VERMONT YANKEE NUCLEAR POWER CORPORATION

Ferry Road, Brattleboro, VT 05301-7002

REPLY TO:
ENGINEERING OFFICE
580 MAIN STREET
BOLTON, MA 01740
(508) 779-6711

November 8, 1994
BVY 94-110

United States Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555

References: a. License No. DPR-28 (Docket No. 50-271)
b. Letter VYNPC to USNRC, BVY 94-07, dated February 11, 1994

Subject: Feedwater Nozzle Inspection Relief Request

Vermont Yankee is currently required to perform a liquid penetrant examination of the feedwater nozzle inner radius during the 1995 Refueling Outage. A relief request was submitted to the USNRC proposing an alternative inspection technique [Reference (b)]. On August 30, 1994 a meeting was held with USNRC staff to discuss the relief request. At that meeting we were requested to clarify certain aspects of the inspection and qualification plan. In addition we were requested to provide additional information concerning the fracture mechanics evaluations performed to support the alternative inspection interval. The purpose of this letter is to transmit the requested information.

Vermont Yankee will conduct a blind qualification test of the automated ID inspection technique using a nozzle mockup. The nozzle will be manufactured from similar material and have similar geometry to the Vermont Yankee reactor vessel feedwater nozzle (same nozzle bore ID and same inner radius geometry). Four axial fatigue cracks with crack depths enveloping the range of depths for qualification sizing will be implanted into the mockup and then clad with stainless steel to reflect the actual condition in the reactor vessel. This will hide the implanted flaws from the qualification inspectors.

Following the blind qualification test the flaws will be ground to simulate the grindouts in the actual feedwater nozzles. Because of the depth of the implanted flaws some remnant flaws will remain. The automated ID inspection technique will again be demonstrated for detection and sizing capability.

The manual ultrasonic inspection technique from the OD of the nozzle to cover the area of the bore under the nozzle boss, taper and safe-end attachment region will be demonstrated on the existing feedwater nozzle mockup. This mockup contains axial notches in the nozzle boss and taper regions. Qualification of this technique will be based on industry accepted techniques for relating notches and actual flaws. This mockup and the inspection technique have been reviewed by USNRC Region I personnel in past ISI inspections.

The goal of the qualification testing is to be able to detect flaws that are one eighth inch or greater into the base metal. The goal of the sizing demonstration is to be able to size flaws covering the range of one-eighth inch to one-half inch into the base metal. Early technique development has confirmed these parameters.

A047

The results of the demonstrations will be reported to the USNRC no later than December 31, 1994. We will inform the NRC of the dates for the qualification demonstrations to allow witnessing if desired. The Electric Power Research Institute (EPRI) NDE Center will act as a third party proctor for the qualifications to maintain sample integrity and to confirm NDE technique adequacy.

Enclosure 1 to this letter shows the inspection volumes of the ID and OD inspection techniques, demonstrating the coverage required by NUREG-0619. We were also requested to provide documentation supporting our determination that a four cycle inspection interval is appropriate. The four cycle interval was established by conservatively estimating the number of expected transient cycles during the interval and calculating the flaw growth rate for a missed flaw one half inch deep into the base metal. The flaw growth during the four cycle interval was less than that required to reach the ASME Section XI maximum permissible flaw depth of one tenth the section thickness of the feedwater nozzle. The details of the evaluation are contained in Enclosure 2 to this letter.

We trust that this additional information proves sufficient for your staff to complete their review of our feedwater nozzle inspection plans, resulting in approval of our relief request. Since Vermont Yankee plans to apply this inspection technique during our planned Spring, 1995 refueling outage, we request that NRC assign a high priority to completion of this relief request. Should your staff require any additional information, please contact this office.

Sincerely,

VERMONT YANKEE NUCLEAR POWER CORPORATION

Leonard A. Tremblay, Jr.

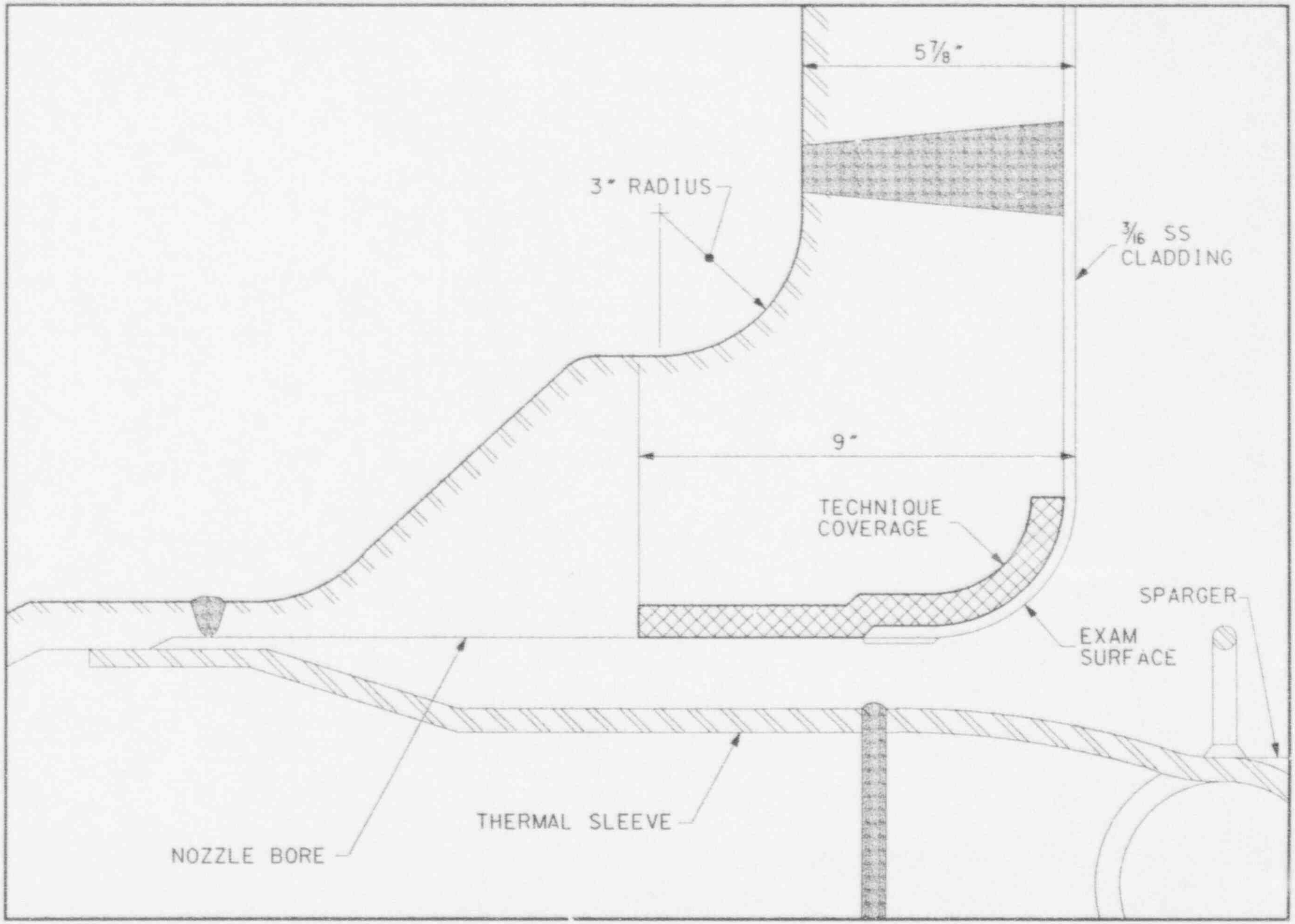
Leonard A. Tremblay, Jr., P.E.
Senior Licensing Engineer

Enclosures 1 and 2

cc: USNRC Region I Administrator
USNRC Resident Inspector - VYNPS
USNRC Project Manager - VYNPS

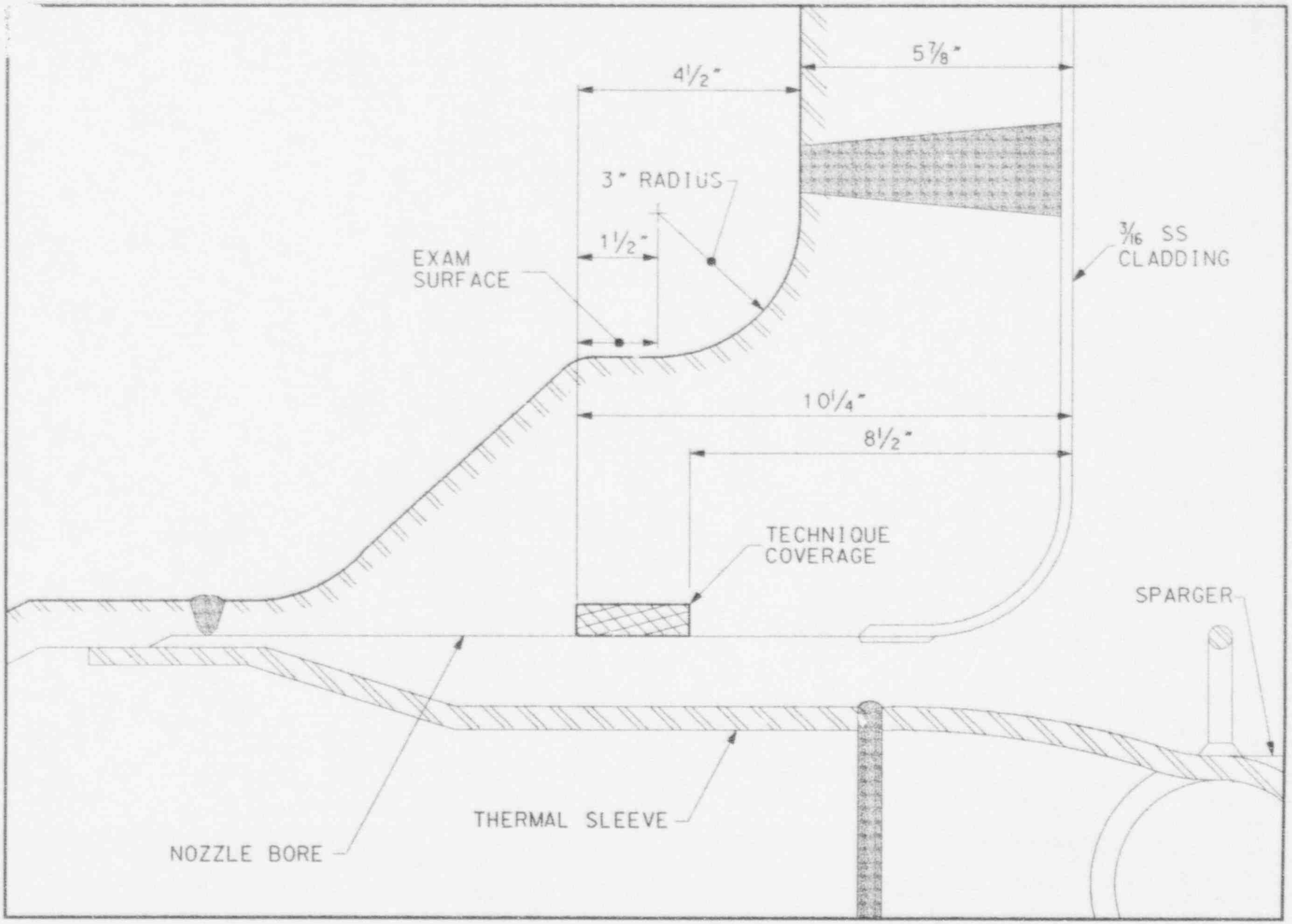
ENCLOSURE 1

COVERAGE WITH NEAR SURFACE ID EXAM TECHNIQUE



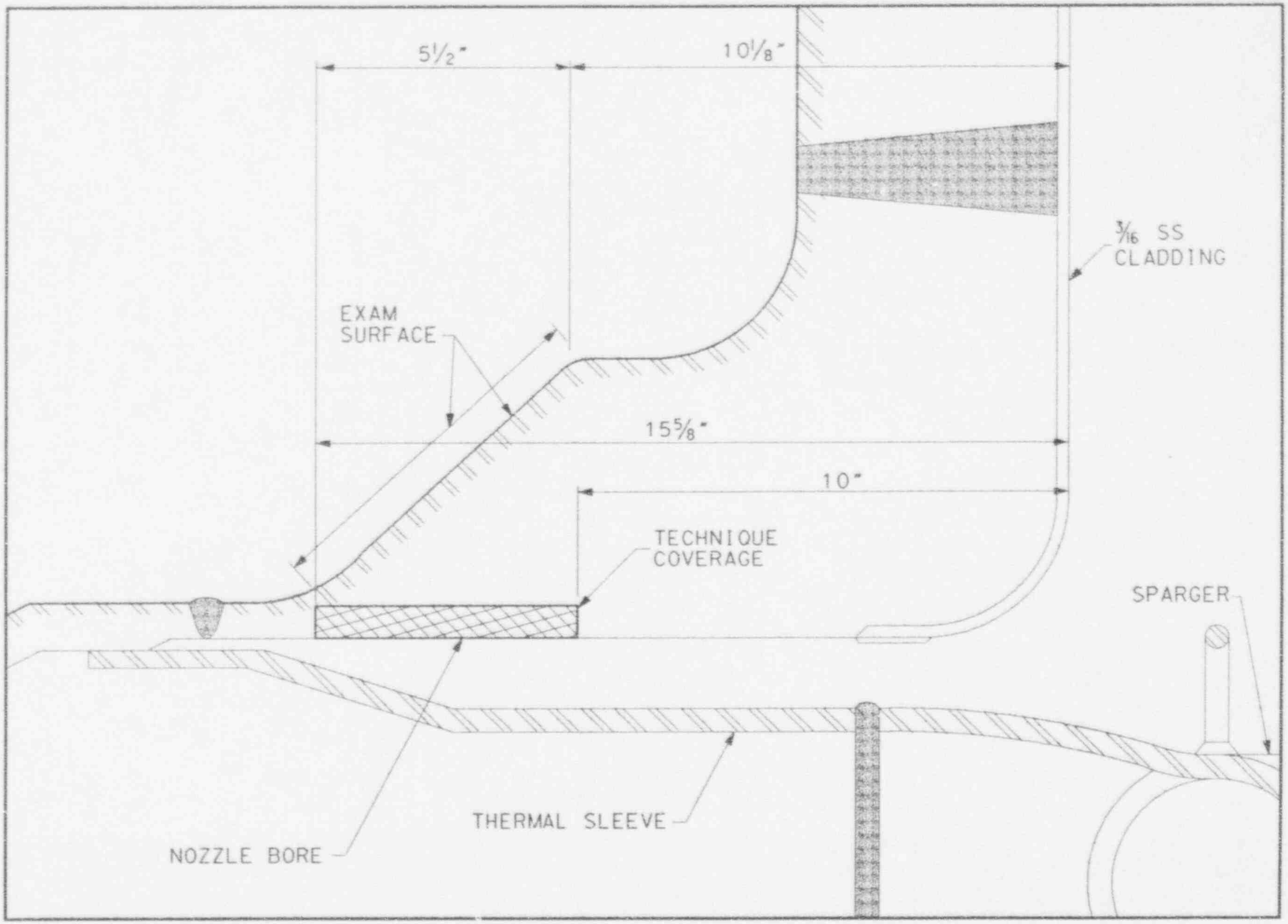
COVERAGE TO 9" DEEP IN NOZZLE BORE IS SPECIFIED IN CONTRACT.

COVERAGE WITH 19° BEAM ANGLE CIRCUMFERENTIAL SCAN EXAM TECHNIQUE



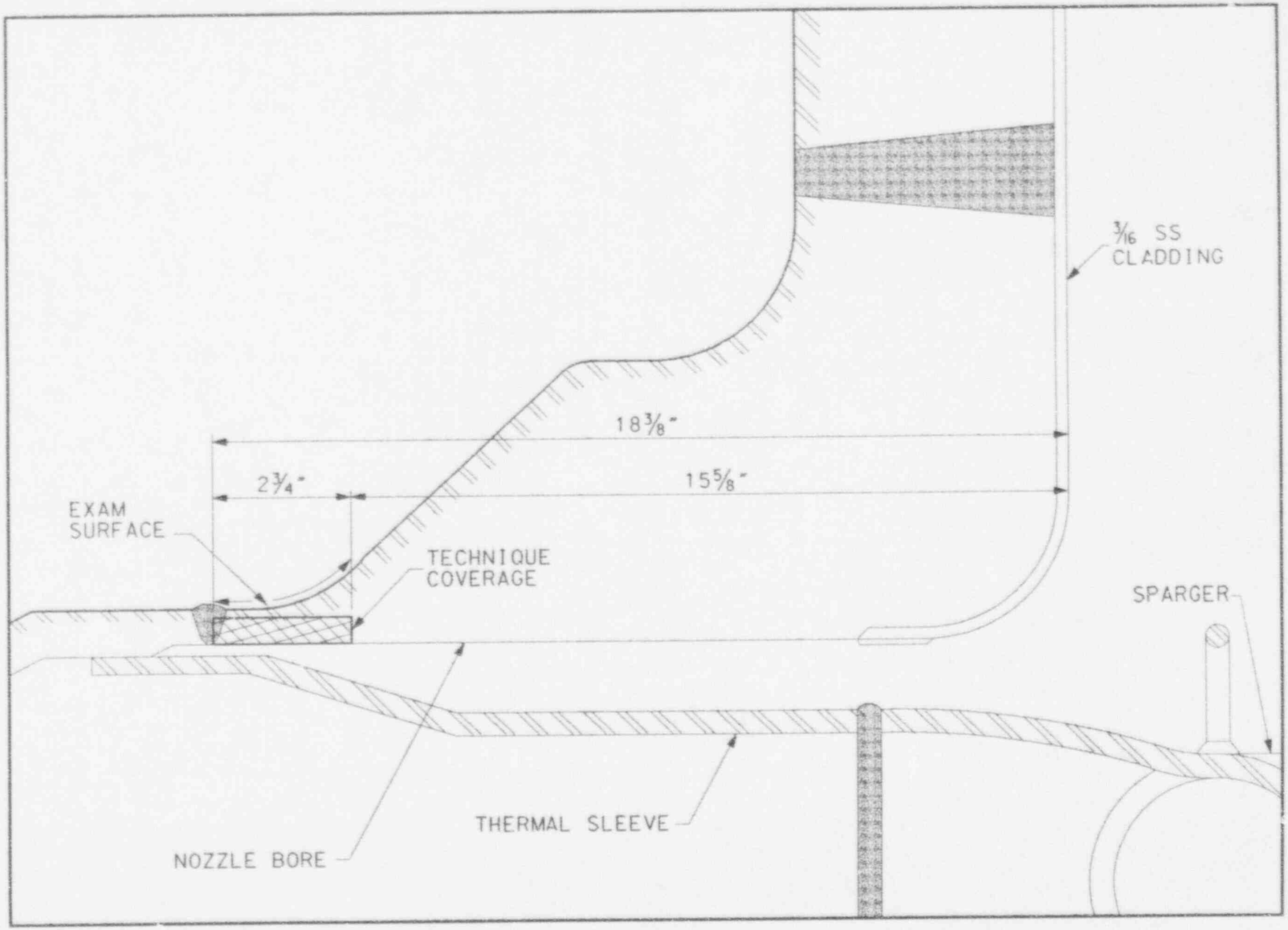
BEAM INTERSECTS ID AT 45° ANGLE

COVERAGE WITH 50° BEAM ANGLE, 48°-63° SKEW SCAN EXAM TECHNIQUE



BEAM INTERSECTS ID AT 45° ANGLE

COVERAGE WITH 39° BEAM ANGLE CIRCUMFERENTIAL SCAN EXAM TECHNIQUE



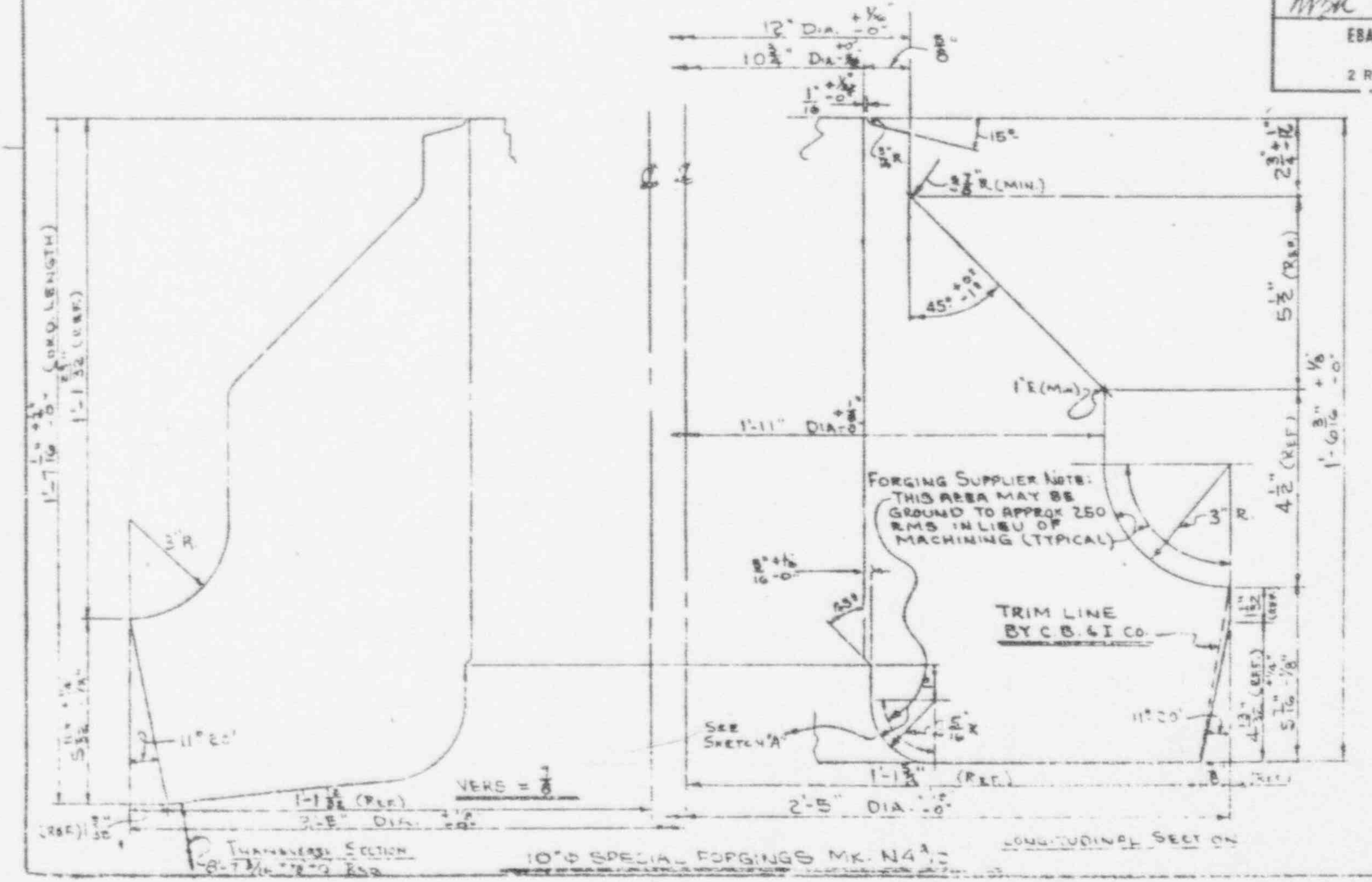
BEAM INTERSECTS ID AT 45° ANGLE

B	PROCEED WITH FABRICATION	NO FURTHER REPRODUCIBLE REQUIRED	4 X
		RESUBMIT REVISED REPRODUCIBLE	5
		RESUBMIT CLOTH OR MYLAR REPRODUCIBLE AS SHIPPED	6
	DO NOT PROCEED WITH FABRICATION RESUBMIT REVISED REPRODUCIBLE		7

SPECIAL FORGINGS
NOZZLES N 4 A THRU
D
(60)

CHECKED BY	DATE	ORIG. DIV.	DAYS TO COMMENT
MJ	5-15-67	N	21

EBASCO SERVICES INCORPORATED
AGENT
2 RECTOR ST., NEW YORK 6, N.Y.



SKETCH "A" - DEPTH BELOW

MATERIAL SPECIFIC
MS-2 (A
FINISH TO BE 25

REVIEWED BY R.F.R. DESIGN ENGINEER
REVIEWED BY R.E.C. WELD ENGINEER

11X17

ENCLOSURE 2

Supplemental Information for Relief from NUREG-0619 Inspection Requirements

Vermont Yankee Feedwater Nozzle

Linear Elastic Fracture Mechanics Evaluation

Table of Contents

List of Sections:

List of Tables:

List of Figures:

List of Attachments:

Reference:

Letter James Pelletier to USNRC, "Request for Relief from NUREG-0619 Inspection Requirements", BVY 94-07, February 11, 1994.

I

Vermont Yankee Feedwater Nozzle Operating Cycles

Table 1 summarizes Vermont Yankee feedwater nozzle cyclic data over the past four operating cycles; XIV, XV, XVI, and XVII. This includes plant experience from September 1987 through August 1993.

This summary was compiled by Engineering with the assistance of senior Vermont Yankee Operations Department personnel. Plant operating logs, scram reports, as well as RPV pressure, reactor level, recirc temperature, feedwater flow, and feedwater temperature records were reviewed to quantify feedwater nozzle startup/shutdown cycling over the last four operating cycles. Attachment 1 includes a more detailed summary by date and event.

Over the last four operating cycles there were 26 total startup events. Feedwater flow remained on for all startup events. While some of these events include full pressurization and heatup many of these startups were from almost full pressure and temperature. The design startup transient (Figure 1), which assumes the reactor was hot during initiation of cold feedwater flow in conjunction with a full pressurization cycle, is a conservative envelope of Vermont Yankee operational startup transients over the last four operating cycles. Based on this recent experience, we have conservatively assumed there will be 35 startup/shutdown cycles over the next four operating cycles.

For the 26 shutdown events, 12 were normal shutdowns and 14 were scram related. Six (6) of the shutdowns were from low power where feedwater heating was never established. The design transient (Figure 1) which assumes a step reduction in feedwater temperature and flow conservatively envelopes the normal Vermont Yankee operational shutdown transients.

Following shutdown, during hot standby or during cooldown, the operational data was reviewed to identify any feedwater flow off/on cycling. A total of 21 off/on feedwater flow changes was identified over the four operating cycles for the A train. The B feedwater train had 30 off/on flow changes. The most common off/on flow events included:

- feedwater pump trip on high level following a scram, and

- RCIC injection tests after shutdown at low feedwater flow.

Other off/on flow events included:

- loss of feed flow due to loss of offsite power followed by HPCI and RCIC on/off injection.

The design transient (Figure 1) depicts five 0% to 25% off/on step flow changes per shutdown. 26 Startup/shutdown design cycles

therefore include 130 additional on/off feedwater flow cycles. The Vermont Yankee operating data indicates that over 26 startup/shutdown cycles Vermont Yankee experienced only 30 additional feedwater cycles.

Based on our review of the feedwater transient data over the past four operating cycles, the Figure 1 startup/shutdown design transient which includes 5 off/on flow changes per shutdown is a conservative representation of typical startup/shutdown fatigue cycle loading.

Vermont Yankee will maintain a cumulative record of feedwater nozzle startup/shutdown transient data between UT exams. We will evaluate the data against the design transient to assess whether the thermal duty is enveloped by the design transient. We will keep a cumulative count of startup/shutdown and on/off flow cycles.

II

Design Transient Stress Information

The NRC requested that Vermont Yankee supply transient stress information at the blend and bore regions for the design transient shown in Figure 1. The transient data depicts through wall stress distribution at the sections shown in the detailed section of the finite element model shown in Figure 5. Stress data for both low and high bypass leak cases are included. The stress data is presented in Attachment 2. Computer files are also included.

The computer codes used to generate the linear elastic fracture mechanics stress intensity values were modified to capture the requested stress information. Documentation and verification of the modified code was also performed.

III

Fatigue Crack Growth Evaluation

Upon review of Vermont Yankee feedwater nozzle transient data the Figure 1 transient was selected as a suitable enveloping transient for normal startup/shutdown cycle counting as demonstrated above in Section I.

Fatigue crack growth curves for this transient assuming an initial 1/2 inch flaw are presented in Figure 2. These curves were developed using the ASME XI crack growth law and the following linear elastic fracture mechanics stress intensity relation:

$$K_I(t) = \sqrt{\pi a}\,[0.706\ C_0(t) + 0.537\ (2a/\pi)\ C_1(t) + 0.448(a^2/2)\ C_2(t) + 0.393\ (4a^3/3\pi)\ C_3(t)]$$

where:

a is the crack depth

C_0, C_1, C_2, C_3 are time dependent stress coefficients

The time dependent stress coefficients where developed with the following third order polynomial function to represent through wall hoop stress distribution at the bore and blend sections:

$$\sigma(x, t) = C_0(t) + C_1(t)\,x + C_2(t)\,x^2 + C_3(t)\,x^3$$

Both ***x*** and crack depth are measured from the inside surface.

In this relief request, we have proposed performing a more detailed evaluation of transients and performing additional crack growth evaluations if the number of startup/shutdown cycles exceeds 35 cycles. As demonstrated in Section I, the Figure 1 transient is a conservative representation of typical startup/shutdown fatigue cycle loading. As shown in Figure 2, in 35 startup/shutdown design cycles a 0.50 inch initial flaw would grow to less than 0.56 inches, much less than the 0.823 inch ASME XI allowable flaw size.

An alternate fracture mechanics evaluation was run using a startup/shutdown transient which included, 30 hot standby off/on feedwater injections assuming a 335^{O}F RPV/feedwater temperature differential and 10 cooldown off/on feedwater injections assuming a 200^{O}F RPV/feedwater temperature differential.

This transient is not easily applied to cycle counting. There are far too many assumed hot standby and cooldown cycles to apply this transient to each plant startup/shutdown event.

On 8/30/94 this crack growth curve was presented as a conservative crack growth curve for the Figure 1 design transient. Upon further evaluation, the 8/30/94 curve was found to be an overly conservative representation. The Figure 2 curve was specifically developed from the Figure 1 design transient and should be used as the representative curve for comparison when performing evaluations.

IV

Additional Fatigue Crack Growth Evaluations

A more detailed evaluation of transients and additional crack growth evaluation will be performed in the following cases:

Startup/shutdown cycles are projected to exceed 35 cycles prior to the next scheduled UT exam.

Additional feedwater on/off cycles are projected to exceed 175 cycles (5 x 35) prior to the next scheduled UT exam.

The Figure 1 design transient cannot be used as a conservative representation of an operating transient.

In the event that conservative crack growth projections based on conservative estimates of pre-existing flaw size and fatigue loading could approach the ASME Section XI (by analysis) allowable flaw size within the four cycle inspection interval, the inspection frequency will be adjusted accordingly.

Table 1 (Page 1 of 2).
Feedwater Nozzle Fatigue Cycle Summary;
Operating Cycles XIV, XV, XVI, XVII.

FEEDWATER NOZZLE SUMMARY		RPV/FEEDWATER STARTUP-SHUTDOWN CYCLES			FW HEATING ON/OFF CYCLES		ADDITIONAL FEEDWATER CYCLES DURING OPERATION			
							A-TRAIN NOZLS		B-TRAIN NOZLS	
PERIOD	DATE	SU	NON SCRAM SD	SCRAM SD	FW HTG ON	FW HTG OFF	FLOW ON	FLOW OFF	FLOW ON	FLOW OFF
CYCLE XIV	10/87 TO 2/89	8	3	5	6	6	6	6	7	7
CYCLE XV	4/89 TO 8/90	4	2	2	3	3	3	3	4	4
CYCLE XVI	10/90 TO 3/92	12	5	7	10	10	10	10	16	16
CYCLE XVII	4/92 TO 8/93	2	2	0	3	3	2	2	3	3
TOTALS	10/87 TO 8/93	26	12	14	22	22	21	21	30	30

Table 1 (Page 2 of 2).
Feedwater Nozzle Fatigue Cycle Summary;
Operating Cycles XIV, XV, XVI, XVII.

Definitions
(Also applicable to Attachment 1 detail cycle summary)

1. SU: Startup cycles include startup events ranging from startup from cold shutdown through heatup and power ascension to startup from hot standby and power ascension.

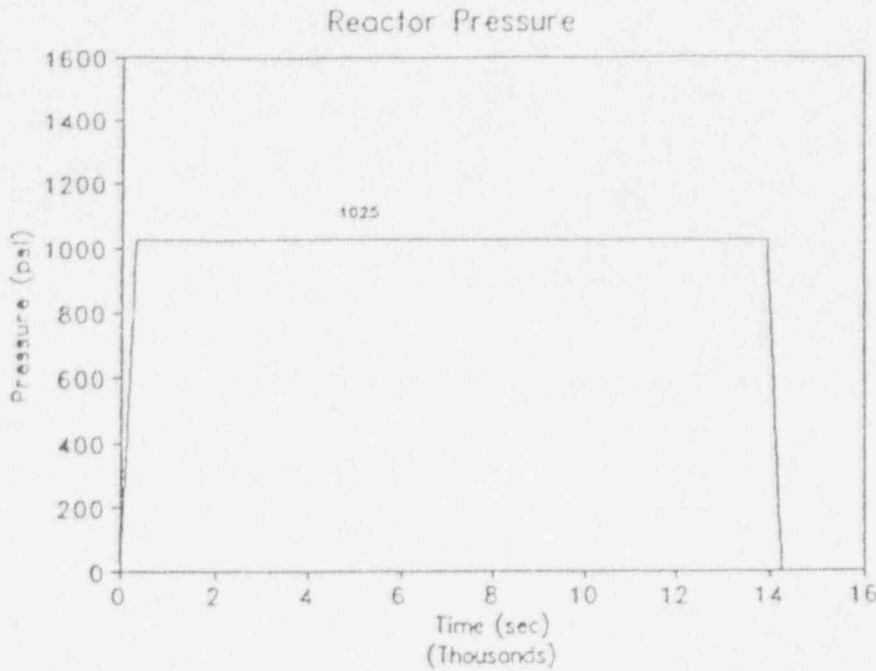
2. Non Scram SD: Non scram shutdown cycles include operator controlled power reductions to hot standby or to cold shutdown.

3. Scram SD: Scram shutdown cycles include low power through full power scram events.

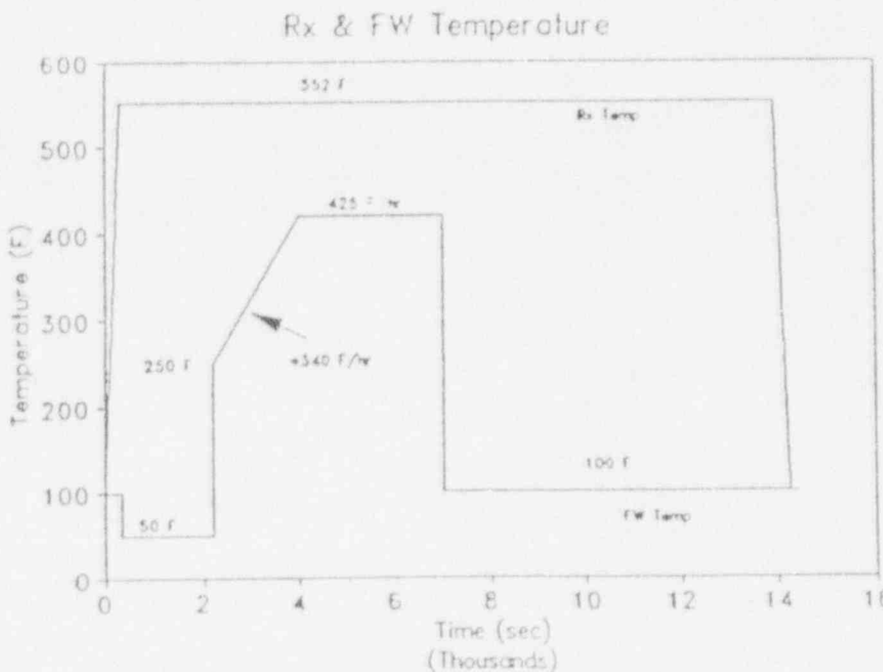
4. FW Htg On/Off Cycles: Feedwater heating On/Off cycles. During heatup and at low power feedwater is at approximately condenser temperature. At approximately 15 to 20% power extraction steam is routed to the feedwater heaters and feedwater heating is established. Table 1 and Attachment 1 indicate for each startup event whether feedwater heating was established and whether feedwater heating was on when each shutdown event was initiated.

5. A/B-Train Nozls On/Off Cycles: Feedwater train on/off flow cycles. Normally feedwater flow is continuous during heatup, normal operation, and cooldown. Table 1 and Attachment 1 indicate events during heatup, hot standby, or cooldown when feedwater flow was interrupted and reinstated.

Figure 1 (Pg 1 of 2). Startup/Shutdown Cycle Design Transient

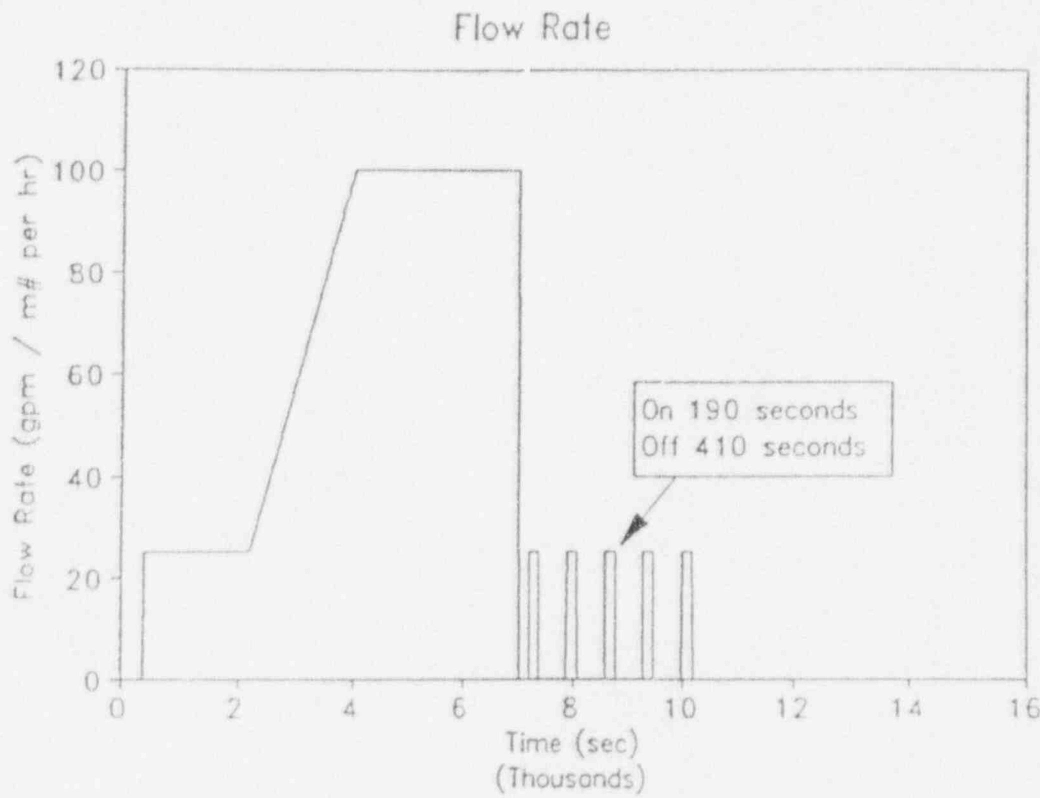


Pressure Transient



Temperature Transients

Figure 1 (Pg 2 of 2). Startup/Shutdown Cycle Design Transient



Feedwater Flow Rate Transient

Figure 2. Feedwater Nozzle Crack Growth; Startup/Shutdown Cycle Design Transient

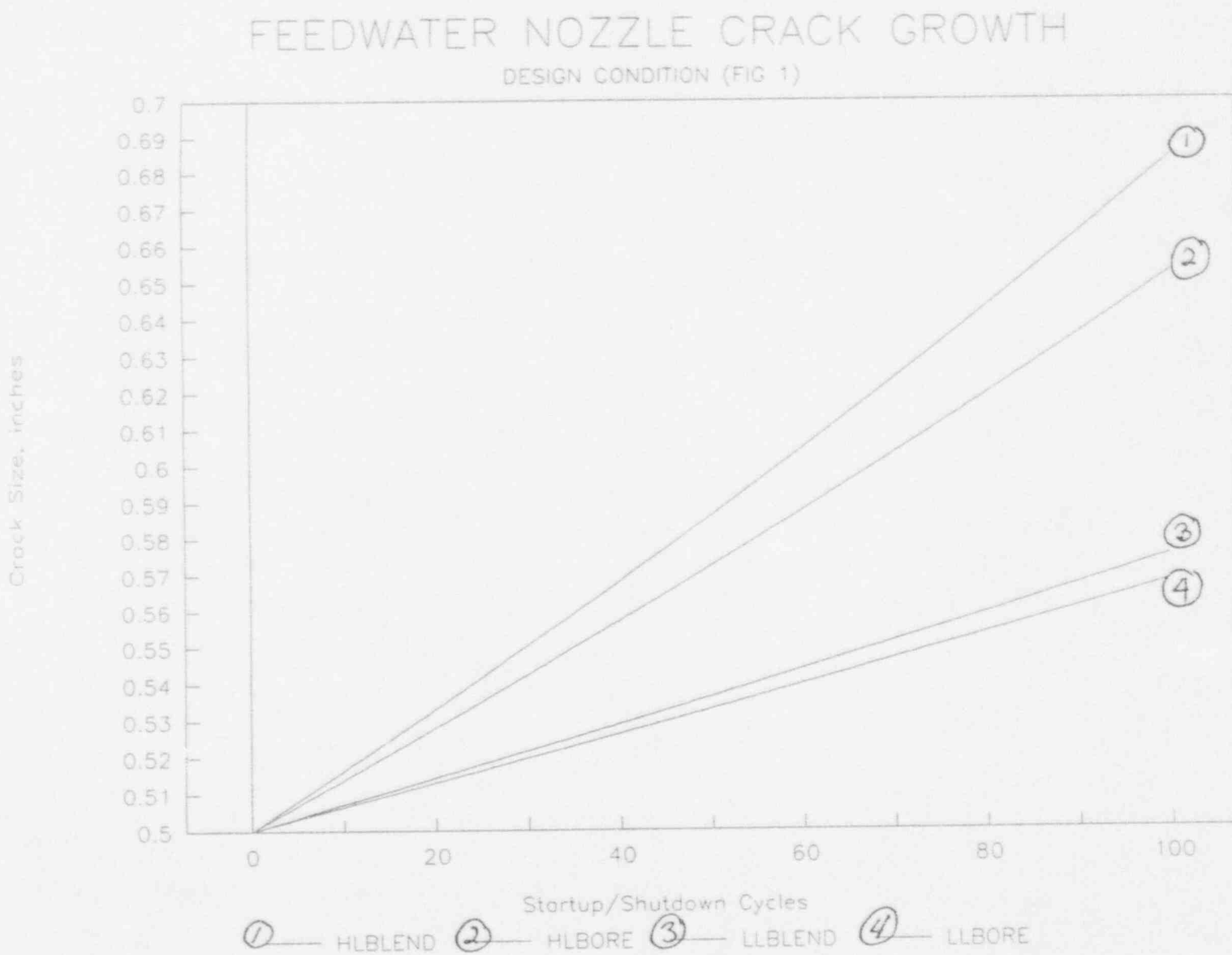


Figure 3. Vermont Yankee Feedwater Nozzle Geometry

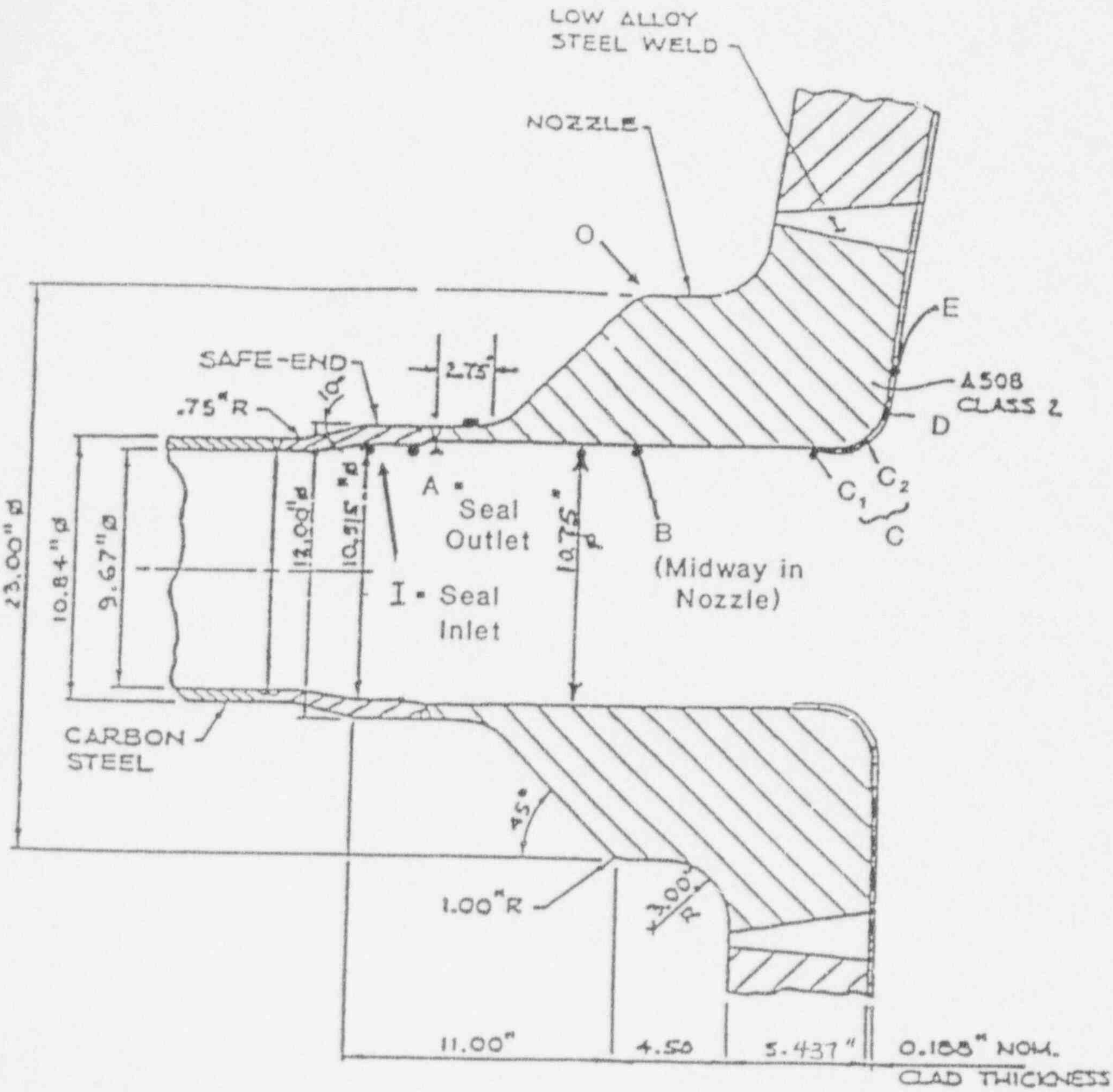


Figure 4. Finite Element Model(FEM) for Vermont Yankee Feedwater Nozzle

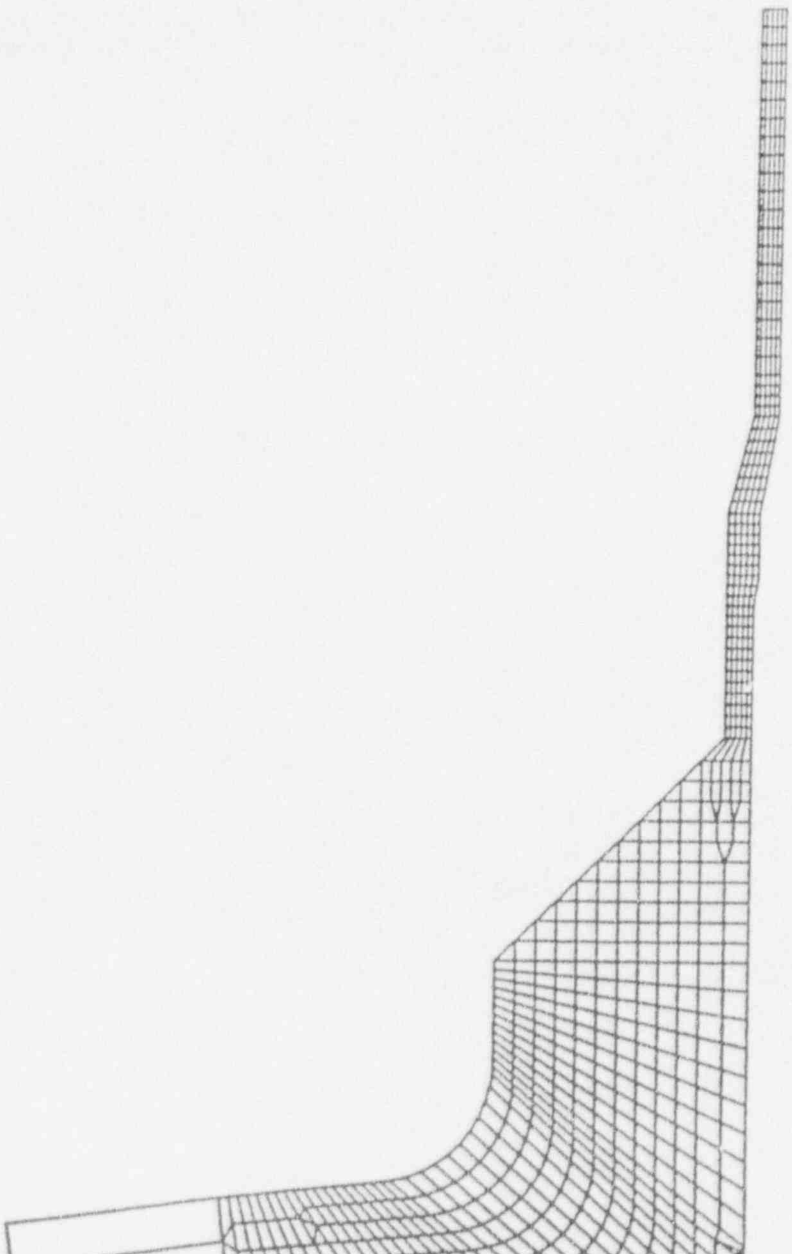
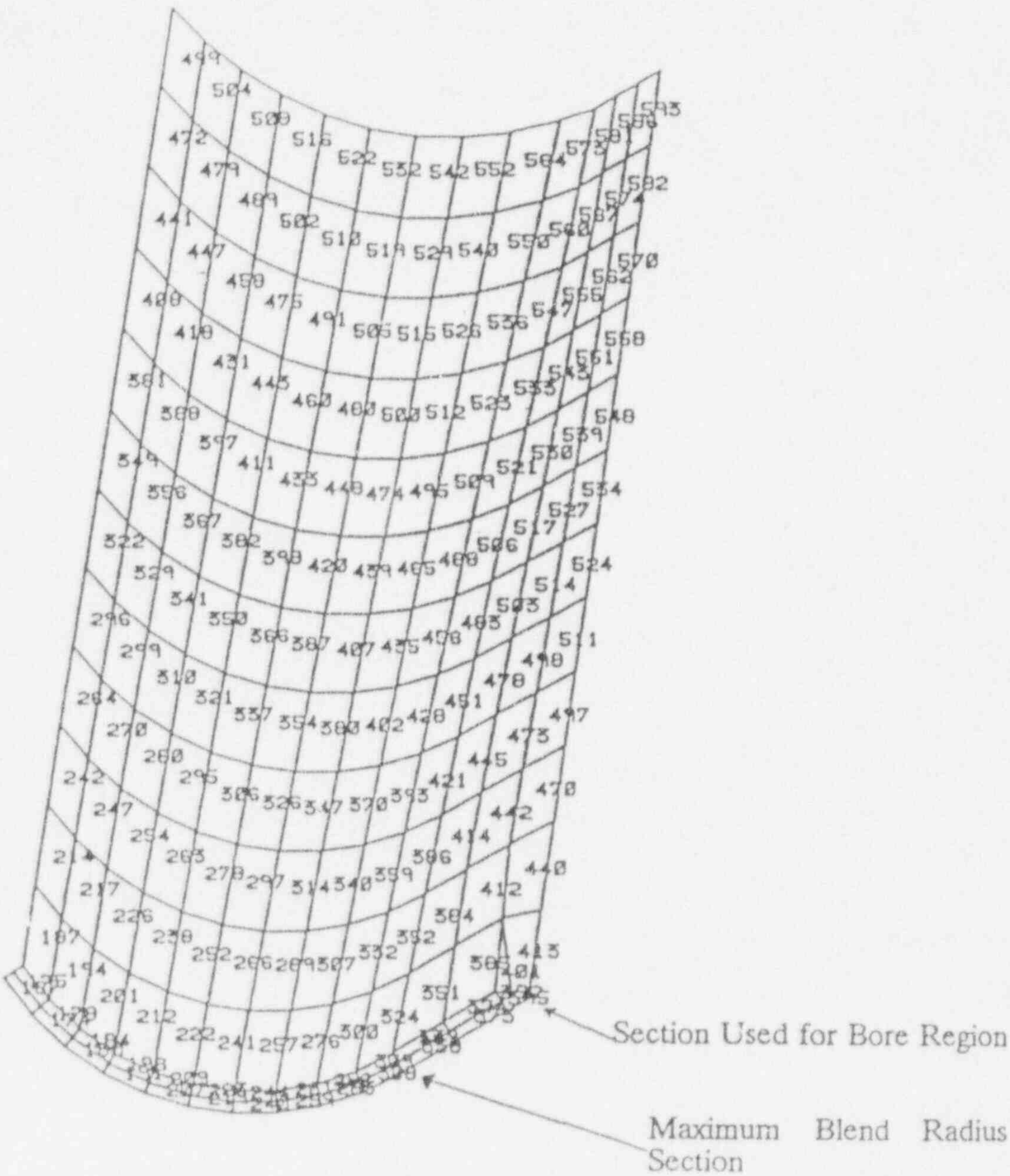


Figure 5. Details of FEM - Blend Radius Region



Attachment 1.

Detailed Feedwater Nozzle Fatigue Cycle Summary; Operating Cycles XIV, XV, XVI, XVII.

		RPV/FEEDWATER STARTUP-SHUTDOWN CYCLES			FW HEATING ON/OFF CYCLES		ADDITIONAL FEEDWATER CYCLES DURING OPERATION				
FEEDWATER NOZZLE SUMMARY							A-TRAIN NOZLS		B-TRAIN NOZLS		
DATE	EVENT	SU	NON SCRAM SD	SCRAM SD	FW HTG ON	FW HTG OFF	FLOW ON	FLOW OFF	FLOW ON	FLOW OFF	APPR PWR LEV
10-2-87	HEATUP/STARTUP	1									12%
10-3-87	SCRAM			1				1		1	12%
							1		1		
10-3-87	COOLDOWN										
10-3-87	HEATUP/STARTUP	1			1						46%
10-6-87	RECRC PMP TRIP										
10-7-87	RECRC PMP TRIP MANUAL										

		RPV/FEEDWATER STARTUP-SHUTDOWN CYCLES			FW HEATING ON/OFF CYCLES		ADDITIONAL FEEDWATER CYCLES DURING OPERATION				
FEEDWATER NOZZLE SUMMARY							A-TRAIN NOZLS		B-TRAIN NOZLS		
DATE	EVENT	SU	NON SCRAM SD	SCRAM SD	FW HTG ON	FW HTG OFF	FLOW ON	FLOW OFF	FLOW ON	FLOW OFF	APPR PWR LEV
11-8-87	REACTOR SCRAM			1		1		1		1	87%
							1		1		
11-9-87	HEATUP/STARTUP	1			1						100%
1-30-88	RECRC PMP TRIP MANUAL										50%
4-30-88	RECRC PMP TRIP MANUAL										52%

FEEDWATER NOZZLE SUMMARY

		RPV/FEEDWATER STARTUP-SHUTDOWN CYCLES			FW HEATING ON/OFF CYCLES		ADDITIONAL FEEDWATER CYCLES DURING OPERATION				
							A-TRAIN NOZLS		B-TRAIN NOZLS		
DATE	EVENT	SU	NON SCRAM SD	SCRAM SD	FW HTG ON	FW HTG OFF	FLOW ON	FLOW OFF	FLOW ON	FLOW OFF	APPR PWR LEV
6-18-88	SCRAM			1		1		1		1	100%
							1		1		
6-19-88	heatup startup	1			1						100%
6-24-88	SCRAM			1		1		1		1	100%
							1		1		
6-25-88	COOLDOWN										

		RPV/FEEDWATER STARTUP-SHUTDOWN CYCLES			FW HEATING ON/OFF CYCLES		ADDITIONAL FEEDWATER CYCLES DURING OPERATION				
FEEDWATER NOZZLE SUMMARY							A-TRAIN NOZLS		B-TRAIN NOZLS		
DATE	EVENT	SU	NON SCRAM SD	SCRAM SD	FW HTG ON	FW HTG OFF	FLOW ON	FLOW OFF	FLOW ON	FLOW OFF	APPR PWR LEV
7-2-88	HEATUP/STARTUP	1			1						55%
7-3-88	SHUTDOWN FROM 55% TO 1					1					55%
7-3-88	SCRAM AT LOW PWR			1				1		1	1%
							1		1		
7-8-88	STARTUP	1			1						98%
8-24-88	SHUTDOWN/COOLDOWN		1			1					100%
8-26-88	HEATUP/STARTUP	1									7%

		RPV/FEEDWATER STARTUP-SHUTDOWN CYCLES			FW HEATING ON/OFF CYCLES		ADDITIONAL FEEDWATER CYCLES DURING OPERATION				
FEEDWATER NOZZLE SUMMARY							A-TRAIN NOZLS		B-TRAIN NOZLS		
DATE	EVENT	SU	NON SCRAM SD	SCRAM SD	FW HTG ON	FW HTG OFF	FLOW ON	FLOW OFF	FLOW ON	FLOW OFF	APPR PWR LEV
8-27-88	SHUTDOWN/COOLDOWN		1								7%
8-28-88	HEATUP/STARTUP	1			1						100%
10-29-88	RECRC PMP TRIP MANUAL										50%
2-11-89	SHUTDWN/RCIC/COOLDWN		1			1					100%
								1		2	

		RPV/FEEDWATER STARTUP-SHUTDOWN CYCLES			FW HEATING ON/OFF CYCLES		ADDITIONAL FEEDWATER CYCLES DURING OPERATION				
FEEDWATER NOZZLE SUMMARY							A-TRAIN NOZLS		B-TRAIN NOZLS		
DATE	EVENT	SU	NON SCRAM SD	SCRAM SD	FW HTG ON	FW HTG OFF	FLOW ON	FLOW OFF	FLOW ON	FLOW OFF	APPR PWR LEV
							1		2		
TOTALS	CYCLE XIV	8	3	5	6	6	6	6	7	7	

DATE	EVENT	RPV/FEEDWATER STARTUP-SHUTDOWN CYCLES			FW HEATING ON/OFF CYCLES		ADDITIONAL FEEDWATER CYCLES DURING OPERATION				
FEEDWATER NOZZLE SUMMARY							A-TRAIN NOZLS		B-TRAIN NOZLS		
DATE	EVENT	SU	NON SCRAM SD	SCRAM SD	FW HTG ON	FW HTG OFF	FLOW ON	FLOW OFF	FLOW ON	FLOW OFF	APPR PWR LEV
4-6-89	HEATUP/STARTUP	1			1						100%
3-16-90	SHUTDOWN/COOLDOWN		1			1					100%
								1		1	
							1		1		
3-19-90	HEATUP/STARTUP	1									8%

FEEDWATER NOZZLE SUMMARY

		RPV/FEEDWATER STARTUP-SHUTDOWN CYCLES			FW HEATING ON/OFF CYCLES		ADDITIONAL FEEDWATER CYCLES DURING OPERATION				
							A-TRAIN NOZLS		B-TRAIN NOZLS		
DATE	EVENT	SU	NON SCRAM SD	SCRAM SD	FW HTG ON	FW HTG OFF	FLOW ON	FLOW OFF	FLOW ON	FLOW OFF	APPR PWR LEV
3-21-90	SCRAM			1							8%
3-25-90	HEATUP/STARTUP	1			1						100%
6-1-90	SCRAM/HOT STANDBY*			1		1		1		1	100%
							1		1		
6-2-90	STARTUP	1			1						100%
8-31-90	SHUTDOWN/RCIC/CLDWN		1			1					100%
								1		2	
							1		2		

					FW HEATING ON/OFF CYCLES		ADDITIONAL FEEDWATER CYCLES DURING OPERATION				
		RPV/FEEDWATER STARTUP-SHUTDOWN CYCLES									
FEEDWATER NOZZLE SUMMARY			NON SCRAM	SCRAM	FW HTG	FW HTG	A-TRAIN NOZLS FLOW	A-TRAIN NOZLS FLOW	B-TRAIN NOZLS FLOW	B-TRAIN NOZLS FLOW	APPR PWR
DATE	EVENT	SU	SD	SD	ON	OFF	ON	OFF	ON	OFF	LEV
TOTALS	CYCLE XV	4	2	2	3	3	3	3	4	4	

		RPV/FEEDWATER STARTUP-SHUTDOWN CYCLES			FW HEATING ON/OFF CYCLES		ADDITIONAL FEEDWATER CYCLES DURING OPERATION				
FEEDWATER NOZZLE SUMMARY							A-TRAIN NOZLS		B-TRAIN NOZLS		
DATE	EVENT	SU	NON SCRAM SD	SCRAM SD	FW HTG ON	FW HTG OFF	FLOW ON	FLOW OFF	FLOW ON	FLOW OFF	APPR PWR LEV
10-15-90	HEATUP/STARTUP	1			1						100%
11-4-90	SCRAM			1		1		1		1	94%
							1		1		
11-5-90	HEATUP/STARTUP	1			1						100%
3-13-91	SCRAM/COOLDOWN			1		1		2		2	100%
							2		2		
3-17-91	HEATUP/STARTUP	1									LOW
3-17-91	SHUTDOWN/COOLDOWN		1								

		RPV/FEEDWATER STARTUP-SHUTDOWN CYCLES			FW HEATING ON/OFF CYCLES		ADDITIONAL FEEDWATER CYCLES DURING OPERATION				
FEEDWATER NOZZLE SUMMARY							A-TRAIN NOZLS		B-TRAIN NOZLS		
DATE	EVENT	SU	NON SCRAM SD	SCRAM SD	FW HTG ON	FW HTG OFF	FLOW ON	FLOW OFF	FLOW ON	FLOW OFF	APPR PWR LEV
3-18-91	HEATUP/STARTUP	1			1						100%
4-23-91	SCRAM/RECIRC TRIP			1							100%
						1		1		1	
							1				
								1	1		
										1	
									1		

		RPV/FEEDWATER STARTUP-SHUTDOWN CYCLES			FW HEATING ON/OFF CYCLES		ADDITIONAL FEEDWATER CYCLES DURING OPERATION				
FEEDWATER NOZZLE SUMMARY							A-TRAIN NOZLS		B-TRAIN NOZLS		
DATE	EVENT	SU	NON SCRAM SD	SCRAM SD	FW HTG ON	FW HTG OFF	FLOW ON	FLOW OFF	FLOW ON	FLOW OFF	APPR PWR LEV
										1	
									1		
										1	
									1		
										1	
									1		
										1	

		RPV/FEEDWATER STARTUP-SHUTDOWN CYCLES			FW HEATING ON/OFF CYCLES		ADDITIONAL FEEDWATER CYCLES DURING OPERATION				
FEEDWATER NOZZLE SUMMARY			NON		FW	FW	A-TRAIN NOZLS		B-TRAIN NOZLS		APPR
			SCRAM	SCRAM	HTG	HTG	FLOW	FLOW	FLOW	FLOW	PWR
DATE	EVENT	SU	SD	SD	ON	OFF	ON	OFF	ON	OFF	LEV
							1		1		
4-30-91	HEATUP/STARTUP	1			1						100%
6-15-91	SCRAM			1		1		1		1	100%
							1		1		

FEEDWATER NOZZLE SUMMARY		RPV/FEEDWATER STARTUP-SHUTDOWN CYCLES			FW HEATING ON/OFF CYCLES		ADDITIONAL FEEDWATER CYCLES DURING OPERATION				
							A-TRAIN NOZLS		B-TRAIN NOZLS		
DATE	EVENT	SU	NON SCRAM SD	SCRAM SD	FW HTG ON	FW HTG OFF	FLOW ON	FLOW OFF	FLOW ON	FLOW OFF	APPR PWR LEV
6-21-91	HEATUP/STARTUP	1			1						100%
9-8-91	SHUTDOWN/COOLDOWN		1			1					100%
9-15-91	HEATUP/STARTUP	1			1						100%
1-16-92	SHUTDOWN/STANDBY		1			1					5%
1-16-92	STANDBY/STARTUP	1			1						100%

FEEDWATER NOZZLE SUMMARY

DATE	EVENT	RPV/FEEDWATER STARTUP-SHUTDOWN CYCLES			FW HEATING ON/OFF CYCLES		ADDITIONAL FEEDWATER CYCLES DURING OPERATION				
							A-TRAIN NOZLS		B-TRAIN NOZLS		
		SU	NON SCRAM SD	SCRAM SD	FW HTG ON	FW HTG OFF	FLOW ON	FLOW OFF	FLOW ON	FLOW OFF	APPR PWR LEV
3-6-92	SHUTDOWN/COOLDOWN										
						1					5%
				1							
								1		2	
							1		2		

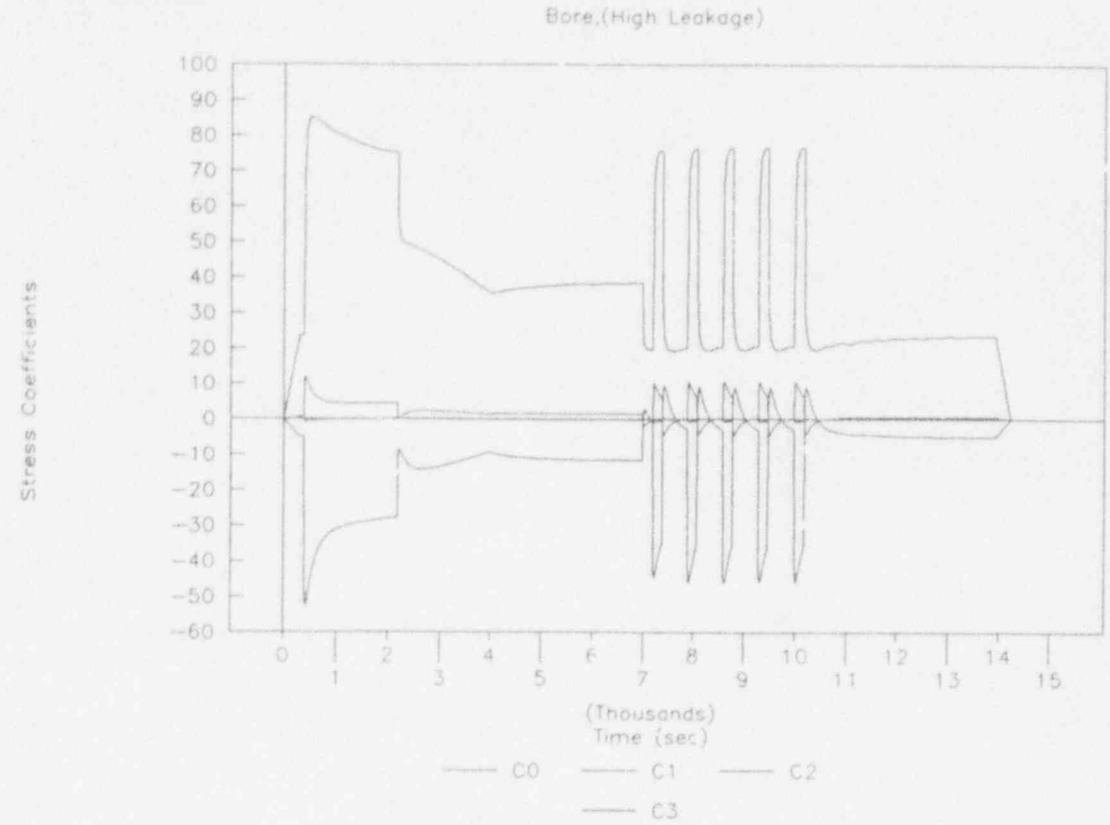
		RPV/FEEDWATER STARTUP-SHUTDOWN CYCLES			FW HEATING ON/OFF CYCLES		ADDITIONAL FEEDWATER CYCLES DURING OPERATION				
FEEDWATER NOZZLE SUMMARY			NON		FW	FW	A-TRAIN NOZLS		B-TRAIN NOZLS		APPR
			SCRAM	SCRAM	HTG	HTG	FLOW	FLOW	FLOW	FLOW	PWR
DATE	EVENT	SU	SD	SD	ON	OFF	ON	OFF	ON	OFF	LEV
4-19-92	HEATUP/STARTUP	1									100%
					1						
						1					
					1						
4-7-93	SHUTDWN/RCIC/COOLDWN										100%
			1			1					
								1		2	
							1		2		
4-16-93	HEATUP/STARTUP	1			1						100%
8-27-93	SHUTDWN/RCIC/COOLDWN		1			1					100%
	RCIC TEST, TOOK 3 MIN							1		1	
							1		1		
TOTAL	CYCLE XVII	2	2	0	3	3	2	2	3	3	

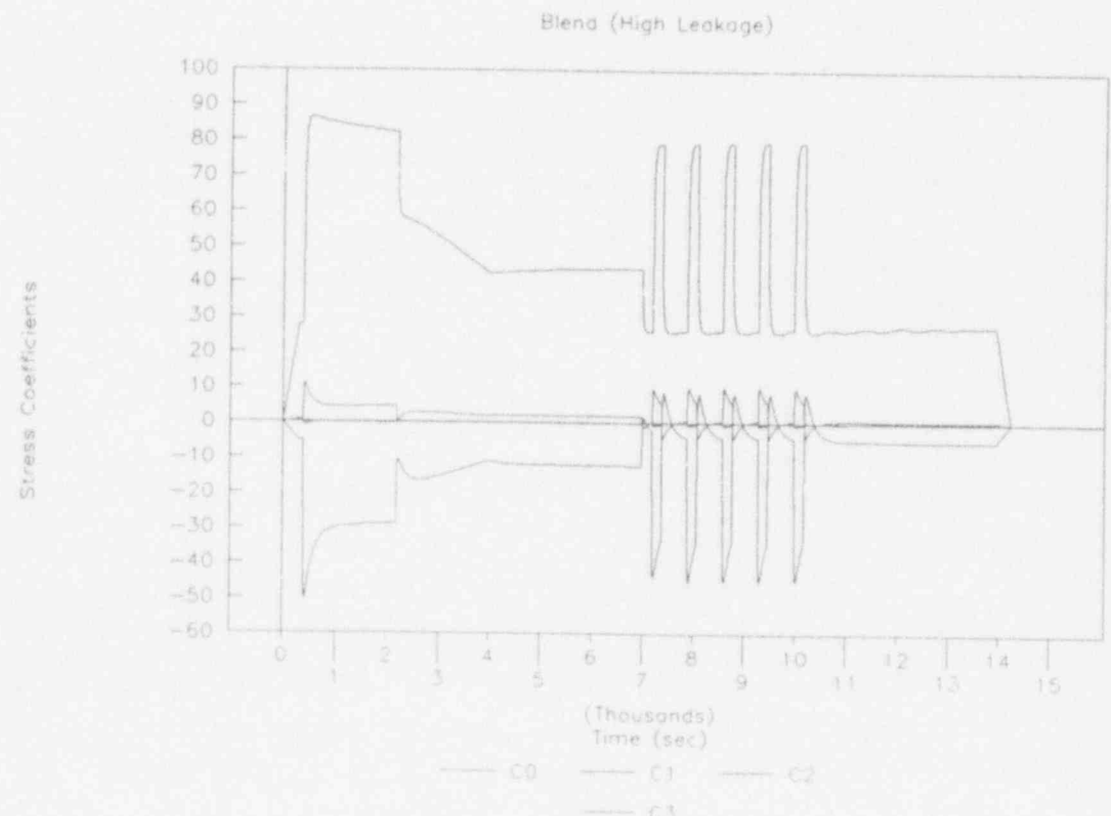
Attachment 2.

Transient Stress Information at the Blend and Bore Regions for the Startup/Shutdown Cycle Design Transient.

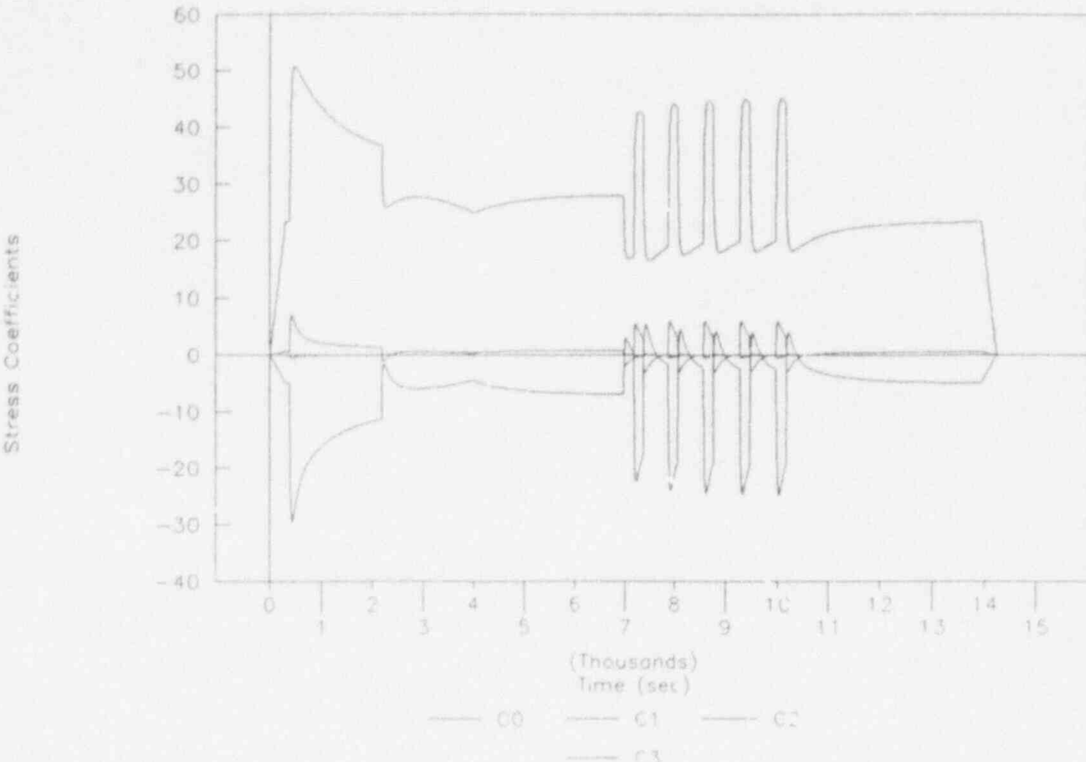
The following pages include stress coefficient plots. Digitized data is included on the attached 3.5" floppy disk. Hard copy of the digitized data will be forwarded upon requested.

SUBDIRECTORY	FILE	NOZZLE LOCATION	BYPASS LEAKAGE
STRESSCO	BOREHL.PRN	BORE	15 GPM
STRESSCO	BLENDHL.PRN	BLEND	15 GPM
STRESSCO	BORELL.PRN	BORE	0 GPM
STRESSCO	BLENDLL.PRN	BLEND	0 GPM


Bore,(High Leakage)
Stress Coefficients
100
90
80
70
60
50
40
30
20
10
0
-10
-20
-30
-40
-50
-60
0
2
4
6
8
10
12
14
1
3
5
7
9
11
13
15
(Thousands)
Time (sec)
C0
C1
C2
C3


Blend (High Leakage)
Stress Coefficients
100
90
80
70
60
50
40
30
20
10
0
-10
-20
-30
-40
-50
-60
0
2
4
6
8
10
12
14
1
3
5
7
9
11
13
15
(Thousands)
Time (sec)
C0
C1
C2
C3

Bore, (Low Leakage)



Blend (Low Leakage)