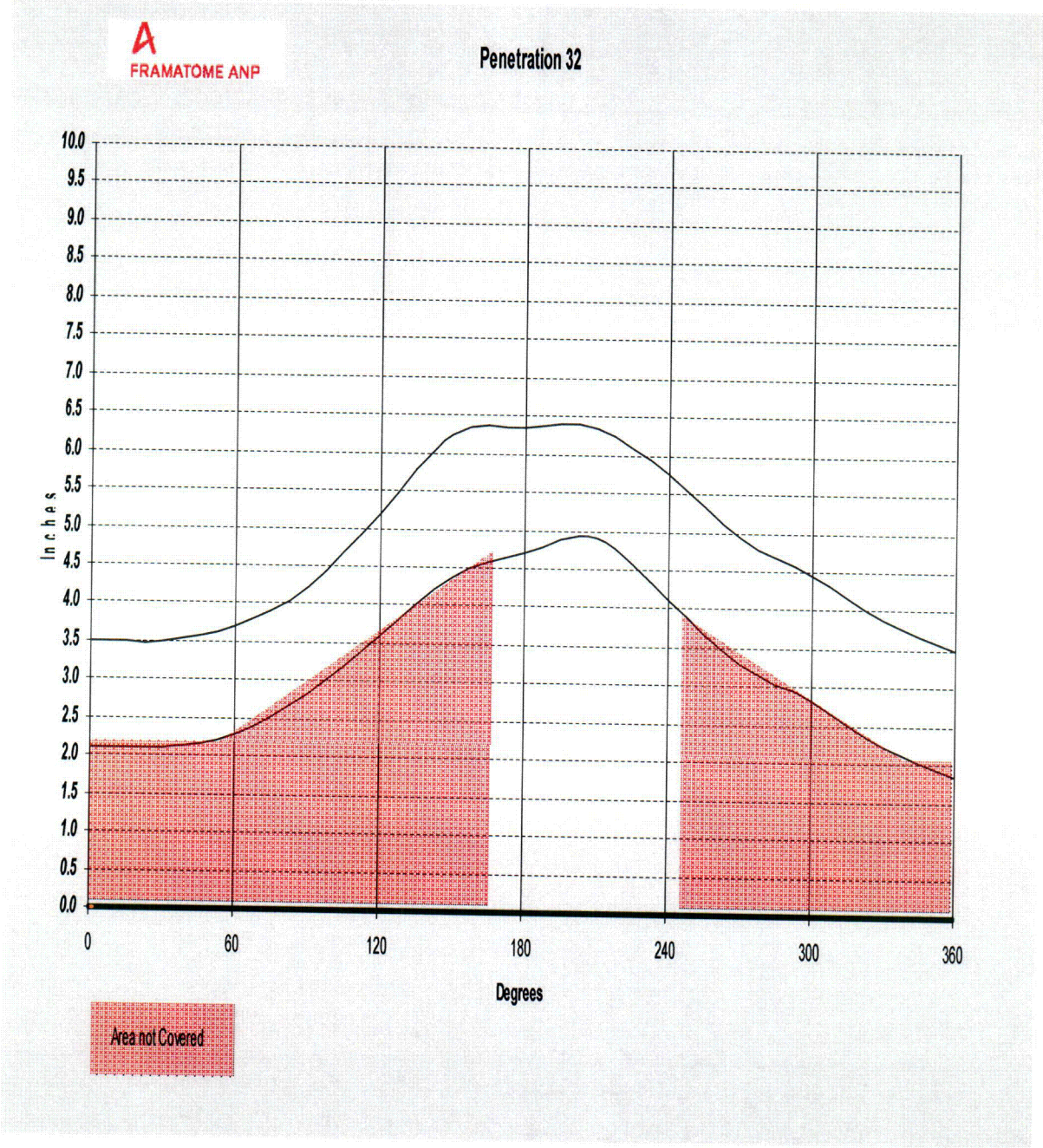
RVH Penetration No. 32 C-Scan UT Data Image



C03

AREVA

RVH Penetration No. 32 Coverage Plot



C04

AREVA

BLADE PROBE / ROTATING UT DATA SHEET

RVH Penetration Number: 33	***RVH Penetration Type:*** ☒-CRDM ☐-CEDM ☐-ICI ☐-Vent-Line

Utility : Nuclear Management Corporation **Plant:** Point Beach **Unit:** 1 **Outage:** U1R28

Procedure No: 54-ISI-100-11 **Procedure Title -** Remote Ultrasonic Examination of Reactor Vessel Head Penetrations

Essential Equipment Description

UT System Make / Model	S/N	VH#	Cal. Due Date	Remote Pulser / Receiver	
RD Tech / Micro-Tomo	63592	8168	01/16/2005	VH# N/A	Cal. Due: N/A

UT Cable Type / Length:	RG174 / 50 ft.	RG58 / 0 ft.	**No. of Connectors:** 2
UT Data Acquisition / Version:	ACCUSONEX™ Data Acqusition / Calibration Version		6.5 / 6.5 (Acq. / Cal.)
UT Data Analysis / Version:	ACCUSONEX™ Data Analysis Software / Version		3.13

Calibration or Nozzle Scan Information:

Scan File Information:	**Total Number of Files:** 3		
File Name(s):	D4119_14.38.43	D4120_00.01.22	
A4123_00.41.28			
Scan Start Θ	-5 °	**Scan End Θ**	+365 °
Scan Start "Z"	0.0 in.	**Scan End "Z"**	9.50 in.
Θ Increment:	2.75 °	**Sync. Value:**	0.05 "
Blade Probe Offset Value:	N/A		

Rotating / Blade Probe Calibration Information:

Calibration Setup No.:	3
Initial Calibration File:	D4119_01.32.40 (Blade 708)
Initial Calibration File:	D4119_19.23.14 (Blade 721)
Calibration Block ID:	02-5032568E01
Calibration Temperature:	N/A °F
RVH Examination Temp.:	N/A °F
Pyrometer S/N or VH No.:	N/A
Pyrometer Cal. Due Date:	N/A

Examination Coverage

Axial Extent Above Up-Hill Weld Root:	**2.57"**
Axial Extent Below Low-Hill Weld Toe[1]:	**N/A**
[1]If Axial Extent Below Low-Hill Weld Toe < 1.0", Number of Degrees this Condition Exists:	**N/A**
Up-Hill Weld Root to Interference Fit Region:	**N/A**

J-Groove Weld Search Unit Parameters

Transducer Manufacturer	Couplant
AREVA SAS	De-Mineralized Water

☐ Rotating Inspection Head ☒ Blade Probe TOFD

Chan.	Angle / Direction / Freq.	DB No. / Model
1	Circ. Blade TOFD / Axial / 5.0	SO708 / CN
1	Circ. Blade TOFD / Axial / 5.0	SO721 / CN
1	Circ. Blade TOFD / Axial / 5.0	SO718 / CN
N/A	N/A	N/A N/A
N/A	N/A	N/A N/A
N/A	N/A	N/A N/A
N/A	N/A	N/A / N/A
N/A	N/A	N/A / N/A

Examination Results

Data Sheet Intended For:

☒ ***UT Examination Data***	☐ ***UT Calibration Data***
☒ No Flaws Detected	☐ Initial Calibration
☐ Axial Flaws Detected	☐ Calibration Verification
☐ Circ. Flaws Detected	☐ Final Calibration

Leak Path Assessment Possible ☒ - Yes ☐ - No

☐ Leak Path Detected Flaw Report No. N/A

Remarks: Initial Calibration File for Blade Probe SO718CN is D4120_23.04.31

Limited UT examination coverage;

- Above weld root coverage equals 83% (300°)
- Weld region coverage equals 83% (300°)
- Below weld region coverage equals 15% (57°)

Note 1: No final calibration performed due to blade probe failure; Probe function was acceptable prior to failure.

Analyzed By:	Pierre Wanders	**Level:**	II	**Date:**	05/02/2004
Reviewed By:	Kent C. Gebetsberger	**Level:**	III	**Date:**	05/02/2004

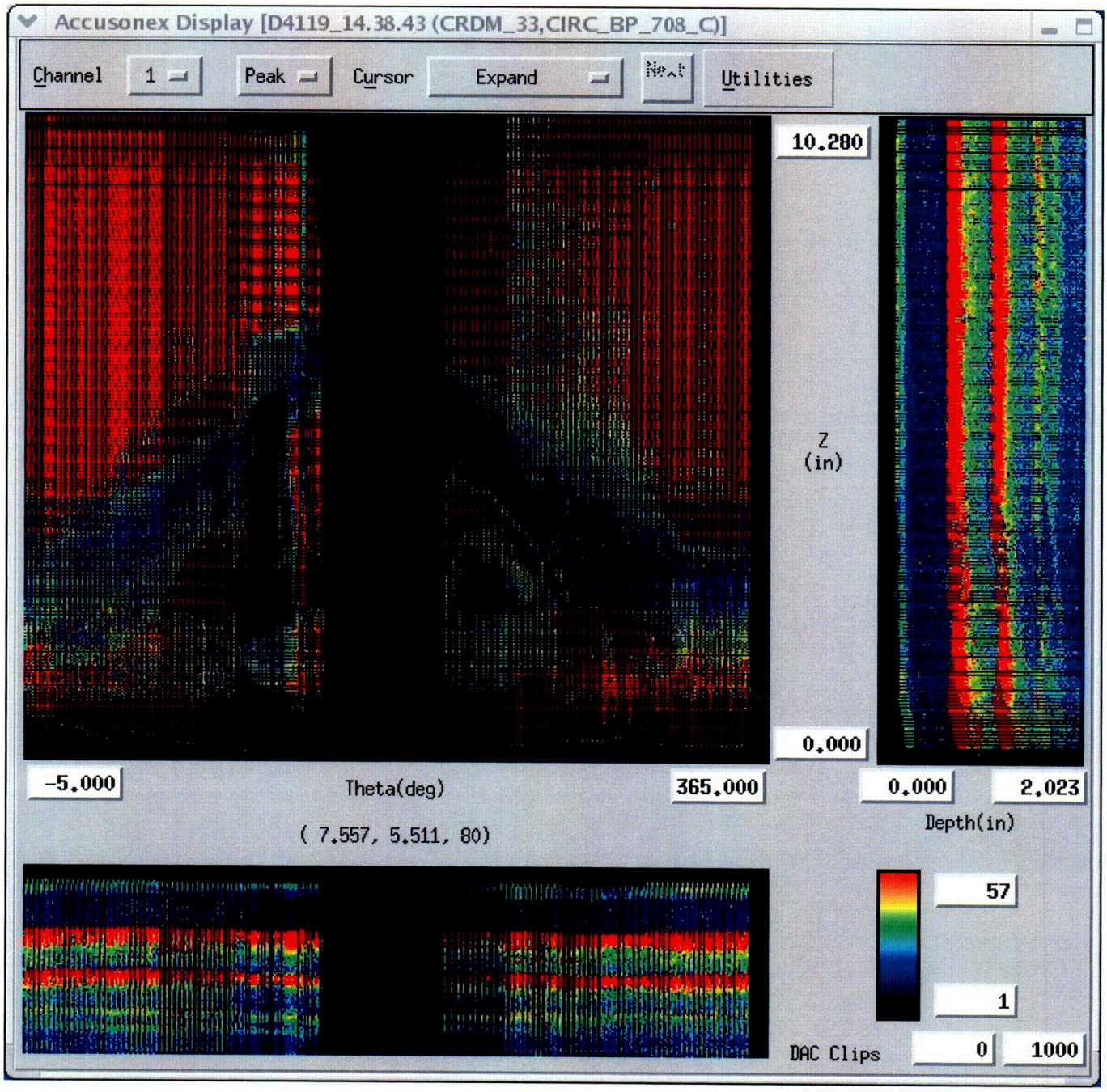
Examination & Calibration Hyperlinks (for electronic version only)

Examination:

Calibration:

AREVA

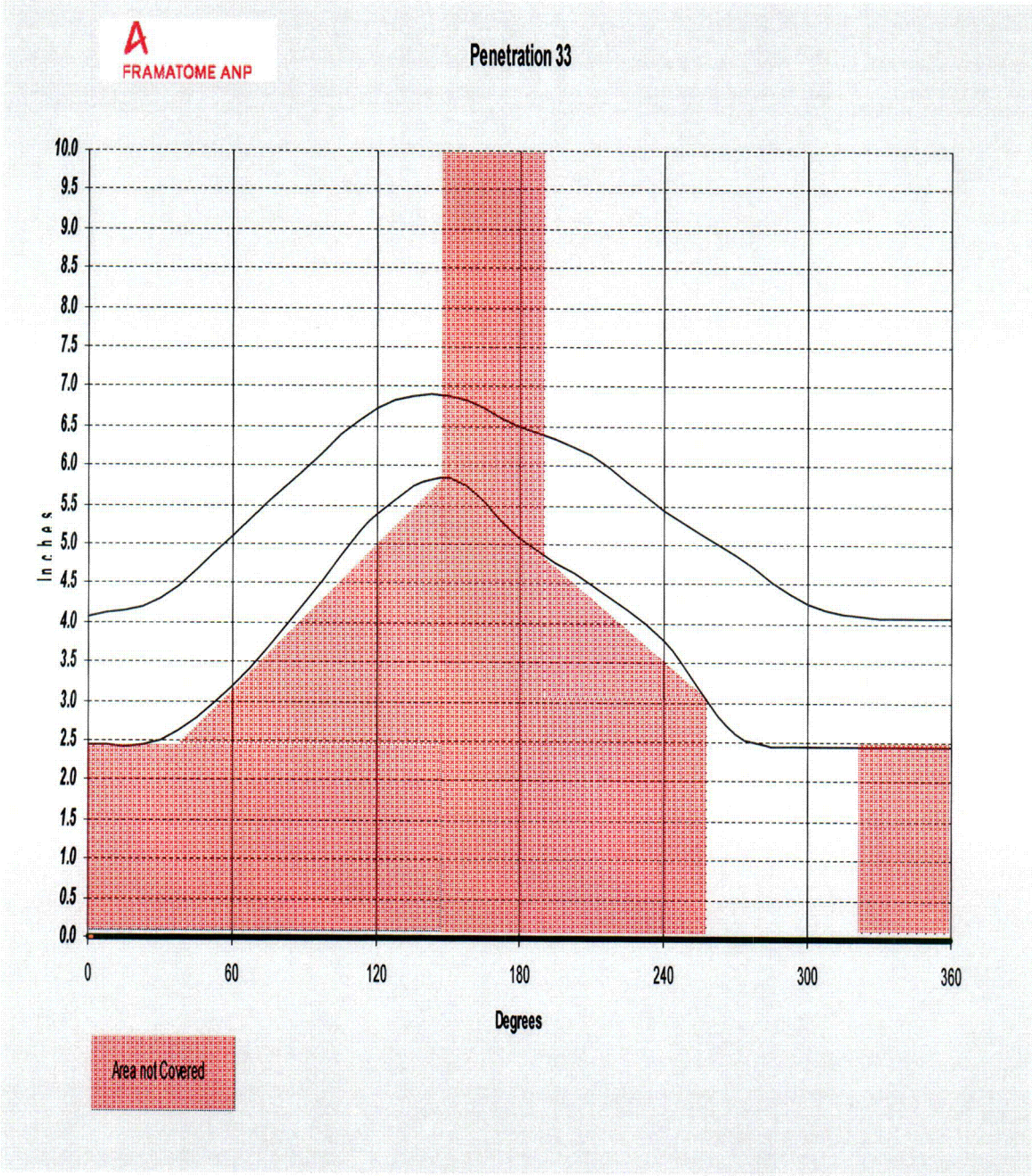
RVH Penetration No. 33 C-Scan UT Data Image



C05

AREVA

RVH Penetration No. 33 Coverage Plot



C06

ENCLOSURE IV

NRC ORDER EA-03-009 RELAXATION REQUEST SUPPLEMENT

STRUCTURAL INTEGRITY ASSOCIATES CALCULATION PBCH-09Q-310
ASSESSMENT OF NOZZLE STRESSES

STRUCTURAL INTEGRITY Associates, Inc.	CALCULATION PACKAGE	FILE No.: PBCH-09Q-310 PROJECT No.: PBCH-09Q

PROJECT NAME: Point Beach Unit 1 CRDM Top Head Analysis

CLIENT: Nuclear Management Company, LLC (Point Beach U1)

CALCULATION TITLE: Assessment of Nozzle Stresses

Document Revision	Affected Pages	Revision Description	Project Mgr. Approval Signature & Date	Preparer(s) & Checker(s) Signatures & Date
0	1-12	Initial Issue	H. L. Gustin 04/14/04	C. R. Limpus 4/14/04 B. P. Templeton 4/14/04
1	1-12	Modified plots to use Outer Diameter Node as reference for inner diameter stresses.	H. L. Gustin 04/15/04	C. R. Limpus 4/15/04 B. P. Templeton 4/15/04

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1.0 INTRODUCTION

The purpose of this calculation is to evaluate the nozzle stresses for the Point Beach Unit 1 top head CRDM penetrations. This calculation extracts the hoop stresses along the inner and outer diameter surfaces of the CRDM tube as a function of height beginning below the J-groove weld region. The stresses are extracted for the downhill and uphill sides for each of the four (4) CRDM configurations (i.e., 0°, 9.6°, 28.2°, and 43.5° azimuths). This assessment is done with the stress analysis results performed by Dominion Engineering, Inc. (DEI) [1] specifically for the residual plus operating stress load step.

2.0 METHODOLOGY

For each CRDM azimuth, the nodal file listing and results file listing were used from [1] to produce the residual plus operating hoop stress as a function of height along the tube surface. Load step for the residual plus operating stresses is at Time=4004 per [1]. The DEI analysis assumed a nozzle material yield strength of 60 ksi. The following files were used from the DEI analysis [1]:

0° CRDM : PB1-0A.nodelocs.txt and PB1-0A.results.txt
9.6° CRDM : PB1-9A.nodelocs.txt and PB1-9A.results.txt
28.2° CRDM : PB1-28A.nodelocs.txt and PB1-28A.results.txt
43.5° CRDM : PB1-43A.nodelocs.txt and PB1-43A.results.txt

The following node numbers are used for each CRDM per Figure 5-1 of [1]:

Table 1: Node Numbers per [1]

Tube Side	Tube Surface	Node Numbers	Node Location
Downhill (-90°)	Inner Diameter	1, 101, 201, 301, 401, 501, 601	Tube Bottom (1) and Tube Top Connected to Top Head (601)
	Outer Diameter	5, 105, 205, 305, 405, 505, 605	Tube Bottom (5) and Tube Top Connected to Top Head (605)
Uphill (90°)	Inner Diameter	80001, 80101, 80201, 80301, 80401, 80501, 80601	Tube Bottom (80001) and Tube Top Connected to Top Head (80601)
	Outer Diameter	80005, 80105, 80205, 80305, 80405, 80505, 80605	Tube Bottom (80005) and Tube Top Connected to Top Head (80605)

3.0 RESULTS

The node locations and stress results (Time = 4004) were obtained from the files of the DEI analysis [1]. Figures 1 through 7 depict the residual plus operating hoop stress as a function of height along a tube surface for the downhill and uphill sides of all four CRDMs of Point Beach Unit 1. Only the 0° azimuth CRDM has one side, downhill side is equivalent to uphill side. These results are contained in EXCEL files PBCH_U1-#A_20K_Limit.XLS, where "#" refers to the CRDM azimuth.

Each plot denotes the nodes at the tube bottom and the tube top connected to the top head and below the J-groove weld. For the inner and outer surface of the tube, a length dimension is approximated from the tube top node number for where the hoop stress is at 20.0 ksi. This is done with the outer diameter (OD) node as the reference since the location is readily accessible for inspection as compared to the inside diameter (ID) node location. A vertical bar is shown on the plot indicating the location. The hoop stress is interpolated for a location that is 1 inch below the OD tube top node location as well.

The 20.0 ksi stress limit information provided in the plots with respect to CRDM inspections is in accordance with the report by Materials Reliability Program – Generic Evaluation of Examination Coverage Requirements for Rector Pressure Vessel Head Penetration Nozzles (MRP-95) [2]. This calculation establishes the 20.0 ksi stress limit criteria (i.e., distance below the weld where 20.0 ksi stress is reached) for both the ID and OD surface hoop stress components to define the prudent inspection zone below the J-groove weld region. Details of this methodology are contained in Section 3 of Reference [2].

The plots are comparable to Figures 5-2 through 5-5 of [1].

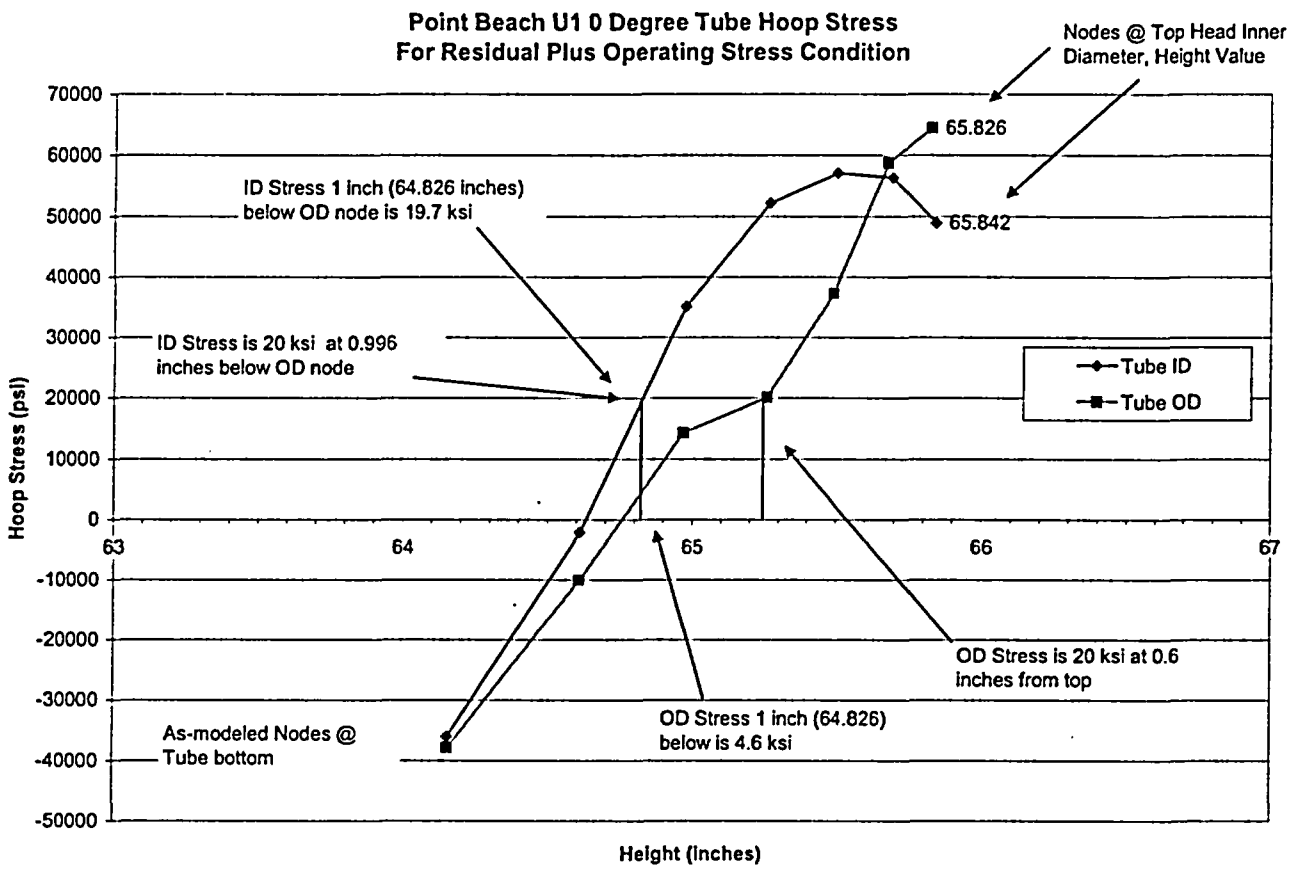

Figure 1: 0° Azimuth Hoop Stress

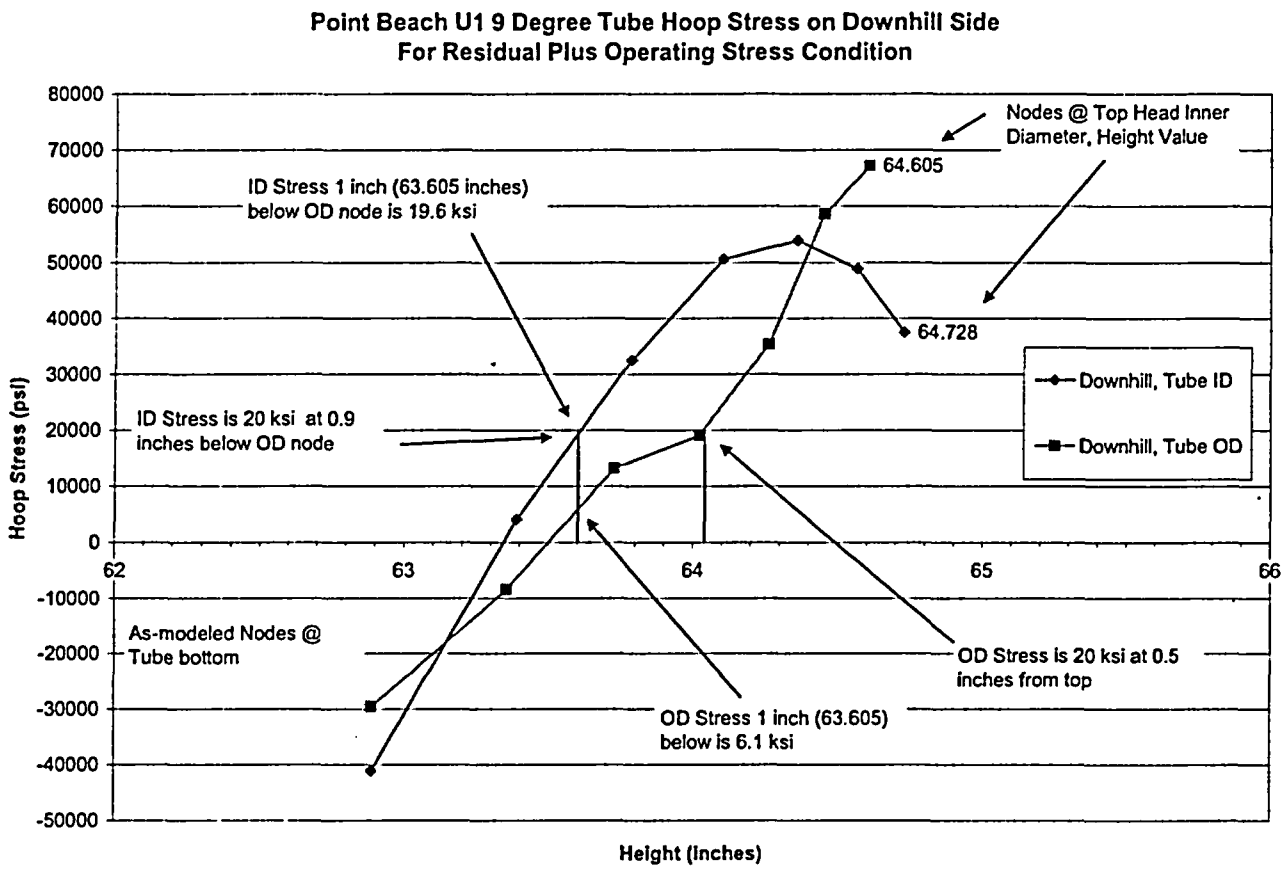

Figure 2: 9.6° Azimuth Hoop Stress for Downhill Side

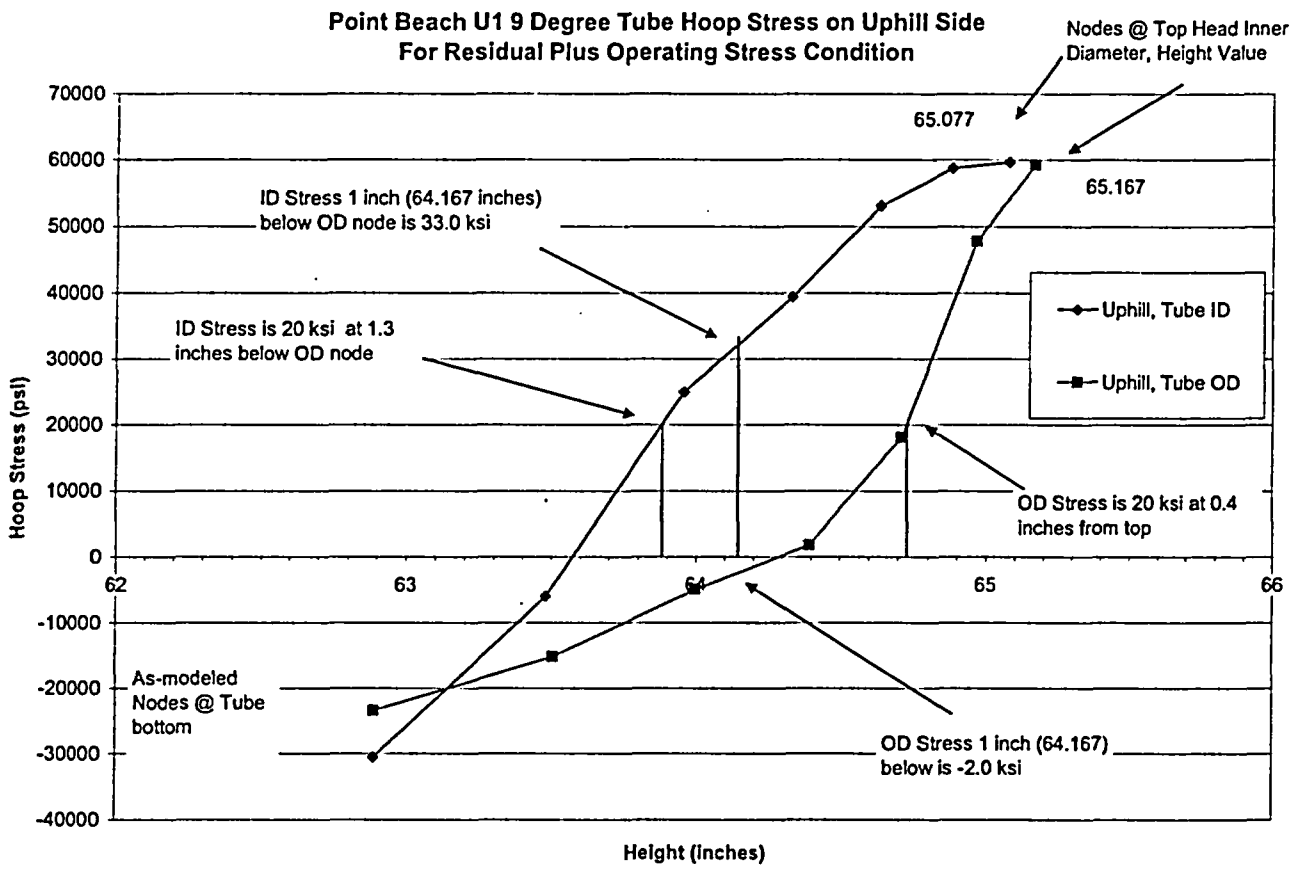

Figure 3: 9.6° Azimuth Hoop Stress for Uphill Side

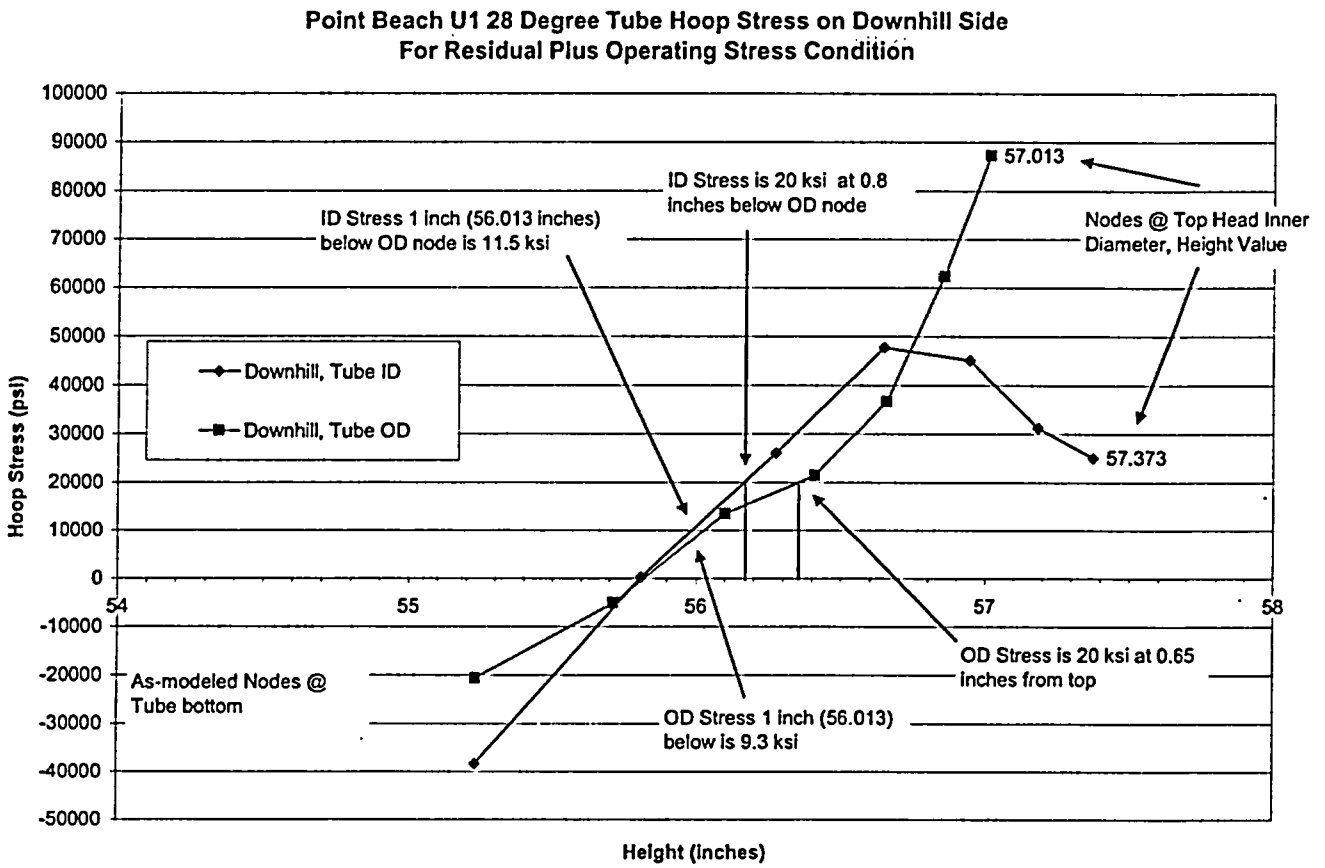

Figure 4: 28.2° Azimuth Hoop Stress for Downhill Side

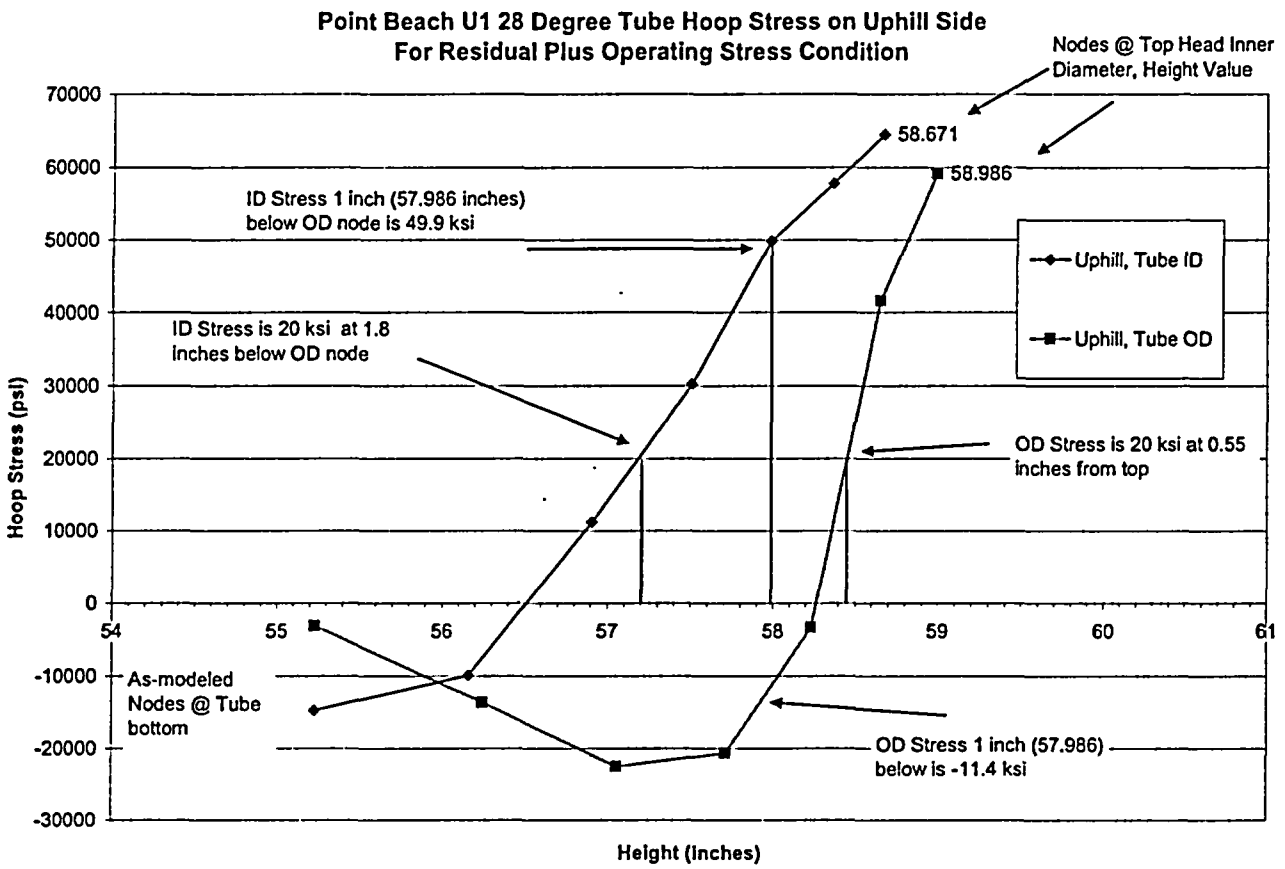

Figure 5: 28.2° Azimuth Hoop Stress for Uphill Side

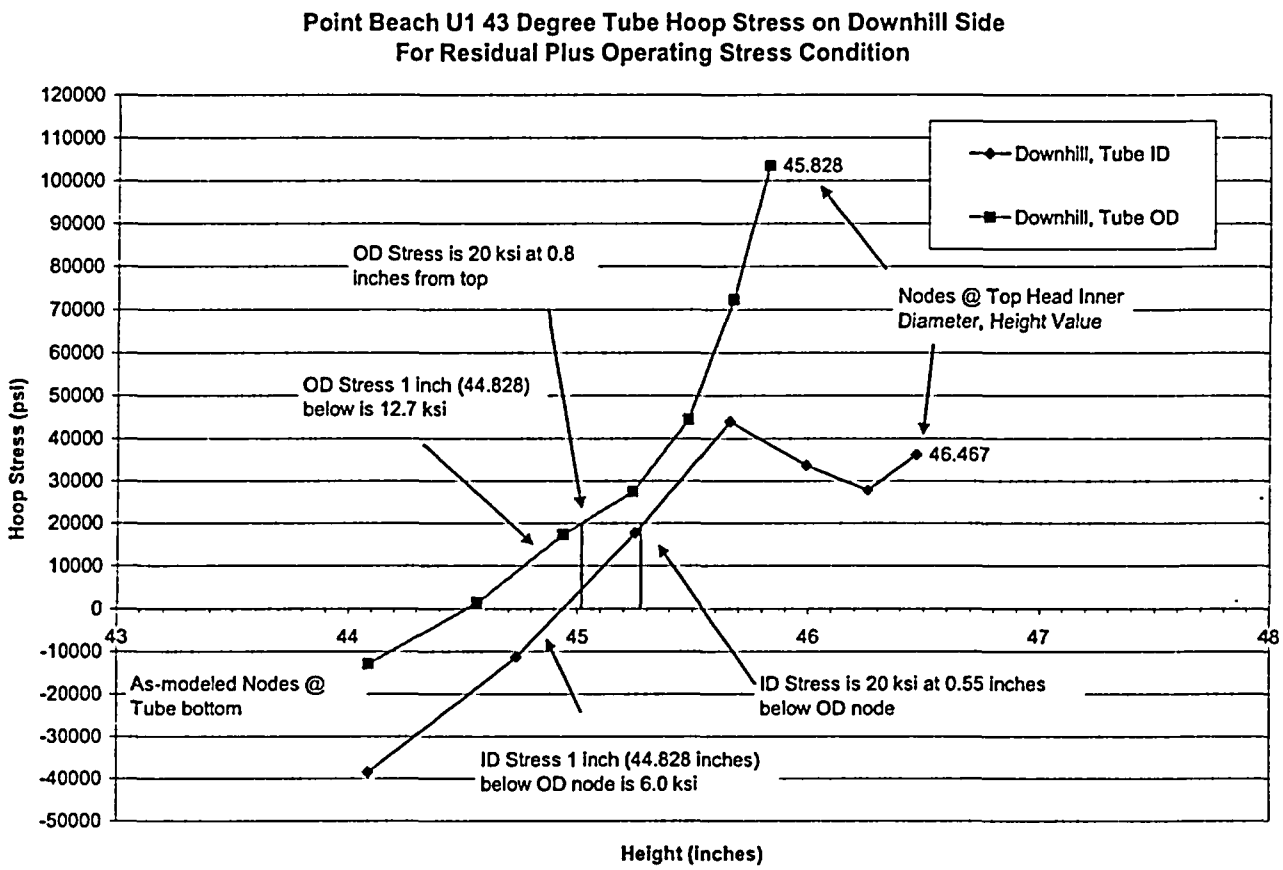

Figure 6: 43.5° Azimuth Hoop Stress for Downhill Side

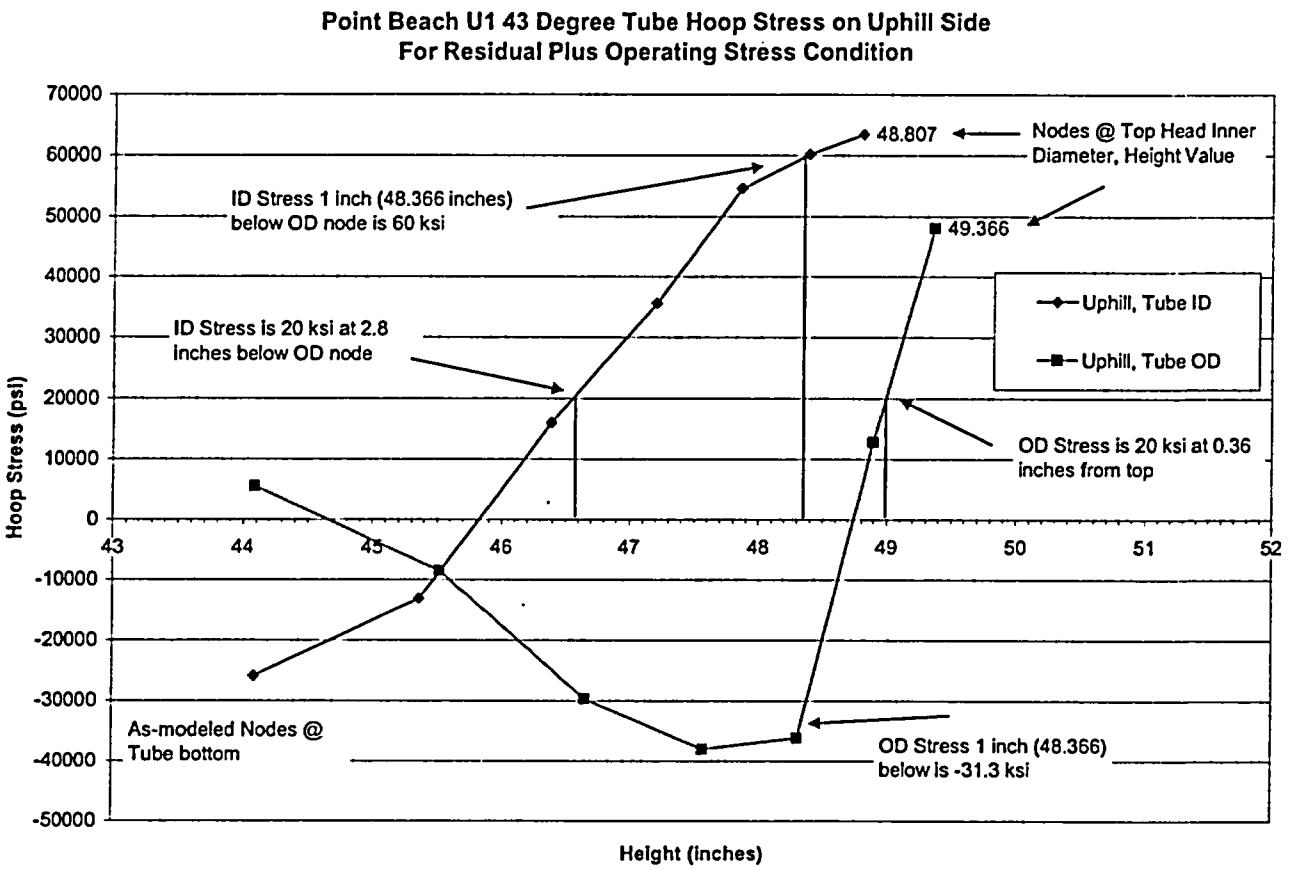

Figure 7: 43.5° Azimuth Hoop Stress for Uphill Side

4.0 REFERENCES

1. Dominion Engineering, Inc. Calculation No. C-4430-00-1, "Point Beach Unit 1 CRDM Stress Analysis," Revision 1, 12/08/2003, SI File No. PBCH-09Q-203.

2. Electric Power Research Institute Topical Report No. 1009129, "Materials Reliability Program: Generic Evaluation of Examination Coverage Requirements for Reactor Pressure Vessel Head Penetration Nozzles (MRP-95)," EPRI, Palo Alto, CA: 2003.