ESR 95-00765 EVALUATION - REVISION 2

UNIT 1 CORE SHROUD EVALUATION
BASED ON B110R1 INSPECTION RESULTS

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EXECUTIVE SUMMARY

PURPOSE

This ESR Evaluation is required as part of CP&L's commitment to USNRC Information Notice 93-79, "Core Shroud Cracking at Beltline Region Welds in Boiling Water Reactors." As such, this evaluation accomplishes the following:

1) Documents the In-Vessel Visual Inspections (IVVI) performed on the Core Shroud during Refueling Outage (RFO) B110R1.

2) Evaluates the current IVVI data relative to previous inspection results and analyses.

3) Provides justification to use the Core Shroud for a minimum of another two (2) operating cycles in the as-found condition. [i.e. concludes that BNP-1 can safely operate in the present condition during the next two fuel cycles (Cycle 10 and Cycle 11) without any operational changes or restrictions.]

BACKGROUND

In October, 1990, RICSIL No. 054 reported cracking near the circumferential seam weld at the core beltline area of the shroud in a GE BWR/4 located outside the United States. Based on recommendations contained in this RICSIL, the BNP Unit 1 shroud was inspected in July, 1993, and a near 360° circumferential crack was confirmed on the inside diameter of the Top Guide Support Ring, at the weld to the shroud mid-section. EER 93-0536 (Reference 3) was issued in 1993 to assess Unit 1 shroud structural integrity.

CONCLUSIONS

The BNP-1 Refueling Outage (RFO) B110R1 Core Shroud inspections are complete and evaluated in this ESR. This ESR concludes that structural integrity of the core shroud will be maintained, with full FSAR safety margins, for at least the next two fuel cycles (currently scheduled to end in April, 1998), based on analysis of the inspection results. Future inspection plans will consider not only these inspection results, but will also consider continuing developments in the industry, to ensure utilization of the best information and technology to address the issue.

Crack growth experienced during Cycle 9 was substantially less than postulated by previous analysis. The inspection results from B110R1 show that the existing condition is essentially unchanged from the condition identified during the B109R1 outage. Furthermore, the postulated crack lengths at the end of Cycles 10 and 11 are fully bounded by previous analyses and will not reduce the structural design margins below allowable values. Therefore, the condition of the core shroud does not impose any restrictions to BNP-1 operation during the next two cycles.

The BNP-1 Core Shroud is "acceptable as is" for Operating Cycles 10 and 11.

EVALUATION

DESIGN INPUTS

1. American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Section XI, 1980 Edition through Winter 1981 Addenda

2. Technical Specifications for Brunswick Steam Electric Plant Unit 1

3. UT and IVVI Inspection data from BNP-1 Refueling Outages 8 (B109R1) and 9 (B110R1)

SHROUD DESIGN

The reactor pressure vessel (RPV) was designed in accordance with applicable portions of Section III of the ASME Boiler and Pressure Vessel Code (B&PV Code), 1965 Edition through Summer, 1967 Addenda (Reference 2). Although the shroud itself is not a Code component, the B&PV Code was used as the design basis for determining limits for stress intensities.

The core shroud is a cylindrical assembly inside the reactor vessel, which provides a partition to properly distribute the flow of coolant delivered to the vessel. The safety design basis of the shroud is to:

a) Provide a floodable volume in which the core can be adequately cooled in the event of a breach in the nuclear system process barrier external to the reactor vessel.

b) Limit deflections and deformations of the reactor vessel internals to assure that the control rods and the core standby cooling systems can perform their safety functions during abnormal operational transients and accidents.

c) Assure that the safety design bases (1) and (2) above are satisfied so that the safe shutdown of the plant and removal of decay heat are not impaired.

The core shroud is composed of three regions: an upper shroud which is bounded by the shroud head and the top fuel guide; a central region which surrounds the fuel; and a lower region which surrounds the lower plenum and is welded to the reactor vessel shroud support ring. The three regions are of different diameters: the top region is approximately 15'-9" diameter; the central region is approximately 14'-9"; and the lower region is tapered from 14'-9" to 14'-3" (see Figures 1 and 2, and Reference 1). Roll out maps of the core shroud depicting the locations of horizontal welds H1-H9, vertical welds V1-V11, and plates P1-P11 are shown in Figures 3 and 4. The weld and plate designations were assigned for inspection purposes. A plan view at the top of the shroud, depicting the 36 sets of shroud head bolt lugs is shown in Figure 5.

The upper shroud consists of the separator support ring, the upper shroud cylindrical shell, and the top guide support ring. The separator support ring is constructed from 6 ring segments having a cross section of approximately 6" X 6", cut from rolled and annealed plate, welded together, then machined to final dimensions. The separator support ring material is Type 304 stainless steel from a single heat, with a carbon content of 0.078 wt%. Thirty-six pairs of shroud bolt hold down lugs are welded to this ring. This assembly is joined to the upper shroud shell at weld H1, which consists of a Double-J prep weld with a fillet on the inside. The shell is formed from (2) 1½" thick semicircular plates, welded together using a Double-U prep. The carbon contents range from 0.049 - 0.060 wt%. The Top Guide Support Ring, with a cross section of 7½" X 3", is constructed and welded (H2) to the upper shroud shell in a manner similar to the separator support ring. The ring material has a carbon content range of 0.063 - 0.064 wt%. The 6 ring segments were fabricated from two heats of material. These welds are oriented such that the axial residual stresses pull across the short transverse orientation (end grain) of the ring material.

The central region of the shroud consists of the mid-shroud barrel, the core support ring, and adjoining welds. The barrel is formed in the same manner as the upper shroud shell, but consists of three cylindrical sections joined together at welds H4 and H5. Carbon contents range from 0.048 - 0.064 wt%. The mid-shroud barrel is welded to the upper shroud assembly at H3, which consists of a Single-J prep weld from the inside, with a back gouge and a fillet reinforcement on the outside. It is welded to the core support ring at H6a, which is a Double-J prep weld with a fillet reinforcement on the inside. The core support ring is similar to the separator and top guide support rings, and has a carbon content range of 0.063 - 0.067 wt%. The 6 ring segments were fabricated from 2 heats of material.

The lower region of the shroud consists of the lower shell course, shroud support ring, jet pump diffuser ring, and associated welds. The lower shell course is formed from (3) 1½" thick plates welded together using Double-U prep welds to form a conical section. Carbon contents range from 0.053 - 0.058 wt%. It is joined to the core support ring at weld H6b, which is similar to H6a. The shroud support ring, which transfers the shroud weight and other loads to the reactor vessel, is 2" thick Inconel Alloy 600. The lower shell course is joined to the shroud support ring using a bimetallic Single Bevel prep weld with a backing ring on the outside (H7). The jet pump diffuser ring is also made of Inconel Alloy 600, and is joined to the shroud support ring at H8, and to the reactor vessel wall at H9. H8 and H9 are Double-J prep welds with fillet reinforcements.

Refer to Table 1 and Figure 6 for shroud weld and materials details.

TABLE 1 - SHROUD WELD DETAILS

COMPONENT DESCRIPTION and WELD NUMBER	PIECE NUMBERS and WELD PREP	MATERIAL and CARBON WT%	COMMENTS
UPPER SHROUD			
SEPARATOR SUPPORT RING (SSR)	Piece 5*	304 SS 0.078 wt%	SSR assembled from six plate segments, welded with 308 SS Double-U welds
WELD H1	Double-J; Fillet on ID	308 SS	ID welded first, OD back-chipped, then welded
UPPER SHROUD SHELL COURSE	Piece 1*	304 SS 0.049 - 0.060 wt%	Assembled from 2 rolled plates, welded together by 308 SS Double-U welds V1 and V2
WELD H2	Double-J; Fillet on ID	308 SS	ID welded first, OD back-chipped, then welded
TOP GUIDE SUPPORT RING (TGSR)	Piece 6*	304 SS 0.063 - 0.064 wt%	TGSR assembled from six plate segments, welded with 308 SS Double- U welds
WELD H3	Single-J on ID; Fillet on OD	308 SS	ID welded first, OD back-chipped, then welded
MID-SHROUD BARREL			
MID-SHROUD TOP SHELL COURSE	Piece 2* (Upper)	304 SS 0.056 wt%	Assembled from 2 rolled plates, welded together by 308 SS Double-U welds V3 and V4
WELD H4	Double-J	308 SS	One of last two welds made to assemble shroud.
MID-SHROUD MIDDLE SHELL COURSE	Piece 3*	304 SS 0.050 - 0.064 wt%	Assembled from 2 rolled plates, welded together by 308 SS Double-U welds V5 and V6
WELD H5	Double-J	308 SS	One of last two welds made to assemble shroud.
MID-SHROUD LOWER SHELL COURSE	Piece 2* (lower)	304 SS 0.048 - 0.058 wt%	Assembled from 2 rolled plates, welded together by 308 SS Double-U welds V7 and V8
WELD H6a	Double-J; Fillet on ID	308 SS	

* Sun Shipbuilding & Dry Dock Fabrication piece reference numbers.

TABLE 1 - SHROUD WELD DETAILS			
COMPONENT DESCRIPTION and WELD NUMBER	**PIECE NUMBERS and WELD PREP**	**MATERIAL and CARBON WT%**	**COMMENTS**
CORE SUPPORT RING (CSR)	Piece 7*	304 SS 0.063 - 0.067 wt%	CSR assembled from six plate segments, welded with 308 SS Double-U welds
WELD H6b	Double Bevel; Fillet on ID	308 SS	
LOWER SHROUD			
LOWER SHROUD TAPERED SHELL COURSE	Piece 4*	304 SS 0.053 - 0.058 wt%	Assembled from 3 rolled plates, welded together by Double-U welds V9, V10, V11
WELD H7	Single Bevel on ID; Fillet Welded Backing Ring on OD	Alloy 82 root Alloy 182 filler	Gas Tungsten Arc Welded (GTAW) Root; Shielded Metal Arc Welded (SMAW) Fill
SHROUD SUPPORT RING (SSR)	N/A	Alloy 600	Plate thickness is 2.0".
WELD H8	Double-J with Fillets	Alloy 82 root Alloy 182 filler	GTAW root. SMAW fill.
JET PUMP DIFFUSER RING	N/A	Alloy 600	Plate thickness is 2.5".
WELD H9 (attaches Jet Pump Diffuser Ring to Reactor Vessel)	Double-J with Fillets	Alloy 82 root Alloy 182 filler	GTAW root. SMAW fill.

* Sun Shipbuilding & Dry Dock Fabrication piece reference numbers.

SHROUD FABRICATION AND INSTALLATION

The core shroud was designed by General Electric and fabricated by Sun Shipbuilding & Dry Dock Company from January 1970 to November 1971. The core shroud was installed in February 1974, with fit-up and welding provided by Brown & Root. CP&L has performed a detailed review of the fabrication and installation records (Reference 1). No significant fabrication or installation details were discovered that would indicate any material conditions unique from standard practice at the time of fabrication and installation.

The weld material was 308 SS for circumferential welds H1, H2, H3, H4, H5, H6a, and H6b and vertical welds V1 - V11 and the Submerged Arc Welding (SAW) and/or Shielded Metal Arc Welding (SMAW) processes were used. Welds H7, H8, and H9 were made using Inconel 82 and Inconel 182 filler materials and the Gas Tungsten Arc Welding (GTAW) and SMAW methods.

CAUSAL FACTORS

The factors that affect IGSCC and their relation to the core shroud are detailed in EER 93-0536, Revision 1 (Reference 3). This evaluation considered water chemistry, shroud materials and fabrication techniques, and critical hours of operation. Cracking histories of other components were also considered.

INSPECTION RESULTS

Inspections of various components within the reactor are routinely performed each refueling outage in accordance with the requirements of ASME Code Section XI, vendor recommendations, and the plant In-Service Inspection (ISI) Program.

RFO B109R1

The inspection plan for RFO B109R1 was based on the experience and observations from other BWRs and the current understanding of the causal factors contributing to the cracking. Accordingly, the initial inspection plan provided extensive inspections for the regions where the most cracking had been observed (above the core plate (H1-H5) where neutron fluence and the oxidizing environment are most prominent), and sampled the regions where little or no cracking was present (below the core plate (H6-H9) and vertical welds). Evaluation and screening was performed in accordance with GENE-523-123-0993, Revision 2, "Evaluation and Screening Criteria for the Brunswick 1 Shroud Indications," dated 11/93 (Reference 5). Visual examinations involved cleaning the weld areas to remove surface film which might hinder detection of very tight indications. The distance to the shroud surface for visual examinations was established to discern a 1 mil wire (0.001 inch diameter) in order to ensure detection of tight cracks.

Table 2 provides a summary account of the inspection findings. Reference 8 contains the specific Inservice Inspection results.

TABLE 2 - UNIT 1 RFO B109R1 DETAILED INSPECTION RESULTS		
WELD	**RESULTS**	
H1	**VISUAL INSPECTIONS:**	100% of OD and ID surfaces were inspected. The cracks are long but not continuous. Primary orientation is circumferential, located on the OD, mainly below the bolting lugs in the Separator Support Ring. Approximately 268° of the circumference (74%) has cracking. No consistent cracking pattern exists, except for some branching associated with attachment welds. Cracks have been found only on the outer surface.
	UT INSPECTIONS:	Measurements made at 8 locations. Depths range from < 0.3" to 0.7".
H2	**VISUAL INSPECTIONS:**	100% of OD was inspected. ID is not accessible. The cracks in the Top Guide Support Ring are long but not continuous. Approximately 224° is cracked on the OD (62%). The cracks above the weld are small.
	UT INSPECTIONS:	Measurements made at 4 locations. Depths range from <0.3" to 0.75".
H3	**VISUAL INSPECTIONS:**	100% of OD and ID surfaces were examined. The crack is 360° around the inside of the Top Guide Support Ring, except for gaps at some of the Top Guide Support Ring's radial welds and some of the eccentric aligner plate welds. The crack opening is more pronounced than for other cracks. The crack is approximately 1/16" from the toe of the weld.
	UT INSPECTIONS:	Measurements made at 11 locations. Depths range from 0.95" to 1.71".
H4	**VISUAL INSPECTIONS:**	100% of the ID and 45% of the OD were examined. Jet pumps prevented access to the remaining OD areas. Cracks are axially oriented (vertical). Cracks are located on both the OD and ID. Most of the cracks on the OD are located below the weld, while cracks on the ID are above the weld. Cracking is concentrated at horizontal and vertical weld intersections. The longest crack extends less than 5" from the toe of the weld. Plates P3 and P4 exhibited a uniform distribution of axial cracking on the inside surface.
	UT INSPECTIONS:	None performed.

TABLE 2 - UNIT 1 RFO B109R1 DETAILED INSPECTION RESULTS

WELD	RESULTS	
H5	VISUAL INSPECTIONS:	100% of the ID and 45% of the OD were examined. 5 of the cracks on the OD are circumferential, extending from 0.5" to 3" in length. The remaining cracks are axial, extending less than 9" from the toe of the weld. Long circumferential cracks (the longest is approximately 42.5") and short axial cracks (less than 4.5") appear on the inside surface.
	UT INSPECTIONS:	Baseline depth measurements taken in 2 locations to benchmark future inspections. Depth ranged from < 0.3" to 0.6".
H6a and H6b	VISUAL INSPECTIONS:	45% of the OD was examined, ID is not readily accessible. Only a few axial indications were found on the OD. The indications extend less than 3" from the toe of the weld.
	UT INSPECTIONS:	None performed.
H7	VISUAL INSPECTIONS:	17% of the OD was examined, ID is not readily accessible. No indications identified.
	UT INSPECTIONS:	None performed.
H8	VISUAL INSPECTIONS:	17% of the OD was examined from the top side of the weld. ID and bottom are not readily accessible. No indications identified.
	UT INSPECTIONS:	None performed.
H9	VISUAL INSPECTIONS:	17% of the circumference was examined from the top side of the weld. Bottom is not readily accessible. No indications identified.
	UT INSPECTIONS:	None performed.
V1 - V11	VISUAL INSPECTIONS:	100% of either the inside or outside surfaces of each vertical weld was examined. Additionally, the accessible portions of the other side were inspected. No indications were found on any vertical welds.
	UT INSPECTIONS:	None performed.
PLATES	VISUAL INSPECTIONS:	All accessible areas of the ID and OD were inspected. One indication was found on the inside of Plate 6, at mid-plate, between welds H4 and H5. The mid-plate indication is oriented approximately 20° from horizontal, and is about 6.0" long. No other plate indications were found.
	UT INSPECTIONS:	None performed.

TABLE 2 - UNIT 1 RFO B109R1 DETAILED INSPECTION RESULTS	
WELD	**RESULTS**
ATTACH-MENTS and COMPON-ENTS	**VISUAL INSPECTIONS**: Additional inspections performed include: - Top Guide Eccentric Pin and Brackets (4 locations) - Shroud Head Bolts (36 bolts) - Shroud Head Bolt Lugs (36 pairs on the Head and Shroud) - Shroud Guide Rod Bracket (0° and 180° azimuths) - Shroud Head Guide Pin Bracket (0° and 180° azimuth) - Manway Access Covers (0° and 180° azimuths) - Separator Support Ring Segment Welds (6 welds) - Top Guide Wedges (24 locations) - Top Guide Bolting (80 bolts around the periphery) - Top Guide Hold-Down Latches (4 locations) - Top Guide Support Ring Segment Welds (6 welds) INDICATIONS - 1 Eccentric Aligner Pin (180° location) - 5 Shroud Head Bolt Lugs (6 indications total in weld material) - 1 indication bottom of the Top Guide (running from a bolt hole to a dowel pin hole at the 180° location). UT INSPECTIONS: UT inspections were performed on the Manway Access Covers and no indications were noted. 9 Shroud Head Bolts were inspected and 7 found to be cracked.

RFO B110R1

The inspection plan was revised to exclude H2 and H3 since a qualified structural repair was performed during RFO B109R1. The plan was also modified to take advantage of weld specific analyses that had been performed - RAM-94-092/SIR-94-029, "Addendum to the Brunswick Unit 1 Screening Criteria" dated 4/6/94 (Reference 6); and RAM-94-099/SIR-94-031, "Minimum Required Unflawed Core Shroud Material at Brunswick, Units 1 and 2", dated 4/11/94 (Reference 7). Analysis indicated that the allowable length for an axial flaw exceeded the width of any of the plate material, so inspection of vertical welds was eliminated.

The inspection scope was structured to meet the intent of NRC Generic Letter 94-03, and focuses on three objectives:

1) Re-examination of selected areas to determine crack growth,

2) Examination of some of the installed clamps (spanning H2 and H3) to verify no inservice degradation, and

3) Utilization of specifically developed tooling to examine accessible portions of certain welds that could not be fully examined during RFO B109R1.

A summary of the inspection plan is presented in Table 3, below.

TABLE 3 - UNIT 1 RFO B110R1 CORE SHROUD INSPECTION PLAN SUMMARY		
WELD	**INSPECTION METHOD AND SCOPE**	
H1	**VISUAL INSPECTIONS:**	None
	UT INSPECTIONS:	Inspect four of eight areas previously UT'd in RFO B109R1. Inspections to be performed from the OD.
H2	No inspections scheduled. Clamps installed during RFO B109R1.	
H3	No inspections scheduled. Clamps installed during RFO B109R1.	

TABLE 3 - UNIT 1 RFO B110R1 CORE SHROUD INSPECTION PLAN SUMMARY		
WELD	**INSPECTION METHOD AND SCOPE**	
H4	Inspection not scheduled. No circumferential indications were identified during RFO B109R1 inspections, so sufficient structural margins exist. Any anticipated growth of axial indications would not impact structural margins. Results of H5 inspections will be considered since H4 and H5 are similar welds.	
H5	VISUAL INSPECTIONS:	Inspection of "punchmarked cracks" for length on ID.
	UT INSPECTIONS:	Reinspection of two (2) areas inspected during RFO B109R1 to determine crack growth.
H6a and H6b	VISUAL INSPECTIONS:	None scheduled.
	UT INSPECTIONS:	Inspect three (3) accessible areas between jet pumps. Inspections to be performed from the OD to look for ID-connected cracking.
H7	No inspections scheduled. Inspection tools/techniques being developed by BWRVIP.	
H8	No inspections scheduled. Inspection tools/techniques being developed by BWRVIP.	
H9	VISUAL INSPECTIONS:	None scheduled.
	UT INSPECTIONS:	100% of circumference scheduled.
V1 - V11	VISUAL INSPECTIONS:	None scheduled. The allowable axial flaw size determined by References 6 and 7 is greater than the widest plate. Therefore, the vertical flaws are bounded by analysis.
	UT INSPECTIONS:	None scheduled.
Shroud Support Legs	No inspections scheduled. Inspection tools/techniques being developed by BWRVIP.	
Repair Clamps	VISUAL INSPECTIONS:	Inspect two (2) clamps for general appearance, missing parts, and integrity of tack welds.
	UT INSPECTIONS:	Not Applicable

Table 4 provides a summary of the RFO B110R1 inspection findings. Reference 12 contains the detailed Inservice Inspection results.

TABLE 4 - UNIT 1 RFO B110R1 DETAILED INSPECTION RESULTS		
WELD	**RESULTS**	
H1	**VISUAL INSPECTIONS:**	None performed.
	UT INSPECTIONS:	Four (4) areas were examined: between Shroud Head Bolt Lug Sets 3-4; 14-15; 26-27; and 33-34. A total of eight (8) OD surface connected planar flaws were detected and maximum observed depth was 0.728". One ID surface connected planar flaw was detected and maximum observed depth was 0.354". Compared to previous sizing data, it was concluded that no change in size occurred during Fuel Cycle #9.
H5	**VISUAL INSPECTIONS:**	"Punch marked cracks" on ID were inspected for length. No changes from RFO B109R1 were noted (i.e. no crack growth).
	UT INSPECTIONS:	Two (2) areas inspected during RFO B109R1 were reinspected to determine crack growth. The examination was performed from the inside surface and from below the weld. Compared to previous sizing data, it was concluded that no change in size occurred during Fuel Cycle #9.
H6a	**VISUAL INSPECTIONS:**	None performed.
	UT INSPECTIONS:	Three (3) areas were examined: between the Jet Pumps @ 75.5° azimuth; @ 225.5° azimuth; and @ 315.5° azimuth. A total of two (2) planar flaw type indications were detected, however only one was determined to be surface connected. The maximum observed depth of the ID connected indication was 0.354".
H6b	**VISUAL INSPECTIONS:**	None performed.
	UT INSPECTIONS:	Three (3) areas were examined: between the Jet Pumps @ 75.5° azimuth; @ 225.5° azimuth; and @ 315.5° azimuth. A total of three (3) planar flaw type indications were detected, however only two were determined to be surface connected (both were ID surface connected). The maximum observed depth of the ID connected indications was 0.551".
H9	**VISUAL INSPECTIONS:**	None performed.
	UT INSPECTIONS:	100% of circumference was inspected from the RPV OD. No indications were detected.
Repair Clamps	**VISUAL INSPECTIONS:**	Inspection of two (2) clamps for general appearance, missing parts, and integrity of tack welds was satisfactory.

ANALYSIS

The RFO B110R1 indications were evaluated by one of the following methods:

1) Comparison of crack depth and length data with conditions assumed in previous analyses (References 14 and 15).

2) Analysis for structural significance by screening indications in accordance with Reference 5, as supplemented by References 6 and 7.

3) Performing weld-specific structural analysis to determine the allowable crack size in accordance with Reference 13.

The screening process (method 2) includes several conservatisms, such as assuming that all cracks are through-wall. It then provides a bounding crack length for initial screening. Cumulative effective crack lengths which are smaller than the bounding crack length are not a structural concern and are considered acceptable.

Flawed welds can be specifically analyzed (method 3) by the "BWR Core Shroud Distributed Ligament Length (DLL) Computer Program" (Reference 13.) This program was prepared for the BWRVIP Assessment Subcommittee by GE to evaluate the structural margins for a given set of flaw configurations in the shroud for both the upset and faulted loading conditions. H6b was evaluated using the DLL analysis method since inspection coverage did not allow application of the (method 2) screening criteria.

The H6b analysis bounds the H6a condition since: (1) the applied stresses are higher at H6b than at H6a and (2) the maximum recorded flaw depth is greater at H6b than at H6a. Analysis conservatively assumed a 360° flaw with the maximum recorded flaw depth and a crack growth rate of 0.1" per cycle through the next three fuel cycles. (Attachment C provides a summary of loads at each horizontal weld location and was used in conjunction with Reference 13.) The 0.1" per cycle growth rate was established by UT equipment uncertainties, as described in Attachment E, and is considered conservative based on comparison of B110R1 inspection results to B109R1 inspection results. Attachment A presents the results of the H6b analysis. The analysis results are summarized in Table 6.

Table 5 provides a summary of the analysis results for each weld joint.

TABLE 5- UNIT 1 ANALYSIS AND RESULTS SUMMARY	
WELD	**ANALYSIS AND RESULTS**
H1	Four (4) areas were examined that had been previously examined in RFO B109R1. A total of nine planar flaw type indications were detected. 1) Comparison to RFO B109R1 data is shown in Attachment D, along with postulated crack depths at the end of two additional fuel cycles (RFO B112R1) and a bounding curve from Reference 15. The postulated extent of cracking in RFO B112R1 is fully bounded by Reference 15, except for the two indications listed below, which were not addressed by the analysis. 2) Indication #2 between lugs 26 and 27 was not previously reported by GE in the RFO B109R1 report, however a review performed by GE (Reference 10) demonstrates that the same indication was located in RFO B109R1. Connection to the OD surface was indeterminate by GE since a 45° shear wave transducer was not used on the lower side of H1. 3) Indication #1 between lugs 3 and 4 was not previously reported by GE in the RFO B109R1 report, however a review (Reference 16) demonstrates that the same indication was located in RFO B109R1, but was interpreted as geometry. 4) Reference 15 does not specifically evaluate the two indications above. The indications are both below the H1 weld and therefore the depth of the H1 reinforcement fillet weld leg cannot be added to the remaining ligament for structural evaluation. However, the remaining net section area evaluated in Reference 15 is less than that projected for the section immediately below the H1 weld at the end of the next two fuel cycles. Therefore, the Reference 15 evaluation fully bounds the identified condition below the H1 weld. A detailed discussion is included in Attachment E.

TABLE 5- UNIT 1 ANALYSIS AND RESULTS SUMMARY

WELD	ANALYSIS AND RESULTS
H5	Two (2) areas inspected during RFO B109R1 were reinspected to determine crack growth. Cracking below the weld in the 169° and 274° areas was detected by VT and sized by UT during RFO B109R1. 1) The RFO B110R1 UT inspections revealed no changes in crack depth or length, as depicted in Attachment D, and therefore the condition of H5 is fully bounded by previous analysis. 2) A deviation in reported flaw locations from RFO B109R1 (GE) and RFO B110R1 (Siemens) was evaluated by GE and concluded to be a reporting error in the B109R1 report. Appropriate correction demonstrates close correlation between B109R1 and B110R1 results.
H6a and H6b	Three (3) areas were examined: between the Jet Pumps @ 75.5° azimuth; @ 225.5° azimuth; and @ 315.5° azimuth. A total of two (2) planar flaw type indications were detected in H6a and three (3) in H6b. 1) A structural integrity analysis of the core shroud was performed for both the upset and the faulted loading conditions and is included as Attachment A. H6b was analyzed as the limiting case since the applied stresses are higher at H6b than at H6a. The results of the Attachment A analyses are summarized in Table 6. 2) The analyses conclude that the core shroud is structurally adequate for continued operation during Fuel Cycles 10 and 11.
H9	UT examination of 100% of the circumference identified no reportable indications.
Repair Clamps	Inspection of two (2) clamps (spanning H2 and H3) for general appearance, missing parts, and integrity of tack welds was satisfactory.

TABLE 6

H6B SAFETY FACTORS FOR WALL THICKNESS USING NRC CRACK GROWTH VALUES

(1) LOADING CONDITION	Required Safety Factor	WELD DESIGNATION	(2) CRACK GROWTH ALLOWANCE (in.)	(3) ASSUMED FLAW SIZE (in.)	REMAINING WALL THICKNESS (in.)	SAFETY FACTOR
NORMAL/UPSET	2.77	H6b	0.6	0.551	0.349	5.71
FAULTED	1.39	H6b	0.6	0.551	0.349	3.53

H6B SAFETY FACTORS FOR WALL THICKNESS USING BNP U1 CALCULATED CRACK GROWTH VALUES

(1) LOADING CONDITION	Required Safety Factor	WELD DESIGNATION	(4) CRACK GROWTH ALLOWANCE (in.)	(3) ASSUMED FLAW SIZE (in.)	REMAINING WALL THICKNESS (in.)	SAFETY FACTOR
NORMAL/UPSET	2.77	H6b	0.1 (1 cycle)	0.551	0.849	13.72
FAULTED	1.39	H6b	0.1 (1 cycle)	0.551	0.849	8.31
NORMAL/UPSET	2.77	H6b	0.3 (3 cycles)	0.551	0.649	10.52
FAULTED	1.39	H6b	0.3 (3 cycles)	0.551	0.649	6.39

(1) Includes Power Uprate pressures and asymmetric loading for the shroud.

(2) NRC mandated allowance of 5×10^{-5} in/hr for one cycle of operation = 0.6"/cycle for BNP.

(3) Flaw size used is maximum observed crack depth for the H6b weld and is assumed 360° thru-wall.

(4) The crack growth used for BNP U1 is 0.1"/cycle and is based on the results of the H1 weld inspections.

SUMMARY

The BNP-1 Refueling Outage (RFO) B110R1 Core Shroud inspections are complete and evaluated in this ESR. Core shroud relevant indications from the RFO B110R1 inspections have been evaluated by methods 1, 2 or 3 as presented in the previous section and have been judged to be acceptable for continued operation of BNP-1 for two cycles of operation.

This ESR concludes that structural integrity of the core shroud will be maintained, with full FSAR safety margins, for at least the next two operating cycles based on analysis of the inspection results.

Crack growth experienced during Cycle 9 was substantially less than postulated by previous analysis. The inspection results from B110R1 show that the existing condition is essentially unchanged from the condition identified in B109R1. Furthermore, the postulated crack lengths at the end of Cycle 11, based upon B110R1 results, are fully bounded by previous analyses and will not reduce the structural design margins below allowable values. Therefore, the condition of the core shroud does not impose any restrictions to BNP-1 operation during the next two operating cycles. The BNP-1 Core Shroud is "acceptable as is" for Operating Cycles 10 and 11.

Future inspection plans will consider not only these inspection results, but will also consider continuing developments in the industry, to ensure utilization of the best information and technology to address the issue.

REFERENCES

1. FP-50096, Sheet 1 of 2, "Assembly and Finish Machining Shroud Core Structure," Revision 2

2. American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Section III, 1965 Edition through Summer, 1967 Addenda

3. EER 93-0536, Evaluation of Unit 1 Core Shroud Indications and Operability Assessment of Unit 1 and 2, Revision 1

4. GE Report NEDC 32300-P, "Brunswick Unit 1 Shroud Sample Metallurgical Evaluations," dated October 1993.

5. GE Report GENE-523-123-0993, Rev. 2, "Evaluation and Screening Criteria for the Brunswick 1 Shroud Indications," November 1993.

6. RAM-94-092/SIR-94-029, "Addendum to the Brunswick Unit 1 Screening Criteria", dated 4/6/94.

7. RAM-94-099/SIR-94-031, "Minimum Required Unflawed Core Shroud Material at Brunswick, Units 1 and 2", dated 4/11/94.

8. GE report R129, RFO B109R1 Data Sheets from OPT-90.1, In-Vessel Visual Examination

9. System Description SD-01, "Nuclear Boiler," Revision 26, dated Nov. 1, 1993.

10. Memorandum, A. R. Jaschke (GE) to John Langdon (CP&L), "Review of Unit 1 1993 Shroud Weld H1 UT Data", dated May 5, 1995

11. Memorandum, A. R. Jaschke (GE) to John Langdon (CP&L), "1993 and 1995 Core Shroud Weld H5 Data for Unit 1", dated May 10, 1995

12. RFO B110R1 IVVI and UT reports, including OPT-90.1 data sheets and video cassettes.

13. GE Report GENE-523-113-0894, Supplement 1, "BWR Core Shroud Distributed Ligament Length Computer Program"

14. CP&L Calculation No. 1-B21-0049, Revision 0

15. GE Report GENE-523-144-1093, "Analysis of Unit 1 Welds H1, H2, & H3 ...", Revision 1, November, 1993

16. Memorandum, E. Black (CP&L) to W. B. Wilton (CP&L), "Review of H1 Weld UT Indication at 30 Degree Azimuth", dated April 17, 1995

DOCUMENT UPDATES

No document updates are required as a result of this ESR.

ESR ACTION ITEMS

No ESR action items are required as a result of this ESR. Future inspections and reportings are governed by OPT-90.1.

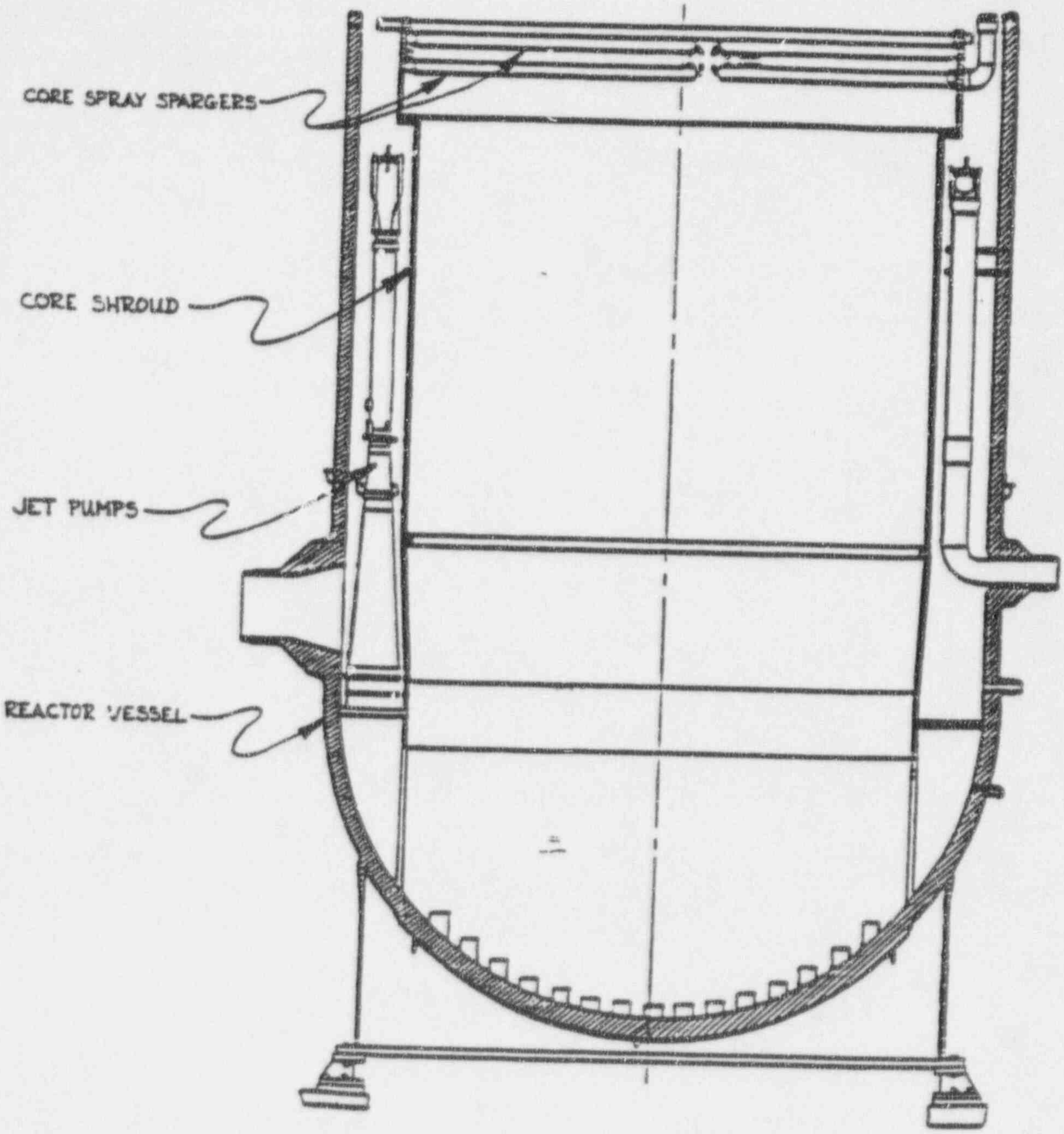

FIGURE 1 - Reactor Vessel Cross-Section Showing Reactor Internals

BRUNSWICK UNIT 1 SHROUD

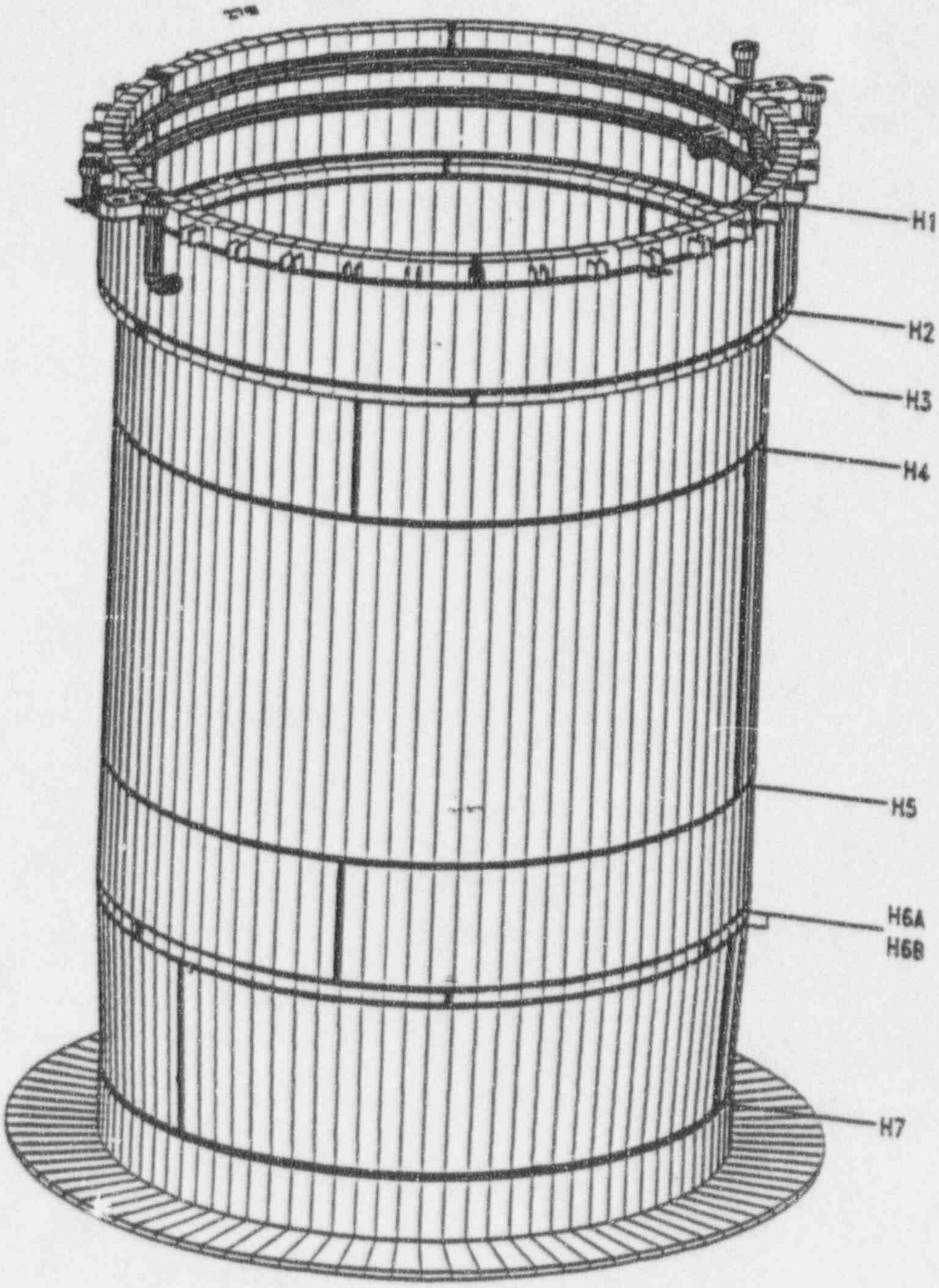

FIGURE 2 - Reactor Shroud Three - Dimensional View

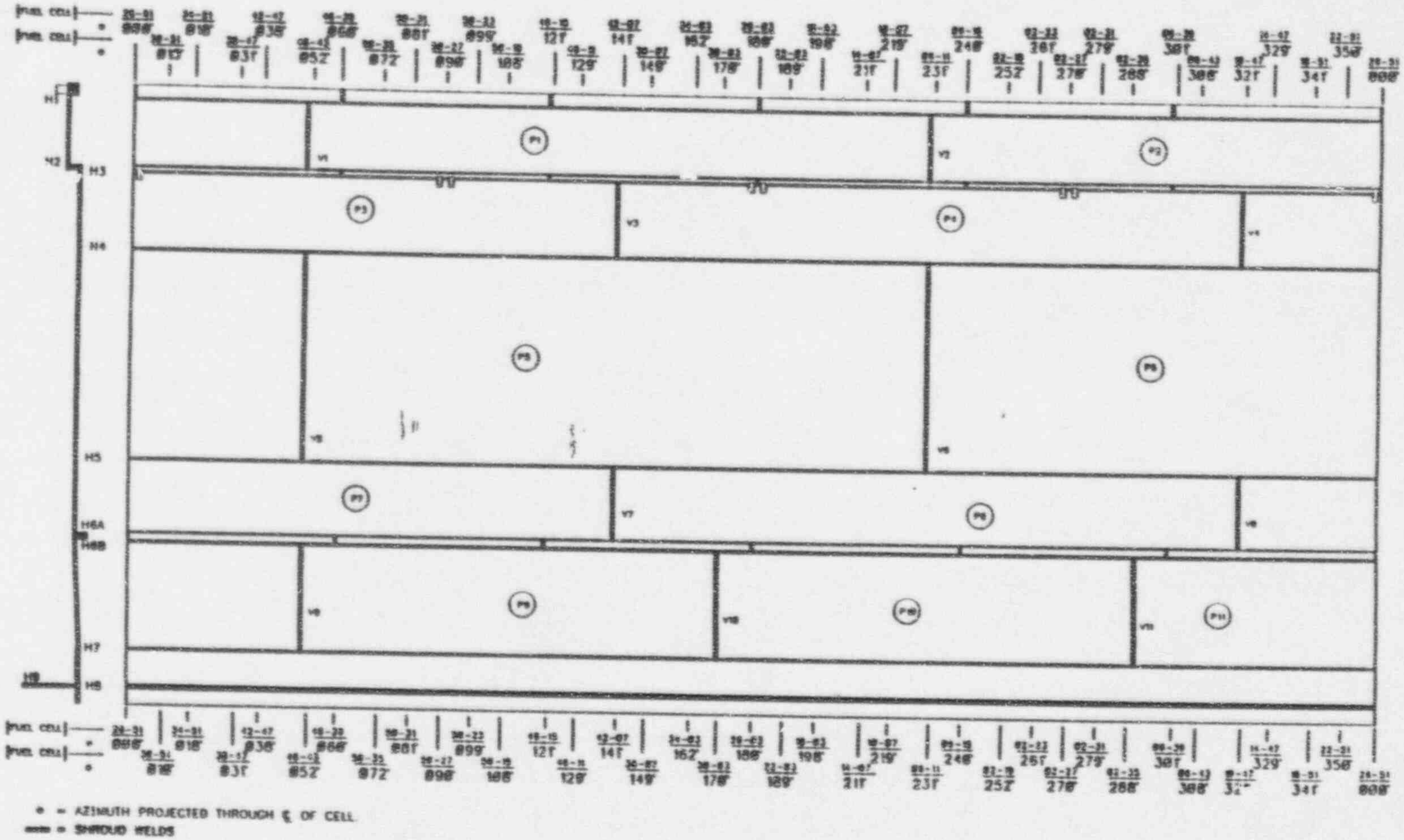

FIGURE 3 - Roll-Out View of Inside Shroud Surface

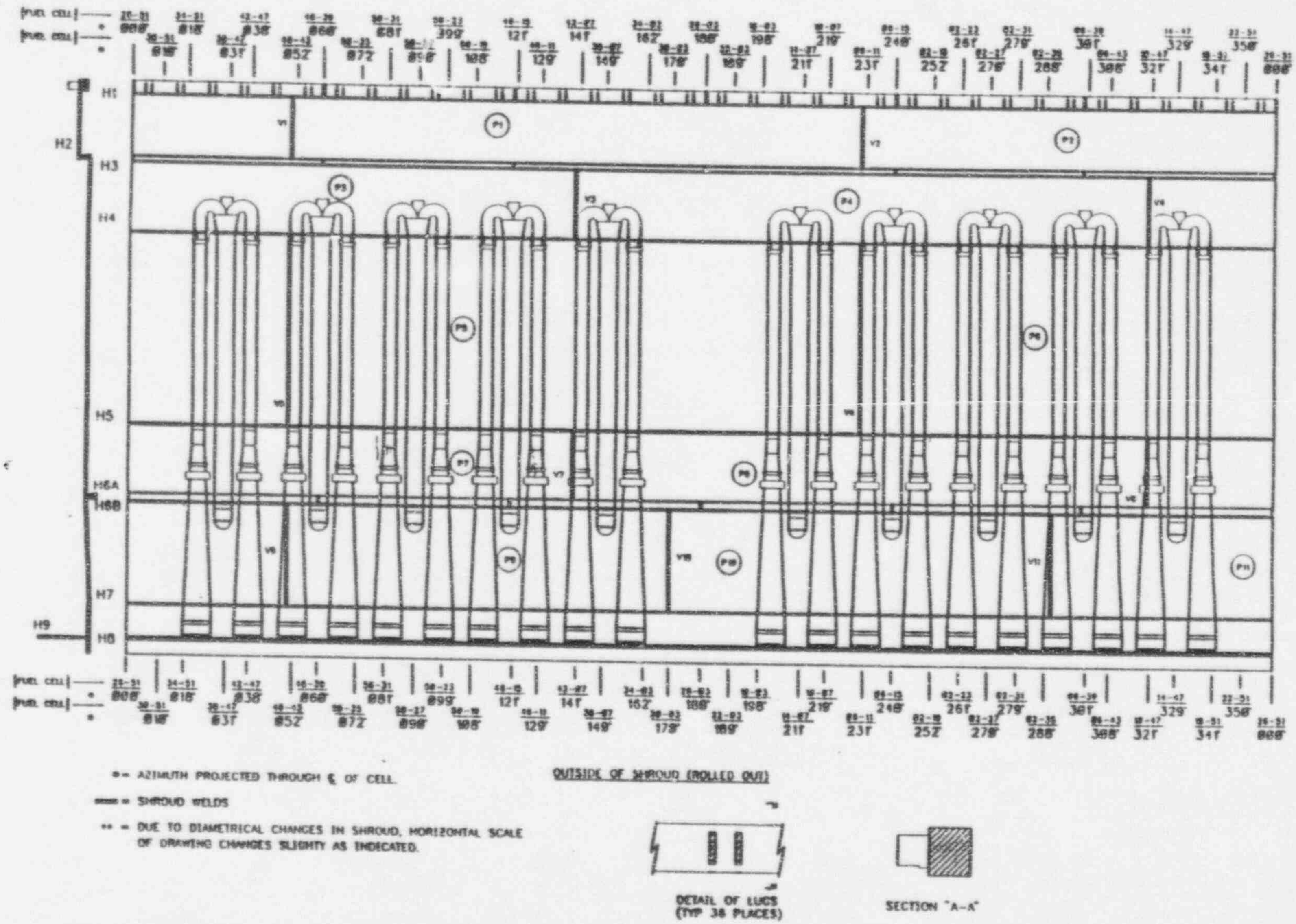

FIGURE 4 - Roll-Out View of Outside Shroud Surface

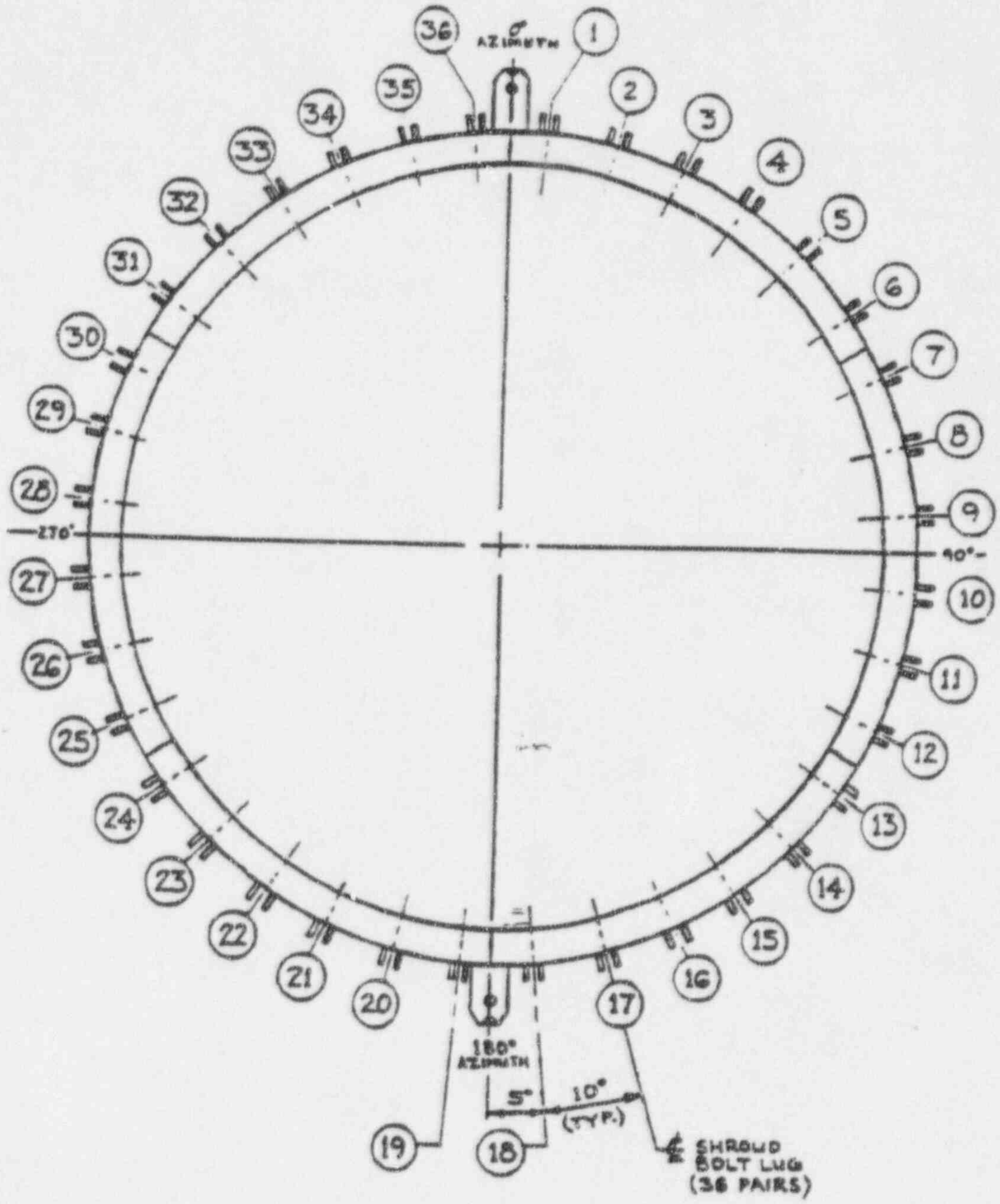

FIGURE 5 - Brunswick Shroud Plan View

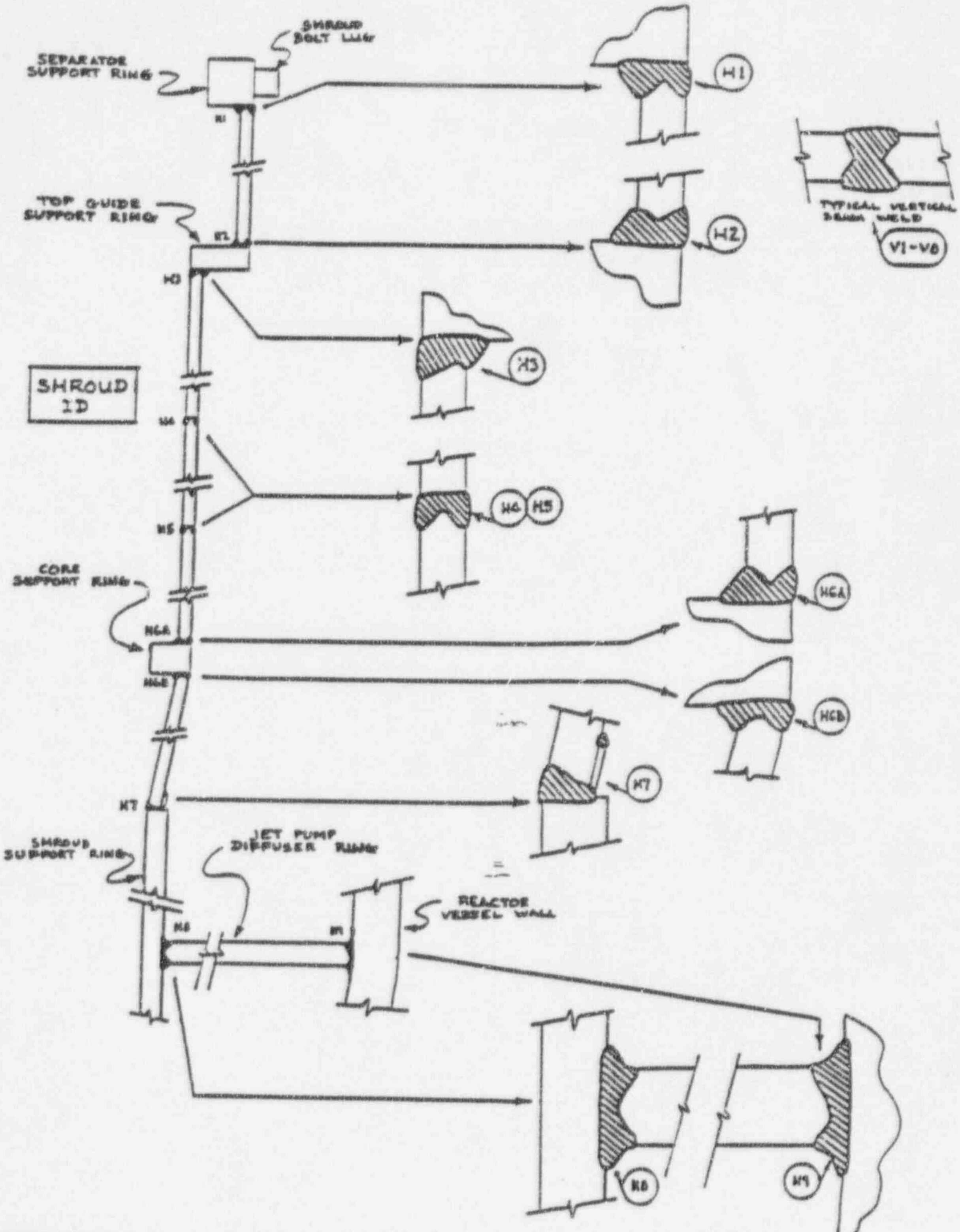

FIGURE 6 - Shroud Cross-Section Showing Welds

H6B Weld Location: Assumed Crack Growth = 0.6"/cycle: Upset Load Case

DLL: DISTRIBUTED LIGAMENT LENGTH EVALUATION (REVISION: 10/07/94) DATE OF CURRENT ANALYSIS: 05/14/1995

SUMMARY OF INPUTS:

Angle increment	=	1.0 deg. (COARSE)
Membrane Stress, Pm	=	309. psi
Bending Stress, Pb	=	2375. psi
Safety Factor, SF	=	2.77
Mean Radius, Rm	=	88.75 inches
Wall Thickness, t	=	1.500 inches
Material	=	304 SS
Stress Intensity, Sm	=	16900. psi
Fluence	=	1.9E+19 n/cm^2

(Thus, LEFM evaluation not applicable)

REGION	THETA1 [deg.]	THETA2 [deg.]	THICKNESS [inches]
1	.0	360.0	.349

LIMIT LOAD RESULTS:

ALPHA [deg]	MOMENT [in-lbs]	Pb' [psi]	SAFETY FACTOR	RESULT
.0	5.569E+08	15005.	5.71	ACCEPTABLE
5.0	5.569E+08	15005.	5.71	ACCEPTABLE
10.0	5.569E+08	15005.	5.71	ACCEPTABLE
15.0	5.569E+08	15005.	5.71	ACCEPTABLE
20.0	5.569E+08	15005.	5.71	ACCEPTABLE
25.0	5.569E+08	15005.	5.71	ACCEPTABLE
30.0	5.569E+08	15005.	5.71	ACCEPTABLE
35.0	5.569E+08	15005.	5.71	ACCEPTABLE
40.0	5.569E+08	15005.	5.71	ACCEPTABLE
45.0	5.569E+08	15005.	5.71	ACCEPTABLE
50.0	5.569E+08	15005.	5.71	ACCEPTABLE
55.0	5.569E+08	15005.	5.71	ACCEPTABLE
60.0	5.569E+08	15005.	5.71	ACCEPTABLE
65.0	5.569E+08	15005.	5.71	ACCEPTABLE
70.0	5.569E+08	15005.	5.71	ACCEPTABLE
75.0	5.569E+08	15005.	5.71	ACCEPTABLE
80.0	5.569E+08	15005.	5.71	ACCEPTABLE

85.0	5.569E+08	15005.	5.71	ACCEPTABLE
90.0	5.569E+08	15005.	5.71	ACCEPTABLE
95.0	5.569E+08	15005.	5.71	ACCEPTABLE
100.0	5.569E+08	15005.	5.71	ACCEPTABLE
105.0	5.569E+08	15005.	5.71	ACCEPTABLE
110.0	5.569E+08	15005.	5.71	ACCEPTABLE
115.0	5.569E+08	15005.	5.71	ACCEPTABLE
120.0	5.569E+08	15005.	5.71	ACCEPTABLE
125.0	5.569E+08	15005.	5.71	ACCEPTABLE
130.0	5.569E+08	15005.	5.71	ACCEPTABLE
135.0	5.569E+08	15005.	5.71	ACCEPTABLE
140.0	5.569E+08	15005.	5.71	ACCEPTABLE
145.0	5.569E+08	15005.	5.71	ACCEPTABLE
150.0	5.569E+08	15005.	5.71	ACCEPTABLE
155.0	5.569E+08	15005.	5.71	ACCEPTABLE
160.0	5.569E+08	15005.	5.71	ACCEPTABLE
165.0	5.569E+08	15005.	5.71	ACCEPTABLE
170.0	5.569E+08	15005.	5.71	ACCEPTABLE
175.0	5.569E+08	15005.	5.71	ACCEPTABLE
180.0	5.569E+08	15005.	5.71	ACCEPTABLE
185.0	5.569E+08	15005.	5.71	ACCEPTABLE
190.0	5.569E+08	15005.	5.71	ACCEPTABLE
195.0	5.569E+08	15005.	5.71	ACCEPTABLE
200.0	5.569E+08	15005.	5.71	ACCEPTABLE
205.0	5.569E+08	15005.	5.71	ACCEPTABLE
210.0	5.569E+08	15005.	5.71	ACCEPTABLE
215.0	5.569E+08	15005.	5.71	ACCEPTABLE
220.0	5.569E+08	15005.	5.71	ACCEPTABLE
225.0	5.569E+08	15005.	5.71	ACCEPTABLE
230.0	5.569E+08	15005.	5.71	ACCEPTABLE
235.0	5.569E+08	15005.	5.71	ACCEPTABLE
240.0	5.569E+08	15005.	5.71	ACCEPTABLE
245.0	5.569E+08	15005.	5.71	ACCEPTABLE
250.0	5.569E+08	15005.	5.71	ACCEPTABLE
255.0	5.569E+08	15005.	5.71	ACCEPTABLE
260.0	5.569E+08	15005.	5.71	ACCEPTABLE
265.0	5.569E+08	15005.	5.71	ACCEPTABLE
270.0	5.569E+08	15005.	5.71	ACCEPTABLE
275.0	5.569E+08	15005.	5.71	ACCEPTABLE
280.0	5.569E+08	15005.	5.71	ACCEPTABLE
285.0	5.569E+08	15005.	5.71	ACCEPTABLE
290.0	5.569E+08	15005.	5.71	ACCEPTABLE
295.0	5.569E+08	15005.	5.71	ACCEPTABLE
300.0	5.569E+08	15005.	5.71	ACCEPTABLE
305.0	5.569E+08	15005.	5.71	ACCEPTABLE
310.0	5.569E+08	15005.	5.71	ACCEPTABLE
315.0	5.569E+08	15005.	5.71	ACCEPTABLE
320.0	5.569E+08	15005.	5.71	ACCEPTABLE

325.0	5.569E+08	15005.	5.71	ACCEPTABLE
330.0	5.569E+08	15005.	5.71	ACCEPTABLE
335.0	5.569E+08	15005.	5.71	ACCEPTABLE
340.0	5.569E+08	15005.	5.71	ACCEPTABLE
345.0	5.569E+08	15005.	5.71	ACCEPTABLE
350.0	5.569E+08	15005.	5.71	ACCEPTABLE
355.0	5.569E+08	15005.	5.71	ACCEPTABLE

ACCEPTABLE! MINIMUM SAFETY FACTOR = 5.71 AT 155.0 DEGREES.

H6B Weld Location: Assumed Crack Growth = 0.6"/cycle: Faulted Load Case

DLL: DISTRIBUTED LIGAMENT LENGTH EVALUATION (REVISION: 10/07/94)
DATE OF CURRENT ANALYSIS: 05/14/1995

SUMMARY OF INPUTS:

Angle increment	=	1.0 deg. (COARSE)
Membrane Stress, Pm	=	1099. psi
Bending Stress, Pb	=	3423. psi
Safety Factor, SF	=	1.39
Mean Radius, Rm	=	88.75 inches
Wall Thickness, t	=	1.500 inches
Material	=	304 SS
Stress Intensity, Sm	=	16900. psi
Fluence	=	1.9E+19 n/cm^2

(Thus, LEFM evaluation not applicable)

REGION	THETA1 [deg.]	THETA2 [deg.]	THICKNESS [inches]
1	.0	360.0	.349

LIMIT LOAD RESULTS:

ALPHA [deg]	MOMENT [in-lbs]	Pb' [psi]	SAFETY FACTOR	RESULT
.0	5.513E+08	14854.	3.53	ACCEPTABLE
5.0	5.513E+08	14854.	3.53	ACCEPTABLE
10.0	5.513E+08	14854.	3.53	ACCEPTABLE
15.0	5.513E+08	14854.	3.53	ACCEPTABLE
20.0	5.513E+08	14854.	3.53	ACCEPTABLE
25.0	5.513E+08	14854.	3.53	ACCEPTABLE
30.0	5.513E+08	14854.	3.53	ACCEPTABLE
35.0	5.513E+08	14854.	3.53	ACCEPTABLE
40.0	5.513E+08	14854.	3.53	ACCEPTABLE
45.0	5.513E+08	14854.	3.53	ACCEPTABLE
50.0	5.513E+08	14854.	3.53	ACCEPTABLE
55.0	5.513E+08	14854.	3.53	ACCEPTABLE
60.0	5.513E+08	14854.	3.53	ACCEPTABLE
65.0	5.513E+08	14854.	3.53	ACCEPTABLE
70.0	5.513E+08	14854.	3.53	ACCEPTABLE
75.0	5.513E+08	14854.	3.53	ACCEPTABLE

80.0	5.513E+08	14854.	3.53	ACCEPTABLE
85.0	5.513E+08	14854.	3.53	ACCEPTABLE
90.0	5.513E+08	14854.	3.53	ACCEPTABLE
95.0	5.513E+08	14854.	3.53	ACCEPTABLE
100.0	5.513E+08	14854.	3.53	ACCEPTABLE
105.0	5.513E+08	14854.	3.53	ACCEPTABLE
110.0	5.513E+08	14854.	3.53	ACCEPTABLE
115.0	5.513E+08	14854.	3.53	ACCEPTABLE
120.0	5.513E+08	14854.	3.53	ACCEPTABLE
125.0	5.513E+08	14854.	3.53	ACCEPTABLE
130.0	5.513E+08	14854.	3.53	ACCEPTABLE
135.0	5.513E+08	14854.	3.53	ACCEPTABLE
140.0	5.513E+08	14854.	3.53	ACCEPTABLE
145.0	5.513E+08	14854.	3.53	ACCEPTABLE
150.0	5.513E+08	14854.	3.53	ACCEPTABLE
155.0	5.513E+08	14854.	3.53	ACCEPTABLE
160.0	5.513E+08	14854.	3.53	ACCEPTABLE
165.0	5.513E+08	14854.	3.53	ACCEPTABLE
170.0	5.513E+08	14854.	3.53	ACCEPTABLE
175.0	5.513E+08	14854.	3.53	ACCEPTABLE
180.0	5.513E+08	14854.	3.53	ACCEPTABLE
185.0	5.513E+08	14854.	3.53	ACCEPTABLE
190.0	5.513E+08	14854.	3.53	ACCEPTABLE
195.0	5.513E+08	14854.	3.53	ACCEPTABLE
200.0	5.513E+08	14854.	3.53	ACCEPTABLE
205.0	5.513E+08	14854.	3.53	ACCEPTABLE
210.0	5.513E+08	14854.	3.53	ACCEPTABLE
215.0	5.513E+08	14854.	3.53	ACCEPTABLE
220.0	5.513E+08	14854.	3.53	ACCEPTABLE
225.0	5.513E+08	14854.	3.53	ACCEPTABLE
230.0	5.513E+08	14854.	3.53	ACCEPTABLE
235.0	5.513E+08	14854.	3.53	ACCEPTABLE
240.0	5.513E+08	14854.	3.53	ACCEPTABLE
245.0	5.513E+08	14854.	3.53	ACCEPTABLE
250.0	5.513E+08	14854.	3.53	ACCEPTABLE
255.0	5.513E+08	14854.	3.53	ACCEPTABLE
260.0	5.513E+08	14854.	3.53	ACCEPTABLE
265.0	5.513E+08	14854.	3.53	ACCEPTABLE
270.0	5.513E+08	14854.	3.53	ACCEPTABLE
275.0	5.513E+08	14854.	3.53	ACCEPTABLE
280.0	5.513E+08	14854.	3.53	ACCEPTABLE
285.0	5.513E+08	14854.	3.53	ACCEPTABLE
290.0	5.513E+08	14854.	3.53	ACCEPTABLE
295.0	5.513E+08	14854.	3.53	ACCEPTABLE
300.0	5.513E+08	14854.	3.53	ACCEPTABLE
305.0	5.513E+08	14854.	3.53	ACCEPTABLE
310.0	5.513E+08	14854.	3.53	ACCEPTABLE
315.0	5.513E+08	14854.	3.53	ACCEPTABLE

320.0	5.513E+08	14854.	3.53	ACCEPTABLE
325.0	5.513E+08	14854.	3.53	ACCEPTABLE
330.0	5.513E+08	14854.	3.53	ACCEPTABLE
335.0	5.513E+08	14854.	3.53	ACCEPTABLE
340.0	5.513E+08	14854.	3.53	ACCEPTABLE
345.0	5.513E+08	14854.	3.53	ACCEPTABLE
350.0	5.513E+08	14854.	3.53	ACCEPTABLE
355.0	5.513E+08	14854.	3.53	ACCEPTABLE

ACCEPTABLE! MINIMUM SAFETY FACTOR = 3.53 AT 155.0 DEGREES.

H6B Weld Location: Assumed Crack Growth = 0.1"/cycle: 1 cycle of growth: Remaining Wall Thickness = 0.849": Upset Load Case

DLL: DISTRIBUTED LIGAMENT LENGTH EVALUATION (REVISION: 10/07/94)
DATE OF CURRENT ANALYSIS: 05/14/1995

SUMMARY OF INPUTS:

Angle increment	=	1.0 deg. (COARSE)
Membrane Stress, Pm	=	309. psi
Bending Stress, Pb	=	2375. psi
Safety Factor, SF	=	2.77
Mean Radius, Rm	=	88.75 inches
Wall Thickness, t	=	1.500 inches
Material	=	304 SS
Stress Intensity, Sm	=	16900. psi
Fluence	=	1.9E+19 n/cm^2

(Thus, LEFM evaluation not applicable)

REGION	THETA1 [deg.]	THETA2 [deg.]	THICKNESS [inches]
1	.0	360.0	.849

LIMIT LOAD RESULTS:

ALPHA [deg]	MOMENT [in-lbs]	Pb' [psi]	SAFETY FACTOR	RESULT
.0	1.356E+09	36524.	13.72	ACCEPTABLE
5.0	1.356E+09	36524.	13.72	ACCEPTABLE
10.0	1.356E+09	36524.	13.72	ACCEPTABLE
15.0	1.356E+09	36524.	13.72	ACCEPTABLE
20.0	1.356E+09	36524.	13.72	ACCEPTABLE
25.0	1.356E+09	36524.	13.72	ACCEPTABLE
30.0	1.356E+09	36524.	13.72	ACCEPTABLE
35.0	1.356E+09	36524.	13.72	ACCEPTABLE
40.0	1.356E+09	36524.	13.72	ACCEPTABLE
45.0	1.356E+09	36524.	13.72	ACCEPTABLE
50.0	1.356E+09	36524.	13.72	ACCEPTABLE
55.0	1.356E+09	36524.	13.72	ACCEPTABLE
60.0	1.356E+09	36524.	13.72	ACCEPTABLE
65.0	1.356E+09	36524.	13.72	ACCEPTABLE
70.0	1.356E+09	36524.	13.72	ACCEPTABLE
75.0	1.356E+09	36524.	13.72	ACCEPTABLE

80.0	1.356E+09	36524.	13.72	ACCEPTABLE
85.0	1.356E+09	36524.	13.72	ACCEPTABLE
90.0	1.356E+09	36524.	13.72	ACCEPTABLE
95.0	1.356E+09	36524.	13.72	ACCEPTABLE
100.0	1.356E+09	36524.	13.72	ACCEPTABLE
105.0	1.356E+09	36524.	13.72	ACCEPTABLE
110.0	1.356E+09	36524.	13.72	ACCEPTABLE
115.0	1.356E+09	36524.	13.72	ACCEPTABLE
120.0	1.356E+09	36524.	13.72	ACCEPTABLE
125.0	1.356E+09	36524.	13.72	ACCEPTABLE
130.0	1.356E+09	36524.	13.72	ACCEPTABLE
135.0	1.356E+09	36524.	13.72	ACCEPTABLE
140.0	1.356E+09	36524.	13.72	ACCEPTABLE
145.0	1.356E+09	36524.	13.72	ACCEPTABLE
150.0	1.356E+09	36524.	13.72	ACCEPTABLE
155.0	1.356E+09	36524.	13.72	ACCEPTABLE
160.0	1.356E+09	36524.	13.72	ACCEPTABLE
165.0	1.356E+09	36524.	13.72	ACCEPTABLE
170.0	1.356E+09	36524.	13.72	ACCEPTABLE
175.0	1.356E+09	36524.	13.72	ACCEPTABLE
180.0	1.356E+09	36524.	13.72	ACCEPTABLE
185.0	1.356E+09	36524.	13.72	ACCEPTABLE
190.0	1.356E+09	36524.	13.72	ACCEPTABLE
195.0	1.356E+09	36524.	13.72	ACCEPTABLE
200.0	1.356E+09	36524.	13.72	ACCEPTABLE
205.0	1.356E+09	36524.	13.72	ACCEPTABLE
210.0	1.356E+09	36524.	13.72	ACCEPTABLE
215.0	1.356E+09	36524.	13.72	ACCEPTABLE
220.0	1.356E+09	36524.	13.72	ACCEPTABLE
225.0	1.356E+09	36524.	13.72	ACCEPTABLE
230.0	1.356E+09	36524.	13.72	ACCEPTABLE
235.0	1.356E+09	36524.	13.72	ACCEPTABLE
240.0	1.356E+09	36524.	13.72	ACCEPTABLE
245.0	1.356E+09	36524.	13.72	ACCEPTABLE
250.0	1.356E+09	36524.	13.72	ACCEPTABLE
255.0	1.356E+09	36524.	13.72	ACCEPTABLE
260.0	1.356E+09	36524.	13.72	ACCEPTABLE
265.0	1.356E+09	36524.	13.72	ACCEPTABLE
270.0	1.356E+09	36524.	13.72	ACCEPTABLE
275.0	1.356E+09	36524.	13.72	ACCEPTABLE
280.0	1.356E+09	36524.	13.72	ACCEPTABLE
285.0	1.356E+09	36524.	13.72	ACCEPTABLE
290.0	1.356E+09	36524.	13.72	ACCEPTABLE
295.0	1.356E+09	36524.	13.72	ACCEPTABLE
300.0	1.356E+09	36524.	13.72	ACCEPTABLE
305.0	1.356E+09	36524.	13.72	ACCEPTABLE
310.0	1.356E+09	36524.	13.72	ACCEPTABLE
315.0	1.356E+09	36524.	13.72	ACCEPTABLE

320.0	1.356E+09	36524.	13.72	ACCEPTABLE
325.0	1.356E+09	36524.	13.72	ACCEPTABLE
330.0	1.356E+09	36524.	13.72	ACCEPTABLE
335.0	1.356E+09	36524.	13.72	ACCEPTABLE
340.0	1.356E+09	36524.	13.72	ACCEPTABLE
345.0	1.356E+09	36524.	13.72	ACCEPTABLE
350.0	1.356E+09	36524.	13.72	ACCEPTABLE
355.0	1.356E+09	36524.	13.72	ACCEPTABLE

ACCEPTABLE! MINIMUM SAFETY FACTOR = 13.72 AT .0 DEGREES.

H6B Weld Location: Assumed Crack Growth = 0.1"/cycle: 1 cycle of grwoth: Remaining Wall Thickness = 0.849": Faulted Load Case

DLL: DISTRIBUTED LIGAMENT LENGTH EVALUATION (REVISION: 10/07/94)
DATE OF CURRENT ANALYSIS: 05/14/1995

SUMMARY OF INPUTS:

Angle increment	=	1.0 deg. (COARSE)
Membrane Stress, Pm	=	1099. psi
Bending Stress, Pb	=	3423. psi
Safety Factor, SF	=	1.39
Mean Radius, Rm	=	88.75 inches
Wall Thickness, t	=	1.500 inches
Material	=	304 SS
Stress Intensity, Sm	=	16900. psi
Fluence	=	1.9E+19 n/cm^2

(Thus, LEFM evaluation not applicable)

REGION	THETA1 [deg.]	THETA2 [deg.]	THICKNESS [inches]
1	.0	360.0	.849

LIMIT LOAD RESULTS:

ALPHA [deg]	MOMENT [in-lbs]	Pb' [psi]	SAFETY FACTOR	RESULT
.0	1.354E+09	36468.	8.31	ACCEPTABLE
5.0	1.354E+09	36468.	8.31	ACCEPTABLE
10.0	1.354E+09	36468.	8.31	ACCEPTABLE
15.0	1.354E+09	36468.	8.31	ACCEPTABLE
20.0	1.354E+09	36468.	8.31	ACCEPTABLE
25.0	1.354E+09	36468.	8.31	ACCEPTABLE
30.0	1.354E+09	36468.	8.31	ACCEPTABLE
35.0	1.354E+09	36468.	8.31	ACCEPTABLE
40.0	1.354E+09	36468.	8.31	ACCEPTABLE
45.0	1.354E+09	36468.	8.31	ACCEPTABLE
50.0	1.354E+09	36468.	8.31	ACCEPTABLE
55.0	1.354E+09	36468.	8.31	ACCEPTABLE
60.0	1.354E+09	36468.	8.31	ACCEPTABLE
65.0	1.354E+09	36468.	8.31	ACCEPTABLE
70.0	1.354E+09	36468.	8.31	ACCEPTABLE
75.0	1.354E+09	36468.	8.31	ACCEPTABLE

80.0	1.354E+09	36468.	8.31	ACCEPTABLE
85.0	1.354E+09	36468.	8.31	ACCEPTABLE
90.0	1.354E+09	36468.	8.31	ACCEPTABLE
95.0	1.354E+09	36468.	8.31	ACCEPTABLE
100.0	1.354E+09	36468.	8.31	ACCEPTABLE
105.0	1.354E+09	36468.	8.31	ACCEPTABLE
110.0	1.354E+09	36468.	8.31	ACCEPTABLE
115.0	1.354E+09	36468.	8.31	ACCEPTABLE
120.0	1.354E+09	36468.	8.31	ACCEPTABLE
125.0	1.354E+09	36468.	8.31	ACCEPTABLE
130.0	1.354E+09	36468.	8.31	ACCEPTABLE
135.0	1.354E+09	36468.	8.31	ACCEPTABLE
140.0	1.354E+09	36468.	8.31	ACCEPTABLE
145.0	1.354E+09	36468.	8.31	ACCEPTABLE
150.0	1.354E+09	36468.	8.31	ACCEPTABLE
155.0	1.354E+09	36468.	8.31	ACCEPTABLE
160.0	1.354E+09	36468.	8.31	ACCEPTABLE
165.0	1.354E+09	36468.	8.31	ACCEPTABLE
170.0	1.354E+09	36468.	8.31	ACCEPTABLE
175.0	1.354E+09	36468.	8.31	ACCEPTABLE
180.0	1.354E+09	36468.	8.31	ACCEPTABLE
185.0	1.354E+09	36468.	8.31	ACCEPTABLE
190.0	1.354E+09	36468.	8.31	ACCEPTABLE
195.0	1.354E+09	36468.	8.31	ACCEPTABLE
200.0	1.354E+09	36468.	8.31	ACCEPTABLE
205.0	1.354E+09	36468.	8.31	ACCEPTABLE
210.0	1.354E+09	36468.	8.31	ACCEPTABLE
215.0	1.354E+09	36468.	8.31	ACCEPTABLE
220.0	1.354E+09	36468.	8.31	ACCEPTABLE
225.0	1.354E+09	36468.	8.31	ACCEPTABLE
230.0	1.354E+09	36468.	8.31	ACCEPTABLE
235.0	1.354E+09	36468.	8.31	ACCEPTABLE
240.0	1.354E+09	36468.	8.31	ACCEPTABLE
245.0	1.354E+09	36468.	8.31	ACCEPTABLE
250.0	1.354E+09	36468.	8.31	ACCEPTABLE
255.0	1.354E+09	36468.	8.31	ACCEPTABLE
260.0	1.354E+09	36468.	8.31	ACCEPTABLE
265.0	1.354E+09	36468.	8.31	ACCEPTABLE
270.0	1.354E+09	36468.	8.31	ACCEPTABLE
275.0	1.354E+09	36468.	8.31	ACCEPTABLE
280.0	1.354E+09	36468.	8.31	ACCEPTABLE
285.0	1.354E+09	36468.	8.31	ACCEPTABLE
290.0	1.354E+09	36468.	8.31	ACCEPTABLE
295.0	1.354E+09	36468.	8.31	ACCEPTABLE
300.0	1.354E+09	36468.	8.31	ACCEPTABLE
305.0	1.354E+09	36468.	8.31	ACCEPTABLE
310.0	1.354E+09	36468.	8.31	ACCEPTABLE
315.0	1.354E+09	36468.	8.31	ACCEPTABLE

320.0	1.354E+09	36468.	8.31	ACCEPTABLE
325.0	1.354E+09	36468.	8.31	ACCEPTABLE
330.0	1.354E+09	36468.	8.31	ACCEPTABLE
335.0	1.354E+09	36468.	8.31	ACCEPTABLE
340.0	1.354E+09	36468.	8.31	ACCEPTABLE
345.0	1.354E+09	36468.	8.31	ACCEPTABLE
350.0	1.354E+09	36468.	8.31	ACCEPTABLE
355.0	1.354E+09	36468.	8.31	ACCEPTABLE

ACCEPTABLE! MINIMUM SAFETY FACTOR = 8.31 AT 350.0 DEGREES.

H6B Weld Location: Assumed Crack Growth = 0.1"/cycle: 3 cycles of growth: Remaining Wall Thickness = 0.649": Upset Load Case

DLL: DISTRIBUTED LIGAMENT LENGTH EVALUATION (REVISION: 10/07/94)
DATE OF CURRENT ANALYSIS: 05/14/1995

SUMMARY OF INPUTS:

Angle increment	=	1.0 deg. (COARSE)
Membrane Stress, Pm	=	309. psi
Bending Stress, Pb	=	2375. psi
Safety Factor, SF	=	2.77
Mean Radius, Rm	=	88.75 inches
Wall Thickness, t	=	1.500 inches
Material	=	304 SS
Stress Intensity, Sm	=	16900. psi
Fluence	=	1.9E+19 n/cm^2

(Thus, LEFM evaluation not applicable)

REGION	THETA1 [deg.]	THETA2 [deg.]	THICKNESS [inches]
1	.0	360.0	.649

LIMIT LOAD RESULTS:

ALPHA [deg]	MOMENT [in-lbs]	Pb' [psi]	SAFETY FACTOR	RESULT
.0	1.036E+09	27920.	10.52	ACCEPTABLE
5.0	1.036E+09	27920.	10.52	ACCEPTABLE
10.0	1.036E+09	27920.	10.52	ACCEPTABLE
15.0	1.036E+09	27920.	10.52	ACCEPTABLE
20.0	1.036E+09	27920.	10.52	ACCEPTABLE
25.0	1.036E+09	27920.	10.52	ACCEPTABLE
30.0	1.036E+09	27920.	10.52	ACCEPTABLE
35.0	1.036E+09	27920.	10.52	ACCEPTABLE
40.0	1.036E+09	27920.	10.52	ACCEPTABLE
45.0	1.036E+09	27920.	10.52	ACCEPTABLE
50.0	1.036E+09	27920.	10.52	ACCEPTABLE
55.0	1.036E+09	27920.	10.52	ACCEPTABLE
60.0	1.036E+09	27920.	10.52	ACCEPTABLE
65.0	1.036E+09	27920.	10.52	ACCEPTABLE
70.0	1.036E+09	27920.	10.52	ACCEPTABLE
75.0	1.036E+09	27920.	10.52	ACCEPTABLE

80.0	1.036E+09	27920.	10.52	ACCEPTABLE
85.0	1.036E+09	27920.	10.52	ACCEPTABLE
90.0	1.036E+09	27920.	10.52	ACCEPTABLE
95.0	1.036E+09	27920.	10.52	ACCEPTABLE
100.0	1.036E+09	27920.	10.52	ACCEPTABLE
105.0	1.036E+09	27920.	10.52	ACCEPTABLE
110.0	1.036E+09	27920.	10.52	ACCEPTABLE
115.0	1.036E+09	27920.	10.52	ACCEPTABLE
120.0	1.036E+09	27920.	10.52	ACCEPTABLE
125.0	1.036E+09	27920.	10.52	ACCEPTABLE
130.0	1.036E+09	27920.	10.52	ACCEPTABLE
135.0	1.036E+09	27920.	10.52	ACCEPTABLE
140.0	1.036E+09	27920.	10.52	ACCEPTABLE
145.0	1.036E+09	27920.	10.52	ACCEPTABLE
150.0	1.036E+09	27920.	10.52	ACCEPTABLE
155.0	1.036E+09	27920.	10.52	ACCEPTABLE
160.0	1.036E+09	27920.	10.52	ACCEPTABLE
165.0	1.036E+09	27920.	10.52	ACCEPTABLE
170.0	1.036E+09	27920.	10.52	ACCEPTABLE
175.0	1.036E+09	27920.	10.52	ACCEPTABLE
180.0	1.036E+09	27920.	10.52	ACCEPTABLE
185.0	1.036E+09	27920.	10.52	ACCEPTABLE
190.0	1.036E+09	27920.	10.52	ACCEPTABLE
195.0	1.036E+09	27920.	10.52	ACCEPTABLE
200.0	1.036E+09	27920.	10.52	ACCEPTABLE
205.0	1.036E+09	27920.	10.52	ACCEPTABLE
210.0	1.036E+09	27920.	10.52	ACCEPTABLE
215.0	1.036E+09	27920.	10.52	ACCEPTABLE
220.0	1.036E+09	27920.	10.52	ACCEPTABLE
225.0	1.036E+09	27920.	10.52	ACCEPTABLE
230.0	1.036E+09	27920.	10.52	ACCEPTABLE
235.0	1.036E+09	27920.	10.52	ACCEPTABLE
240.0	1.036E+09	27920.	10.52	ACCEPTABLE
245.0	1.036E+09	27920.	10.52	ACCEPTABLE
250.0	1.036E+09	27920.	10.52	ACCEPTABLE
255.0	1.036E+09	27920.	10.52	ACCEPTABLE
260.0	1.036E+09	27920.	10.52	ACCEPTABLE
265.0	1.036E+09	27920.	10.52	ACCEPTABLE
270.0	1.036E+09	27920.	10.52	ACCEPTABLE
275.0	1.036E+09	27920.	10.52	ACCEPTABLE
280.0	1.036E+09	27920.	10.52	ACCEPTABLE
285.0	1.036E+09	27920.	10.52	ACCEPTABLE
290.0	1.036E+09	27920.	10.52	ACCEPTABLE
295.0	1.036E+09	27920.	10.52	ACCEPTABLE
300.0	1.036E+09	27920.	10.52	ACCEPTABLE
305.0	1.036E+09	27920.	10.52	ACCEPTABLE
310.0	1.036E+09	27920.	10.52	ACCEPTABLE
315.0	1.036E+09	27920.	10.52	ACCEPTABLE

320.0	1.036E+09	27920.	10.52	ACCEPTABLE
325.0	1.036E+09	27920.	10.52	ACCEPTABLE
330.0	1.036E+09	27920.	10.52	ACCEPTABLE
335.0	1.036E+09	27920.	10.52	ACCEPTABLE
340.0	1.036E+09	27920.	10.52	ACCEPTABLE
345.0	1.036E+09	27920.	10.52	ACCEPTABLE
350.0	1.036E+09	27920.	10.52	ACCEPTABLE
355.0	1.036E+09	27920.	10.52	ACCEPTABLE

ACCEPTABLE! MINIMUM SAFETY FACTOR = 10.52 AT 25.0 DEGREES.

H6B Weld Location: Assumed Crack Growth = 0.1"/cycle: 3 cycles of growth: Remaining Wall Thickness = 0.649": Faulted Load Case

DLL: DISTRIBUTED LIGAMENT LENGTH EVALUATION (REVISION: 10/07/94)
DATE OF CURRENT ANALYSIS: 05/14/1995

SUMMARY OF INPUTS:

Angle increment	=	1.0 deg. (COARSE)
Membrane Stress, Pm	=	1099. psi
Bending Stress, Pb	=	3423. psi
Safety Factor, SF	=	1.39
Mean Radius, Rm	=	88.75 inches
Wall Thickness, t	=	1.500 inches
Material	=	304 SS
Stress Intensity, Sm	=	16900. psi
Fluence	=	1.9E+19 n/cm^2

(Thus, LEFM evaluation not applicable)

REGION	THETA1 [deg.]	THETA2 [deg.]	THICKNESS [inches]
1	.0	360.0	.649

LIMIT LOAD RESULTS:

ALPHA [deg]	MOMENT [in-lbs]	Pb' [psi]	SAFETY FACTOR	RESULT
.0	1.032E+09	27801.	6.39	ACCEPTABLE
5.0	1.032E+09	27801.	6.39	ACCEPTABLE
10.0	1.032E+09	27801.	6.39	ACCEPTABLE
15.0	1.032E+09	27801.	6.39	ACCEPTABLE
20.0	1.032E+09	27801.	6.39	ACCEPTABLE
25.0	1.032E+09	27801.	6.39	ACCEPTABLE
30.0	1.032E+09	27801.	6.39	ACCEPTABLE
35.0	1.032E+09	27801.	6.39	ACCEPTABLE
40.0	1.032E+09	27801.	6.39	ACCEPTABLE
45.0	1.032E+09	27801.	6.39	ACCEPTABLE
50.0	1.032E+09	27801.	6.39	ACCEPTABLE
55.0	1.032E+09	27801.	6.39	ACCEPTABLE
60.0	1.032E+09	27801.	6.39	ACCEPTABLE
65.0	1.032E+09	27801.	6.39	ACCEPTABLE
70.0	1.032E+09	27801.	6.39	ACCEPTABLE
75.0	1.032E+09	27801.	6.39	ACCEPTABLE

80.0	1.032E+09	27801.	6.39	ACCEPTABLE
85.0	1.032E+09	27801.	6.39	ACCEPTABLE
90.0	1.032E+09	27801.	6.39	ACCEPTABLE
95.0	1.032E+09	27801.	6.39	ACCEPTABLE
100.0	1.032E+09	27801.	6.39	ACCEPTABLE
105.0	1.032E+09	27801.	6.39	ACCEPTABLE
110.0	1.032E+09	27801.	6.39	ACCEPTABLE
115.0	1.032E+09	27801.	6.39	ACCEPTABLE
120.0	1.032E+09	27801.	6.39	ACCEPTABLE
125.0	1.032E+09	27801.	6.39	ACCEPTABLE
130.0	1.032E+09	27801.	6.39	ACCEPTABLE
135.0	1.032E+09	27801.	6.39	ACCEPTABLE
140.0	1.032E+09	27801.	6.39	ACCEPTABLE
145.0	1.032E+09	27801.	6.39	ACCEPTABLE
150.0	1.032E+09	27801.	6.39	ACCEPTABLE
155.0	1.032E+09	27801.	6.39	ACCEPTABLE
160.0	1.032E+09	27801.	6.39	ACCEPTABLE
165.0	1.032E+09	27801.	6.39	ACCEPTABLE
170.0	1.032E+09	27801.	6.39	ACCEPTABLE
175.0	1.032E+09	27801.	6.39	ACCEPTABLE
180.0	1.032E+09	27801.	6.39	ACCEPTABLE
185.0	1.032E+09	27801.	6.39	ACCEPTABLE
190.0	1.032E+09	27801.	6.39	ACCEPTABLE
195.0	1.032E+09	27801.	6.39	ACCEPTABLE
200.0	1.032E+09	27801.	6.39	ACCEPTABLE
205.0	1.032E+09	27801.	6.39	ACCEPTABLE
210.0	1.032E+09	27801.	6.39	ACCEPTABLE
215.0	1.032E+09	27801.	6.39	ACCEPTABLE
220.0	1.032E+09	27801.	6.39	ACCEPTABLE
225.0	1.032E+09	27801.	6.39	ACCEPTABLE
230.0	1.032E+09	27801.	6.39	ACCEPTABLE
235.0	1.032E+09	27801.	6.39	ACCEPTABLE
240.0	1.032E+09	27801.	6.39	ACCEPTABLE
245.0	1.032E+09	27801.	6.39	ACCEPTABLE
250.0	1.032E+09	27801.	6.39	ACCEPTABLE
255.0	1.032E+09	27801.	6.39	ACCEPTABLE
260.0	1.032E+09	27801.	6.39	ACCEPTABLE
265.0	1.032E+09	27801.	6.39	ACCEPTABLE
270.0	1.032E+09	27801.	6.39	ACCEPTABLE
275.0	1.032E+09	27801.	6.39	ACCEPTABLE
280.0	1.032E+09	27801.	6.39	ACCEPTABLE
285.0	1.032E+09	27801.	6.39	ACCEPTABLE
290.0	1.032E+09	27801.	6.39	ACCEPTABLE
295.0	1.032E+09	27801.	6.39	ACCEPTABLE
300.0	1.032E+09	27801.	6.39	ACCEPTABLE
305.0	1.032E+09	27801.	6.39	ACCEPTABLE
310.0	1.032E+09	27801.	6.39	ACCEPTABLE
315.0	1.032E+09	27801.	6.39	ACCEPTABLE

320.0	1.032E+09	27801.	6.39	ACCEPTABLE
325.0	1.032E+09	27801.	6.39	ACCEPTABLE
330.0	1.032E+09	27801.	6.39	ACCEPTABLE
335.0	1.032E+09	27801.	6.39	ACCEPTABLE
340.0	1.032E+09	27801.	6.39	ACCEPTABLE
345.0	1.032E+09	27801.	6.39	ACCEPTABLE
350.0	1.032E+09	27801.	6.39	ACCEPTABLE
355.0	1.032E+09	27801.	6.39	ACCEPTABLE

ACCEPTABLE! MINIMUM SAFETY FACTOR = 6.39 AT 25.0 DEGREES.

Safety Review Cover Sheet (with Signatures)

Page On File

10 CFR50.59 Program Manual Rev. 3

ATTACHMENT A
CP&L SAFETY REVIEW PACKAGE

PART I: SAFETY ANALYSIS
(See instructions in Section 8.4.1)
(Attach additional sheets as necessary.)

DOCUMENT NO. SE 95-0134 REV. NO. 1

DESCRIPTION OF CHANGE: **Invessel Visual Inspection (IVVI) of selected Core Shroud welds was performed per OPT-90.1 during the B110R1 outage. Additionally, Ultrasonic UT) inspections were performed on selected welds. Inspections revealed minimal growth in cracks which had been identified and analyzed during the previous Refueling Outage (RFO B109R1). Relevant indications were identified in welds H6a and H6b in areas that had not been previously UT inspected.**

ANALYSIS: **The reactor internals perform the following safety related design basis functions as specified in the UFSAR:**

1. **Provide a floodable volume in which the core can be adequately cooled in the event of a breach in the nuclear system process barrier external to the reactor vessel.**

2. **Limit deflections and deformation to assure that the control rods and the core standby cooling systems can perform their safety functions during abnormal operational transients and accidents.**

3. **Assure that the safety design bases (1) and (2) above are satisfied so that the safe shutdown of the plant and removal of decay heat are not impaired.**

Intergranular stress corrosion cracking (IGSCC) of the type and form experienced with recirculation piping and related systems in Boiling Water Reactors (BWRs) is the cause of cracking. Crack extension is possibly assisted by neutron fluence and "oxide wedging" at certain locations. Susceptible material conditions, high residual stress from fabrication, and exposure to a strong oxidizing environment are sufficient to produce the cracking observed. Because these factors are not consistently present across the shroud, the location and degree of cracking varies across the shroud.

The core shroud must maintain a floodable volume above the two-thirds core height elevation. The cracks are caused by intergranular stress corrosion cracking, and inherently are tight. Any through wall cracks would result in negligible leakage into the downcomer region and the leakage would be contained by the reactor pressure vessel. The Emergency Core Cooling systems provide sufficient make-up and cooling capacity to ensure that the fuel will remain covered.

EER 93-0536 was issued to assess Unit 1 shroud structural integrity after RFO B109R1 and to justify continued operation for one cycle. The RFO B110R1 inspections are complete and ESR 95-00765 provides results of the analysis of the cracking on the Unit 1 shroud, and therefore serves as an update to EER 93-0536, Revision 1. Structural integrity of the core shroud will be maintained, with full FSAR safety margins, for a minimum of two operating cycles based on analysis of the inspections performed.

The current inspection results show no significant changes in crack length or patterns, except for the new indications identified by UT on welds H6a and H6b. A weld-specific structural analysis (Attachment A to ESR 95-00765) was performed for these indications in accordance with ASME Section III, Appendix A guidelines and results were acceptable.

Estimated crack lengths and patterns through the end of Fuel Cycle #11 (two fuel cycles from the time of this evaluation) are fully bounded by the previous analyses (References 1, 2 and 3), based on trending from inspection results and on conservative analyses. Therefore, all conclusions reached in the analyses remain valid for the next two fuel cycles. The Core Shroud cracks have been previously addressed in a 10 CFR50.59 Safety Evaluation in EER 93-0536, Revision 1 (Reference 4). Since the Safety Evaluation considered crack growth rates and end-of-cycle crack lengths, patterns, and consequences postulated by the analyses, the Safety Evaluation fully bounds the current condition and supports continued operation for the next two fuel cycles.

REFERENCES:

1) General Electric Report # GE-NE-523-123-0993, Revision 2, November, 1993

2) Structural Integrity Report # RAM-94-092/SIR-94-029, April, 1994

3) Structural Integrity Report # RAM-94-099/SIR-94-031, April, 1994

4) EER No. 93-0536 and associated 10 CFR50.59 Safety Evaluation, Revision 1

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ATTACHMENT A
CP&L SAFETY REVIEW PACKAGE
PART II: ITEM CLASSIFICATION

DOCUMENT NO. SE-95-0134 REV. NO. 1

			Yes	No
1.	Does this item represent:			
	a.	A change to the facility as described in the SAFETY ANALYSIS REPORT?	[]	[X]
	b.	A change to the procedures as described in the SAFETY ANALYSIS REPORT?	[]	[X]
	c.	A test or experiment not described in the SAFETY ANALYSIS REPORT?	[]	[X]
2.	Does this item involve a change to the individual plant Operating License or to its Technical Specifications?		[]	[X]
3.	Does this item require a revision to the FSAR?		[]	[X]
4.	Does this item involve a change to the Off-Site Dose Calculation Manual?		[]	[X]
5.	Does this item constitute a change to the Process Control Program?		[]	[X]
6.	Does this item involve a major change to a Radwaste Treatment System?		[]	[X]
7.	Does this item involve a change to the Technical Specification Equipment List (BSEP and SHNPP only)?		[]	[X]
8.	Does this item impact the NPDES Permit (all 3 sites) or constitute an "unreviewed environmental question" (SHNPP Environmental Plan, Section 3.1) or a "significant environmental impact" (BSEP)?		[]	[X]
9.	Does this item involve a change to a previously accepted:			
	a.	Quality Assurance Program	[]	[X]
	b.	Security Plan (including Training, Qualification, and Contingency Plans)?	[]	[X]
	c.	Emergency Plan?	[]	[X]
	d.	Independent Spent Fuel Storage Installation license? (If "yes," refer to Section 8.4.2, "Question 9," for special considerations. Complete Part VI in accordance with Section 8.4.6)	[]	[X]

SEE SECTION 8.4.2 FOR INSTRUCTIONS FOR EACH "YES" ANSWER.

REFERENCES. List FSAR and Technical Specification references used to answer questions 1-9 above. Identify specific reference sections used for any "Yes" answer.

UFSAR Sections 1.2.2.5.11, 3.2.1.2, 3.9.2.5.1, 3.9.5.1, 5.3.1, 5.3.3.1.2.3, 5.4.1, 7.3.3.1.3.5, 7.7.1.1.2.2, 7.3.3, 9.3.4.2, and Chapter 15
Unit 1 Technical Specification Sections 3/4.3.3 and associated basis

ATTACHMENT 2

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PART III: UNREVIEWED SAFETY QUESTION DETERMINATION SCREEN

DOCUMENT NO. SE 95-0134 REV. NO. 1

	Yes	No
1. Is this change fully addressed by another completed UNREVIEWED SAFETY QUESTION determination? (See Sections 7.2.1, 7.2.2.5, and 7.9.1.1)	[X]	[]

REFERENCE DOCUMENT: EER No. 93-0536 REV. NO. 1

	Yes	No
2. For procedures, is the change a non-intent change which only (check all that apply): (See Section 7.2.2.3)	[NA]	[NA]

[] Corrects typographical errors which do not alter the meaning or intent of the procedure; or,

[] Adds or revises steps for clarification (provided they are consistent with the original purpose or applicability of the procedure); or,

[] Changes the title of an organizational position; or,

[] Changes names, addresses, or telephone numbers of persons; or,

[] Changes the designation of an item of equipment where the equipment is the same as the original equipment or is an authorized replacement; or,

[] Changes a specified tool or instrument to an equivalent substitute; or,

[] Changes the format of a procedure without altering the meaning, intent, or content; or

[] Deletes a part or all of a procedure, the deleted portions of which are wholly covered by approved plant procedures?

If the answer to either Question 1 or Question 2 in PART III is "Yes," then PART IV need not be completed.

References: BWR Core Shroud Evaluation "Load Definition Guideline", SL-4942, Rev. 0

Symbols:

D =Dead Loads
B =Buoyancy Forces
P =Internal Pressure Differential
Pn =Normal Pressure
Pu =Upset Pressure
Pf =Faulted Pressure
MSLOCA =Main Steam LOCA
RRLOCA =Reactor Recirculation LOCA
OBE =Operating Basis Earthquake
SSE =Safe Shutdown Earthquake
Pm =Primary Membrane Stresses
Pb =Primary Bending Stresses

This spreadsheet uses the absolute sum method for combination of stresses and may need to be modified to accomodate plant specific requirements for the combination of loads and stresses.

Inputs:

Vertical OBE = 2/3 Horiz. OBE	0.0535 g	Normal Head Dp	10 Psi
Vertical SSE = 2/3 Horiz. SSE	0.1070 g	Upset Head Dp	11.8 Psi
Density Water =	0.036 lb./in^3	Faulted Head Dp	29.4 Psi
Density Shroud =	0.290 lb./in^3	Normal Core Plate Dp	20 Psi
Shroud Head Area =	27317.915 In.^2	Upset Core Plate Dp	22.4 Psi
Acoustic Load =	60.000 Kips	Faulted Core Plate Dp	32 Psi
Acoustic Uniform =	0.195 K/In.	Number of Drive Tubes	177
		Drive Tube Diameter	10.875 In.
		Core Pl. Effective Area	7474.8184 In.^2

Notes:

1. The shaded headings represent the design inputs used to calculate the stresses.
2. Maximum primary membrane and bending stresses are for use in limit load calculations.
3. Negative values for loads indicate that they act upward opposite gravity.
4. Negative values for stresses indicate tension.

SUMMARY OF LOADS AND STRESSES AT EACH HORIZONTAL WELD LOCATION - Brunswick Unit 1

Shroud Weld Designation	Weld Elevation (Inches)	Shroud Outside Radius (Inches)	Shroud Inside Radius (Inches)	Shroud Thickness (Inches)	Shroud Wall Area (In.^2)	Shroud Centerline Section Modulus (In.^3)	OBE Moment (In-Kips)	SSE Moment (In-Kips)	RR LOCA Moment Blowdown (In-Kips)	RR LOCA Moment Acoustic (In-Kips)
H1	388.963	94.750	93.250	1.500	885.929	4.164E +04	2.010E +04	2.650E +04	7.313E +01	2.130E +02
H2	356.963	94.750	93.250	1.500	885.929	4.164E +04	2.630E +04	3.460E +04	3.841E +02	6.039E +02
H3	353.963	88.750	87.250	1.500	829.380	3.650E +04	2.630E +04	3.460E +04	4.290E +02	6.508E +02
H4	317.963	88.750	87.250	1.500	829.380	3.650E +04	3.670E +04	4.890E +04	9.676E +02	1.350E +03
H5	219.713	88.750	87.250	1.500	829.380	3.650E +04	6.620E +04	8.880E +04	4.596E +03	4.541E +03
H6A	183.713	88.750	87.250	1.500	829.380	3.650E +04	7.890E +04	1.060E +05	7.459E +03	6.180E +03
H6B	179.463	85.500	84.000	1.500	798.750	3.385E +04	8.040E +04	1.080E +05	7.860E +03	6.390E +03
H7	127.400	85.500	83.500	2.000	1061.858	4.487E +04	9.970E +04	1.350E +05	1.498E +04	9.251E +03

SUMMARY OF LOADS AND STRESSES AT EACH HORIZONTAL WELD LOCATION - Brunswick Unit 1

Shroud Weld Designation	Shear OBE [Kips]	Shear SSE [Kips]	Shroud Weight [Kips]	Buoyant Force [Kips]	Vertical OBE Uplift [Kips]	Vertical SSE Uplift [Kips]	Effective Weight OBE [Kips]	Effective Weight SSE [Kips]	Horizontal Bending OBE Pb [Psi]	Horizontal Bending SSE Pb [Psi]
H1	191.00	382.00	126.00	15.64	6.74	13.48	103.62	96.88	482.69	636.39
H2	256.00	512.00	137.10	17.02	7.33	14.67	112.75	105.41	631.58	830.91
H3	256.00	512.00	148.60	18.45	7.95	15.90	122.20	114.25	720.64	948.06
H4	286.00	572.00	157.80	19.59	8.44	16.88	129.77	121.33	1005.61	1339.90
H5	329.00	658.00	182.80	22.69	9.78	19.56	150.33	140.55	1813.93	2433.18
H6A	414.00	828.00	192.00	23.83	10.27	20.54	157.89	147.62	2161.92	2904.48
H6B	414.00	828.00	213.80	26.54	11.44	22.88	175.82	164.38	2375.21	3190.58
H7	414.00	828.00	227.10	28.19	12.15	24.30	186.76	174.61	2221.98	3008.71
H8	414.00	828.00	227.10	28.19	12.15	24.30	186.76	174.61	2340.10	3164.71

SUMMARY OF LOADS AND STRESSES AT EACH HORIZONTAL WELD LOCATION - Brunswick Unit 1

Shroud Weld Designation	Dead Load Stresses Pm [Psi]	Buoyency Stresses Pm [Psi]	Vertical OBE Stresses Pm [Psi]	Vertical SSE Stresses Pm [Psi]	Upset & Normal Pressure Stresses Pm [Psi]	MS LOCA Faulted Pressure Stresses Pm [Psi]	RRLOCA Bending Stresses Blowdown Pb [Psi]	RRLOCA Bending Stresses Acoustic Pb [Psi]	Combined Stresses D +B +Pn [Psi]	Combined Stresses D +B +Pu +OBE [Psi] Compression	Combined Stresses D +B +Pu +OBE [Psi] Tension
H1	142.224	-17.655	-7.609	-15.218	-308.353	-906.559	1.756	5.115	-183.785	291.[illegible]00	-674.088
H2	154.753	-19.211	-8.279	-16.559	-308.353	-906.559	9.224	14.503	-172.811	450.434	-812.675
H3	179.170	-22.242	-9.586	-19.171	-329.377	-968.369	11.755	17.833	-172.449	538.604	-902.674
H4	190.263	-23.619	-10.179	-20.358	-329.377	-968.369	26.513	36.986	-162.734	832.694	-1178.519
H5	220.405	-27.361	-11.792	-23.583	-329.377	-968.369	125.922	124.422	-136.333	1665.803	-1962.052
H6A	231.498	-28.738	-12.385	-24.770	-509.628	-1256.771	204.379	189.344	-306.868	1842.664	-2481.170
H6B	267.668	-33.228	-14.320	-28.641	-529.171	-1304.965	232.192	188.789	-294.731	2066.156	-2684.258
H7	213.870	-26.549	-11.442	-22.884	-398.053	-981.620	333.850	206.163	-210.732	1999.811	-2444.158
H8	213.870	-26.549	-11.442	-22.884	-398.053	-981.620	333.850	227.411	-210.732	2117.930	-2562.278

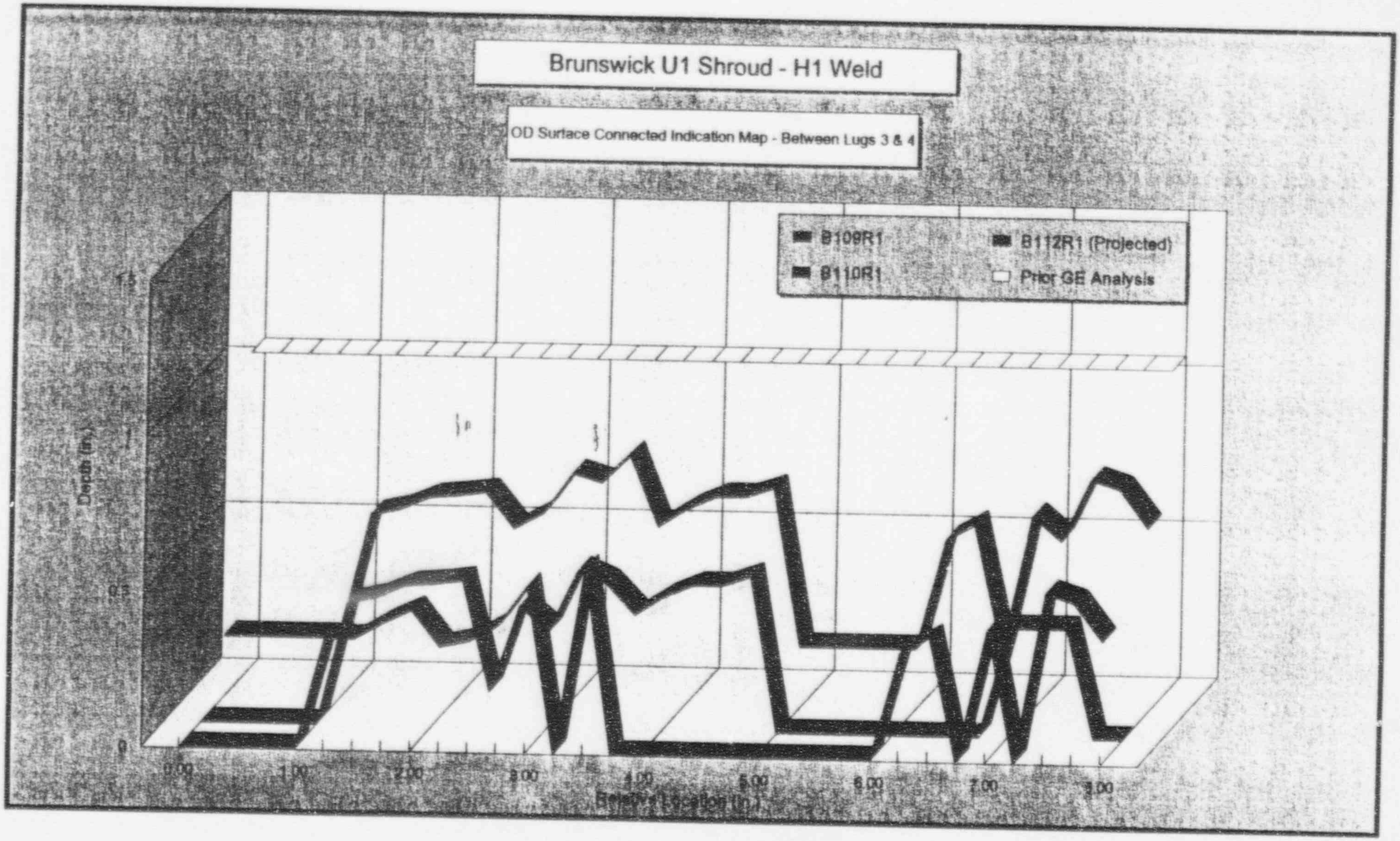
SUMMARY OF LOADS AND STRESSES AT EACH HORIZONTAL WELD LOCATION - Brunswick Unit 1

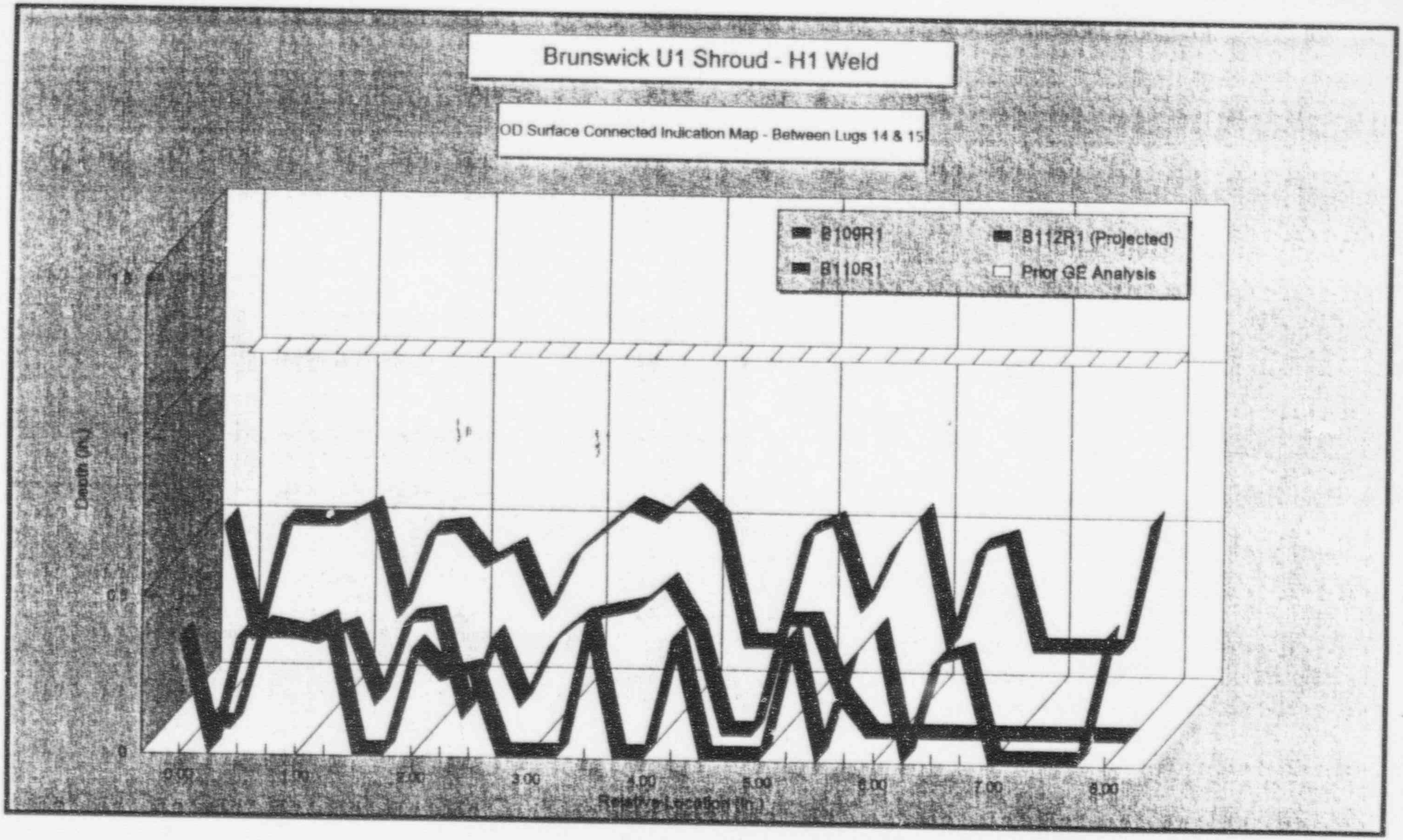
Shroud Weld Designation	Combined Stresses D +B +Pf MS LOCA [Psi]	Combined Stresses D +B +Pn +SSE [Psi] Compression	Combined Stresses D +B +Pn +SSE [Psi] Tension	Combined Stresses D +B +Pf +SSE MS LOCA [Psi] Compression	Combined Stresses D +B +Pf +SSE MS LOCA [Psi] Tension	Combined Stresses D +B +Pf +SSE RR LOCA Blowdown [Psi] Compression	Combined Stresses D +B +Pf +SSE RR LOCA Blowdown [Psi] Tension	Combined Stresses D +B +Pf +SSE RR LOCA Acoustic [Psi] Compression	Combined Stresses D +B +Pf +SSE RR LOCA Acoustic [Psi] Tension
H1	-781.990	437.384	-835.390	-160.821	-1433.595	439.140	-837.146	442.499	-840.505
H2	-771.017	641.536	-1020.275	43.330	-1618.481	650.760	-1029.499	656.039	-1034.779
H3	-811.441	756.444	-1139.685	117.452	-1778.677	768.199	-1151.440	774.277	-1157.518
H4	-801.728	1156.803	-1522.987	517.811	-2161.979	1183.316	-1549.500	1193.790	-1559.973
H5	-775.325	2273.268	-2593.100	1634.276	-3232.092	2399.190	-2719.022	2397.690	-2717.522
H6A	-1054.010	2572.838	-3236.114	1825.696	-3983.257	2777.217	-3440.493	2742.182	-3405.458
H6B	-1070.525	2867.205	-3513.948	2091.412	-4289.742	3099.397	-3746.140	3055.995	-3702.737
H7	-794.299	2775.090	-3242.321	2191.523	-3825.888	3108.940	-3576.172	2981.253	-3448.484
H8	-794.299	2931.096	-3398.328	2347.530	-3981.895	3264.947	-3732.179	3158.507	-3625.739

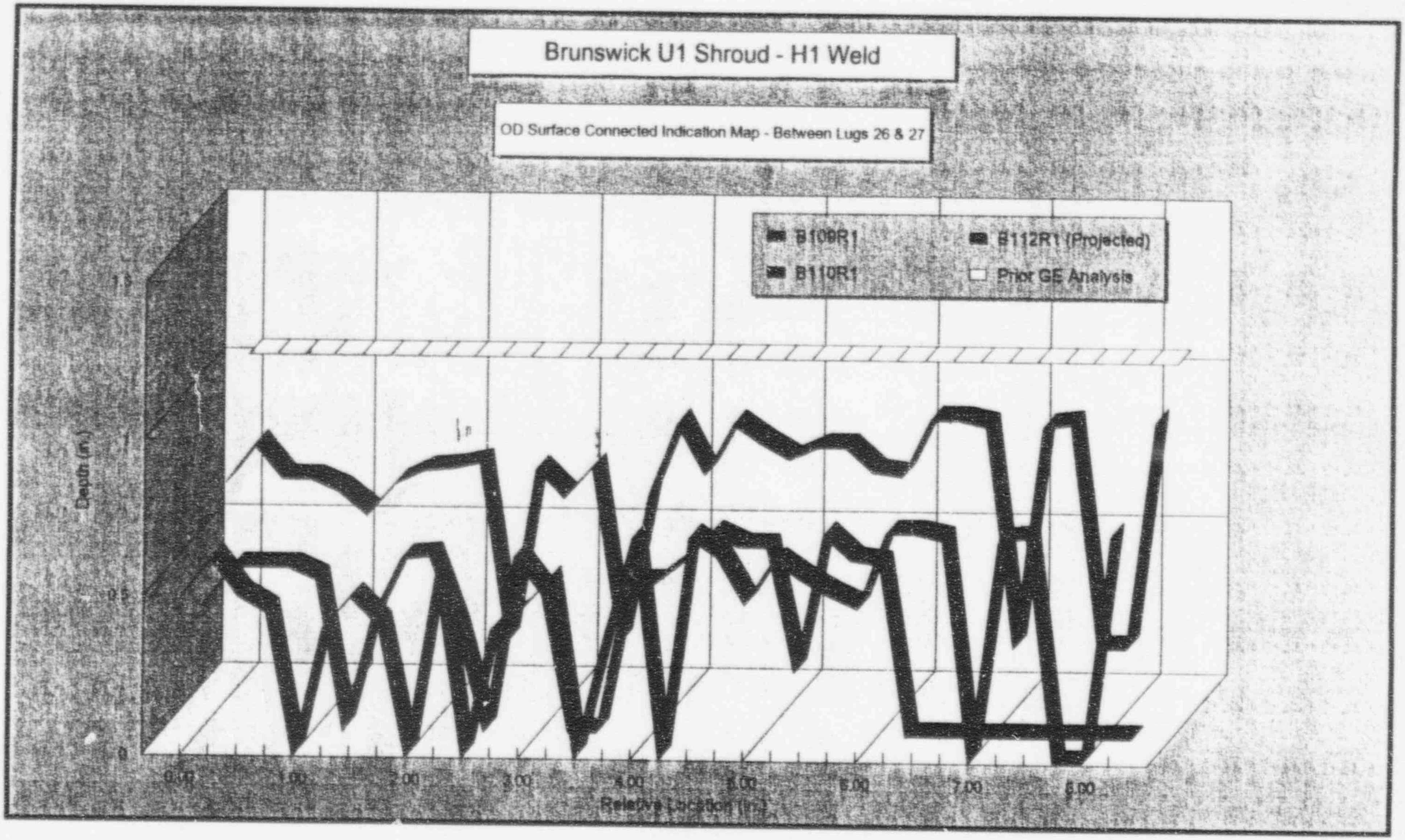
SUMMARY OF LOADS AND STRESSES AT EACH HORIZONTAL WELD LOCATION - Brunswick Unit 1

Shroud Weld Designation	Combined Primary Membrane Stresses Upset D +B +Pu +OBEv [Psi]	Combined Primary Bending Stresses Upset OBEh [Psi]	Combined Primary Membrane Stresses Faulted MS D +B +Pf +SSEv [Psi]	Combined Primary Bending Stresses Faulted SSEh [Psi]	Combined Primary Membrane Stresses Faulted RR D +B +Pf +SSEv [Psi]	Combined Primary Bending Stresses Faulted SSEh +Blowdwn [Psi]	Combined Primary Bending Stresses Faulted SSEh +Acoustic [Psi]	Emergency 1 D +B +Pn +SSE [Psi]	Emergency 2 D +B +MS LOCA [Psi]
H1	-191.394	-482.69	-797.208	-636.39	-199.003	-638.14	-641.50	437.38	-781.99
H2	-181.090	-631.58	-787.575	-830.91	-189.370	-840.13	-845.41	641.54	-771.02
H3	-182.035	-720.64	-830.613	-948.06	-191.620	-959.82	-965.90	756.44	-811.44
H4	-172.913	-1005.61	-822.084	-1339.90	-183.092	-1366.41	-1376.88	1156.80	-801.73
H5	-148.124	-1813.93	-798.908	-2433.18	-159.916	-2559.11	-2557.61	2273.27	-775.32
H6A	-319.253	-2161.92	-1078.780	-2904.48	-331.638	-3108.86	-3073.82	2572.84	-1054.01
H6B	-309.051	-2375.21	-1099.165	-3190.58	-323.371	-3422.77	-3379.37	2867.21	-1070.52
H7	-222.174	-2221.98	-817.183	-3008.71	-233.616	-3342.56	-3214.87	2775.09	-794.30
H8	-222.174	-2340.10	-817.183	-3164.71	-233.616	-3498.56	-3392.12	2931.10	-794.30

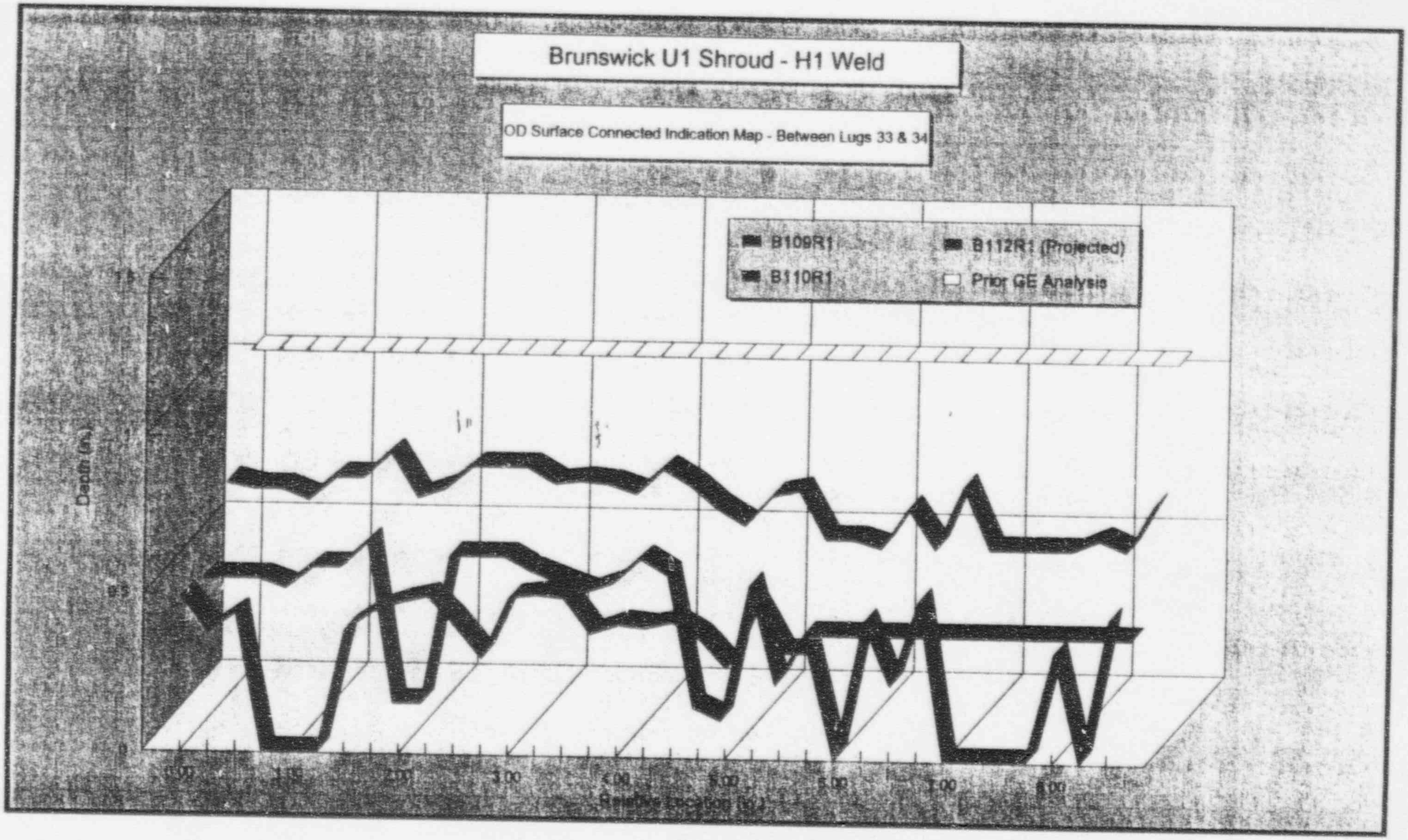
SUMMARY OF LOADS AND STRESSES AT EACH HORIZONTAL WELD LOCATION - Brunswick Unit 1

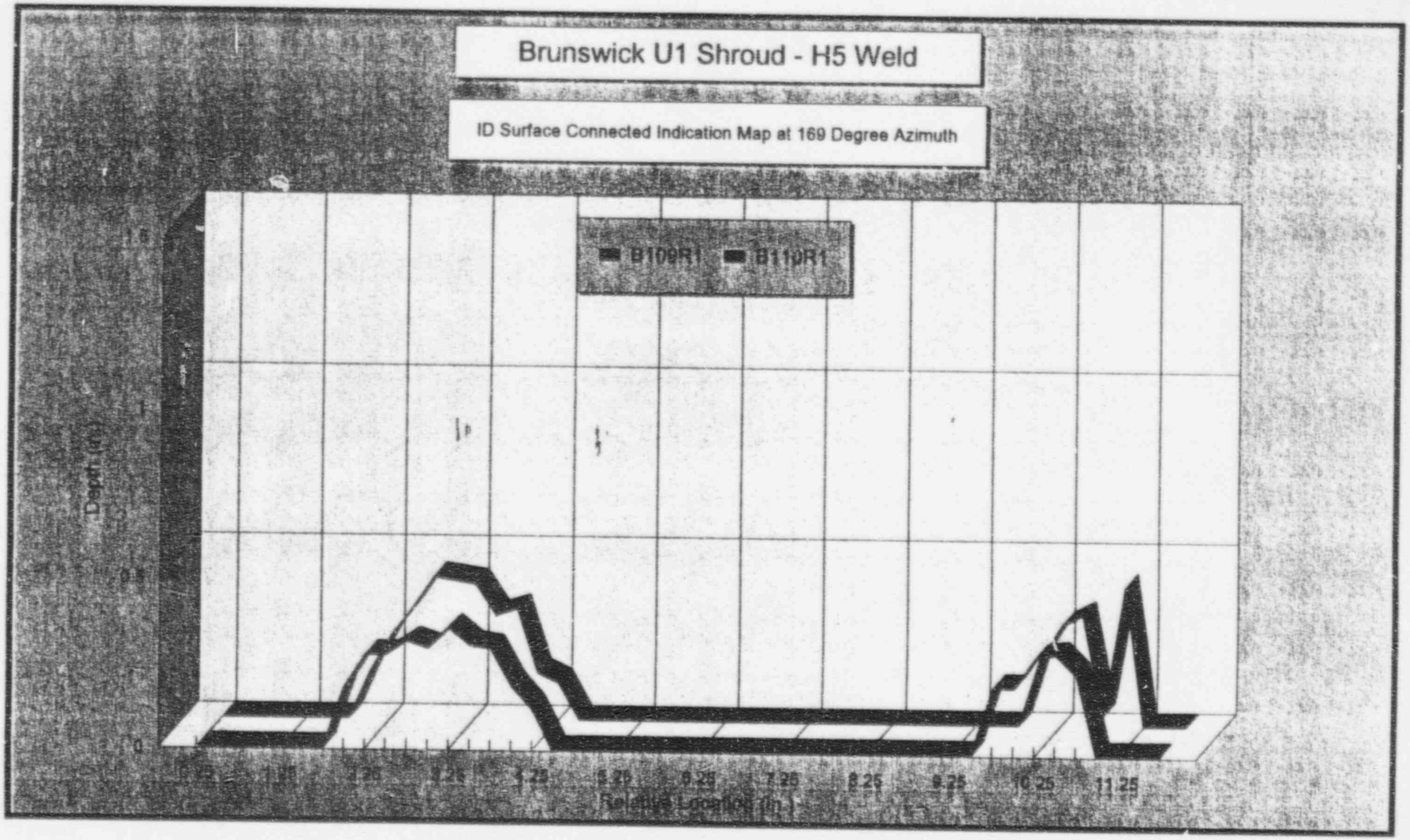

Brunswick U1 Shroud - H1 Weld
OD Surface Connected Indication Map - Between Lugs 3 & 4
B109R1
B110R1
B112R1 (Projected)
Prior GE Analysis
Depth (in.)
1.5
1
0.5
0
0.00
1.00
2.00
3.00
4.00
5.00
6.00
7.00
8.00
Relative Location (in.)

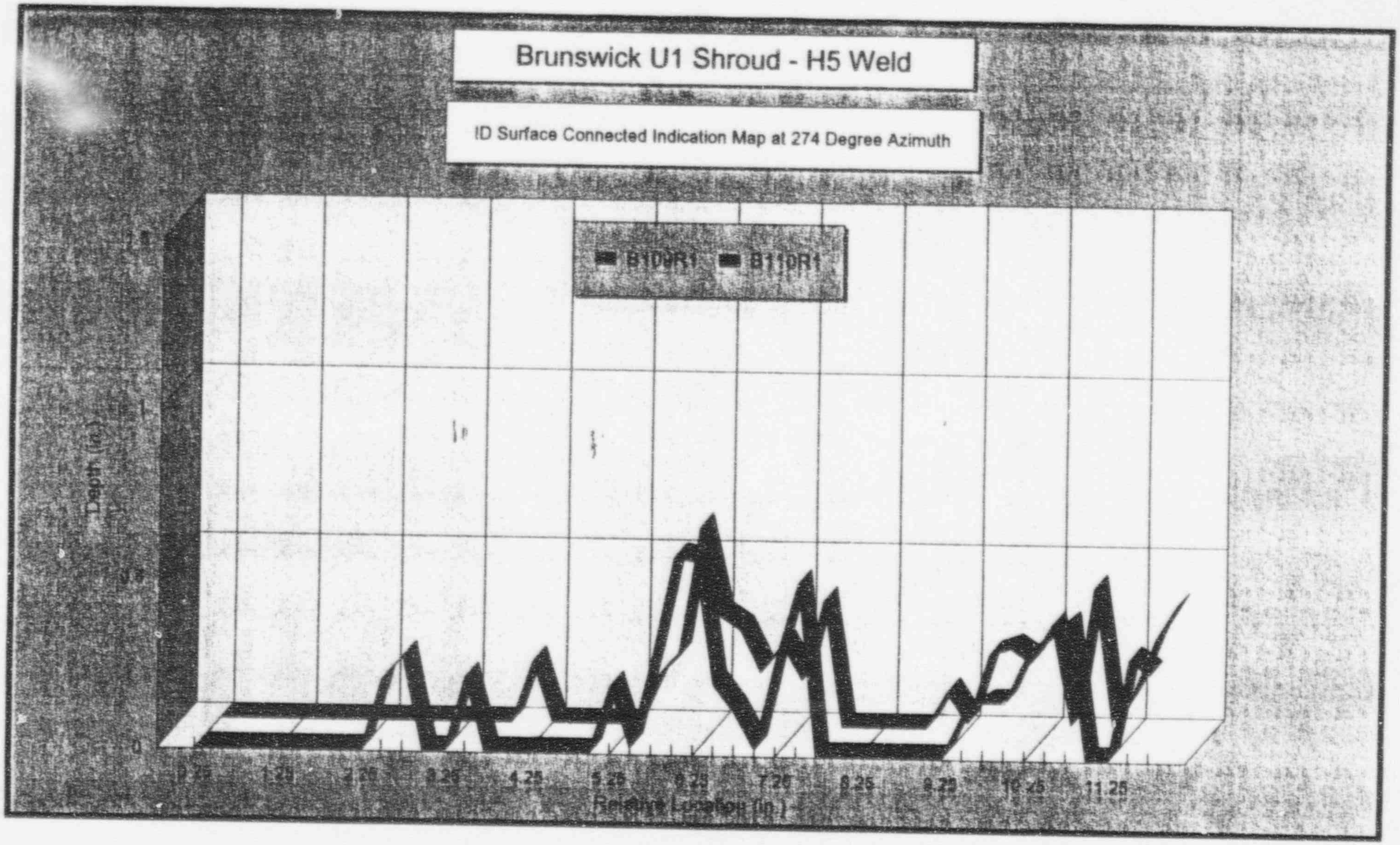

Brunswick U1 Shroud - H1 Weld
OD Surface Connected Indication Map - Between Lugs 14 & 15
B109R1
B110R1
B112R1 (Projected)
Prior GE Analysis
Depth (in.)
1.5
1
0.5
0
0.00
1.00
2.00
3.00
4.00
5.00
6.00
7.00
8.00
Relative Location (in.)



Brunswick U1 Shroud - H1 Weld
OD Surface Connected Indication Map - Between Lugs 26 & 27
B109R1
B110R1
B112R1 (Projected)
Prior GE Analysis
Depth (in.)
0
0.5
1
1.5
0.00
1.00
2.00
3.00
4.00
5.00
6.00
7.00
8.00
Relative Location (in.)


Brunswick U1 Shroud - H1 Weld
OD Surface Connected Indication Map - Between Lugs 33 & 34
B109R1
B110R1
B112R1 (Projected)
Prior GE Analysis
Depth (in.)
Relative Location (in.)


Brunswick U1 Shroud - H5 Weld
ID Surface Connected Indication Map at 169 Degree Azimuth
B109R1
B110R1
Depth (in.)
1.5
1
0.5
0
1.25
2.25
3.25
4.25
5.25
6.25
7.25
8.25
9.25
10.25
11.25
Relative Location (in.)


Brunswick U1 Shroud - H5 Weld
ID Surface Connected Indication Map at 274 Degree Azimuth
B109R1
B110R1
Depth (in.)
Relative Location (in.)
1.25
4.25
5.25
7.25
8.25
9.25
11.25

DISCUSSION OF INDICATIONS BELOW WELD H1

BACKGROUND

The H1 weld was inspected by visual and ultrasonic methods during Refuel Outage (RFO) B109R1, as summarized in Table 1 below.

TABLE 1 - UNIT 1 WELD H1 INSPECTION RESULTS (RFO B109R1)	
VISUAL INSPECTIONS:	100% of OD and ID surfaces were inspected. The cracks are long but not continuous. Primary orientation is circumferential, located on the OD, mainly below the bolting lugs in the Separator Support Ring. Approximately 268° of the circumference (74%) contains cracks. No consistent cracking pattern exists, except for some branching associated with attachment welds. Cracks have been found only on the outer surface.
UT INSPECTIONS:	Measurements were made at eight (8) locations. Depths ranged from < 0.3" to 0.7".

The H1 indications did not meet the preliminary screening criteria of Reference 1, as documented by References 2 and 3. Therefore, specific analysis (Reference 4) was performed by General Electric (GE) in accordance with ASME Section XI (Reference 5) techniques for flawed austenitic stainless steel weldments. The analysis considered postulated "end of cycle" (EOC) crack depths and assumed 360° crack length.

The analysis results demonstrated that the flawed H1 weld had sufficient structural margin to justify continued operation of BNP-1. In fact, calculated safety factors were more than twenty (20) times the required safety factors. A summary is shown in Table 2 below.

TABLE 2 - SUMMARY OF H1 ANALYSIS FROM RFO B109R1						
CONDITION	PRESERVICE SECTION THICKNESS (inches)	ASSUMED E.O.C. CRACK DEPTH (inches)	ASSUMED E.O.C. SECTION THICKNESS (inches)	NET SECTION STRESS (ksi)	CALCULATED SAFETY FACTOR	REQUIRED SAFETY FACTOR
Upset	2.25	1.03	1.22	1.06 ksi	47.7	2.25
Faulted	2.25	1.03	1.22	1.93 ksi	26.3	1.125

During RFO B110R1, the H1 weld was UT examined in four areas (30° , 60° , 140° , and 260°) that had been previously examined during RFO B109R1. Table 3 provides a summary of the RFO B110R1 inspection findings.

TABLE 3 - UNIT 1 WELD H1 INSPECTION RESULTS (RFO B110R1)	
VISUAL INSPECTIONS:	None performed.
UT INSPECTIONS:	Four (4) areas were examined: between Shroud Head Bolt Lug Sets 3-4; 14-15; 26-27; and 33-34. A total of eight (8) OD surface connected planar flaws were detected and maximum observed depth was 0.728". One ID surface connected planar flaw was detected and maximum observed depth was 0.354".

ANALYSIS

Four (4) areas were UT examined that had been previously examined in RFO B109R1. A total of nine planar flaw type indications was detected.

Comparison to RFO B109R1 data is shown in Attachment D to ESR #95-00765, along with postulated crack depths at the end of two additional fuel cycles (RFO B112R1) and a bounding curve from Reference 4. The postulated extent of cracking in RFO B112R1 is explicitly bounded by Reference 4, except for the two indications listed below, which were not addressed by the analysis.

1) Indication #2 between lugs 26 and 27 was not previously reported by GE in the RFO B109R1 report, however a review performed by GE (Reference 6) demonstrates that the same indication was located in RFO B109R1. It was not reported because its connection to the OD surface was indeterminate since a 45° shear wave transducer was not used by GE on the lower side of H1.

2) Indication #1 between lugs 3 and 4 is ID surface connected and was not previously reported by GE in the RFO B109R1 report. However a review (Reference 8) demonstrates that the same indication was located in RFO B109R1, but was interpreted as geometry.

Reference 4 does not specifically evaluate the two indications described above. The indications are both below the H1 weld and therefore the depth of the H1 reinforcement fillet weld leg cannot be added to the remaining ligament for structural evaluation (i.e., the preservice section thickness must be considered to be 1.50 inches in lieu of 2.25 inches).

This analysis considers the cracks below weld H1 in the same terms as the reference 4 analysis.

Average Flaw Depth

The average flaw depth was determined by summing the individual crack depth measurements (for the flaws identified below H1) and dividing by the number of measurements. UT data sheets (Reference 7) indicate that at least 710 millimeters (mm) of circumference was examined during RFO B110R1 and data was recorded at least every five (5) mm. Therefore, approximately 142 readings (710/5) were taken. Of these, less than 25 showed flaws below H1 and the total summed flaw depth for these readings was less than 147 mm. Accordingly, the average flaw depth for a postulated equivalent flaw extending around the entire shroud circumference below H1 is less than 0.05 inches (147mm/142 readings = 1.04 mm < 0.05 inches).

Flaw Growth Rate

The B110R1 inspection data was compared with B109R1 data to determine actual crack growth rates. Based on data comparison, and as shown graphically in Attachment D to ESR #95-00765, crack growth is substantially less than postulated in Reference 4.

Indication #2 between lugs 26 and 27 was not previously reported by GE in the RFO B109R1 report, however a review performed by GE (Reference 6) demonstrates that the same indication was located in RFO B109R1 and showed an approximate depth of 0.45". The RFO B110R1 UT data indicates a maximum depth of 0.472". Thus, the observed crack growth during Fuel Cycle #9 was

0.022". This is significantly less than the maximum equipment uncertainty of the UT equipment used in RFO B109R1 and RFO B110R1, as shown in the following chart:

REFUEL OUTAGE	SURFACE CONNECTION	EQUIPMENT UNCERTAINTY
B109R1	ID or OD	0.1 "
B110R1	ID	0.028"
B110R1	OD	0.011"

H1 crack growth can be conservatively bounded by equipment uncertainties and is considered to be 0.1" per fuel cycle for the purposes of this evaluation.

Safety Factor Determination

Analysis of the surface connected flaws below H1 for the next two fuel cycles is summarized in Table 4 below:

TABLE 4
SUMMARY OF ANALYSIS FROM RFO B110R1
FOR SURFACE CONNECTED FLAWS BELOW WELD H1

CONDITION	PRESERVICE SECTION THICKNESS (Inches)	AVE. B110R1 CRACK DEPTH (Inches)	ASSUMED CRACK GROWTH PER CYCLE (Inches)	B112R1 ASSUMED E.O.C. CRACK DEPTH (Inches)	B112R1 ASSUMED E.O.C. SECTION THICKNESS (Inches)	NET SECTION STRESS (ksi)	COMPUTED SAFETY FACTOR	REQUIRED SAFETY FACTOR
Upset	1.50	0.05	0.10	0.25	1.25	1.03 ksi	48.8	2.25
Faulted	1.50	0.05	0.10	0.25	1.25	1.86 ksi	26.9	1.125

SUMMARY

The remaining net section thickness area projected for the section immediately below the H1 weld after the next two fuel cycles will be greater than that acceptably evaluated in Reference 4 (Compare Table 4 to Table 2). Therefore, the Reference 4 evaluation fully bounds the identified condition below the H1 weld. The postulated crack lengths at the end of Cycle 11 (RFO B112R1) will not reduce the structural design margins below allowable values. Therefore, the evaluated condition does not impose any restrictions to BNP-1 operation during the next two operating cycles.

REFERENCES

1. GE Report GENE-523-123-0993, Rev. 2, "Evaluation and Screening Criteria for the Brunswick 1 Shroud Indications," November 1993.
2. CP&L Calculation No. 1-B21-0049, Revision 0
3. EER 93-0536, Evaluation of Unit 1 Core Shroud Indications and Operability Assessment of Unit 1 and 2, Revision 1
4. GE Report GENE-523-144-1093, "Analysis of Unit 1 Welds H1, H2, & H3 ...," Revision 1, November 1993
5. American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Section XI, 1980 Edition through Winter 1981 Addenda
6. Memorandum, A. R. Jaschke (GE) to John Langdon (CP&L), "Review of Unit 1 1993 Shroud Weld H1 UT Data," dated May 5, 1995
7. RFO B110R1 IVVI and UT reports, including OPT-90.1 data sheets and video cassettes.
8. Memorandum, E. Black (CP&L) to W. B. Wilton (CP&L), "Review of H1 Weld UT Indication at 30 Degree Azimuth", dated April 17, 1995