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STRUCTURAL INTEGRITY Associates, Inc.	CALCULATION PACKAGE	FILE No: **DUKE-11Q-303-5** PROJECT No: **DUKE-11Q-1**

PROJECT NAME: **ASME Class 1 Analysis of Oconee Piping**

CLIENT: **Duke Power Company**

CALCULATION TITLE: **Class 1 Fatigue Reconciliation for HPI Nozzle**

PROBLEM STATEMENT OR OBJECTIVE OF THE CALCULATION:

The purpose of this calculation is to reconcile the Class 1 fatigue evaluation of the High Pressure Injection Nozzle considering the new piping loads due to the valves recently replaced at Oconee Unit 2 and planned for replacement at Oconee Unit 3.

FOR INFORMATION ONLY

Document Revision	Affected Pages	Revision Description	Project Mgr. Approval Signature & Date	Preparer(s) & Checker(s) Signatures & Date
0	1 - 8 A0-A3 B0-B9 C0-C9 D0-D9 1 Disk	Original Issue	Gary L. Stevens 11/26/96	DAC 11/25/96 Denise A. Curd GLS 11/26/96 Gary L. Stevens
1	1-5, 8 C0-C9 D0-D9 E0-E3 1 Disk	Revised Data Point for Thermal Moments	Gary L. Stevens 4/1/97	DAC Apr 1, 1997 Denise Curd Gary L. Stevens Gary L. Stevens GLS 4/1/97

1.0 INTRODUCTION

The purpose of this calculation is to reconcile the Class 1 fatigue evaluation of the High Pressure Injection Nozzle [1] considering the new piping loads due to the valves recently replaced at Oconee Unit 2 and planned for replacement at Oconee Unit 3.

2.0 METHODOLOGY

2.1 New Piping Loads

The methodology of Reference 1 was used in recalculate the usage factor for the 40 year design life of the HPI nozzle with the new piping loads. The piping loads were extracted from the SUPERPIPE runs made by Duke Power Company personnel [2]. The output files were named "P25124N.GLA" and "P25315N.GLA" and were reflective of the piping problem numbers being run: (1) Problem 2-51-24, and (2) Problem 2-53-15. According to Duke personnel, these problem numbers correspond to the East Coolant Loop (Problem 2-53-15) which is the normal line, and the West Coolant Loop (Problem 2-51-24) which is the emergency line. These descriptions are consistent with the problem numbers and layouts given on the Reference 3 and 4 drawings.

According to Duke personnel, the emergency lines are more limiting -- this is consistent with conclusions made on page 23 of Reference 5. Therefore, the forces and moments from file "P25124N.GLA" were extracted for use in the stress and fatigue analyses. Based on Reference 6, the following load cases were extracted from the SUPERPIPE output file:

Load Case Name	Description
FPTH	Full Power thermal conditions.
STRS	Stratified Stress Conditions
OBXY	Horizontal earthquake (X-Y Direction).
OBZY	Horizontal earthquake (Z-Y Direction).

From the Reference 3 drawing, nodes 175A and 300A represent the nozzle location in each leg of the West Coolant Loop.

The SUPERPIPE output file [2] is extremely large and could not easily be printed. Therefore, the applicable portions of the file were "cut and pasted" into a separate file using a DOS editor. The resulting smaller file is listed in Appendix A. That file provides the necessary forces and moments.

The forces and moments from Appendix A are summarized in Table 1 for the locations and load

cases under consideration. The maximum absolute value of the forces and moments is tabulated for subsequent use in the fatigue analysis.

2.2 Fatigue Analysis

A spreadsheet was used to recreate the original fatigue analysis (FATIGUE1.XLS). The new piping loads (full power thermal and OBE) were then substituted into the analysis to determine the new fatigue usage (FATIGUE2.XLS). For the new analysis, the OBE piping loads were analyzed without Deadweight, unlike the original analysis in which OBE+Deadweight was conservatively used. Consistent with the original fatigue analysis, the elastic-plastic correction factor, K_e, was determined from Figure F-105(a) of Reference 7 (reproduced in Figure 1). The fatigue curve for stainless steel from Reference 7 is reproduced in Figure 2. A program to interpolate the fatigue curve was used (FATIGUE.EXE) to obtain more exact results. A third analysis was conducted with the stratified stress condition loads to determine which would be more limiting (FATIGUE3.XLS). The full power thermal piping loads proved to be more limiting. The spreadsheets used for the analysis are reproduced in Appendices B-D and the reconciled fatigue usage is summarized in Table 2.

3.0 RESULTS

The reconciled 40 year fatigue usage for the HPI nozzle is 0.884.

Table 1

Piping Loads for HPI Nozzle Analysis

Loads Obtained from File "NOZZLE.TXT")

Load Case = FPTH
Multiplier [8] 1.102

	Node No.	Axial Force (lbs)	Y Force (lbs)	Z Force (lbs)	Torsional Moment (ft-lbs)	YY Moment (ft-lbs)	ZZ Moment (ft-lbs)
Nozzle	175A	204.54	-291.84	142.8	-188.07	611.03	2105.47
Nozzle	300A	200.11	-71.87	-136.33	549.82	139.03	645.57
Maximums		**225.4031**	**321.6077**	**157.3656**	**605.9016**	**673.3551**	**2320.228**

Load Case = OBXY

	Node No.	Axial Force (lbs)	Y Force (lbs)	Z Force (lbs)	Torsional Moment (ft-lbs)	YY Moment (ft-lbs)	ZZ Moment (ft-lbs)
Nozzle	175A	65.48	57.69	63.87	65.87	118.73	112.83
Nozzle	300A	52.64	99.67	260.21	207.54	662	253.51

Load Case = OBZY

	Node No.	Axial Force (lbs)	Y Force (lbs)	Z Force (lbs)	Torsional Moment (ft-lbs)	YY Moment (ft-lbs)	ZZ Moment (ft-lbs)
Nozzle	175A	84.69	60.42	52.09	50.82	105.91	150.29
Nozzle	300A	54.45	89.83	189.31	145.98	472.56	235.09

Load Case = SRSS of OBXY and OBZY

	Node No.	Axial Force (lbs)	Y Force (lbs)	Z Force (lbs)	Torsional Moment (ft-lbs)	YY Moment (ft-lbs)	ZZ Moment (ft-lbs)
Nozzle	175A	107.05	83.54	82.42	83.20	159.10	187.93
Nozzle	300A	75.73	134.18	321.79	253.74	813.36	345.74
Maximums		**107.05**	**134.18**	**321.79**	**253.74**	**813.36**	**345.74**

Load Case = STRS
Multiplier [8] 1.03

	Node No.	Axial Force (lbs)	Y Force (lbs)	Z Force (lbs)	Torsional Moment (ft-lbs)	YY Moment (ft-lbs)	ZZ Moment (ft-lbs)
Nozzle	175A	716.74	62.24	40.18	54.31	587.45	1560.22
Nozzle	300A	353.56	-86.08	-315.48	-234.61	-210.72	540.44
Maximums		**738.2422**	**88.6624**	**324.9444**	**241.6483**	**605.0735**	**1607.027**

TABLE 2

Reconciled Fatigue Usage

		Fig F-106(b)		
Transient Pair	Salt	N	Nreq	U
Dpz	188.09	191	40	0.209424
Dpz				
Test	119.21	755	40	0.05298
Zero Load				
A+OBE	261.19	81	30	0.37037
B-OBE				
A	202.17	159	40	0.251572
B				
OBE	9.95	1.00E+21	610	6.1E-19
OBE				
			Total Usage	0.884347

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FIGURE 1

Elastic-Plastic Correction Factor, K_ε

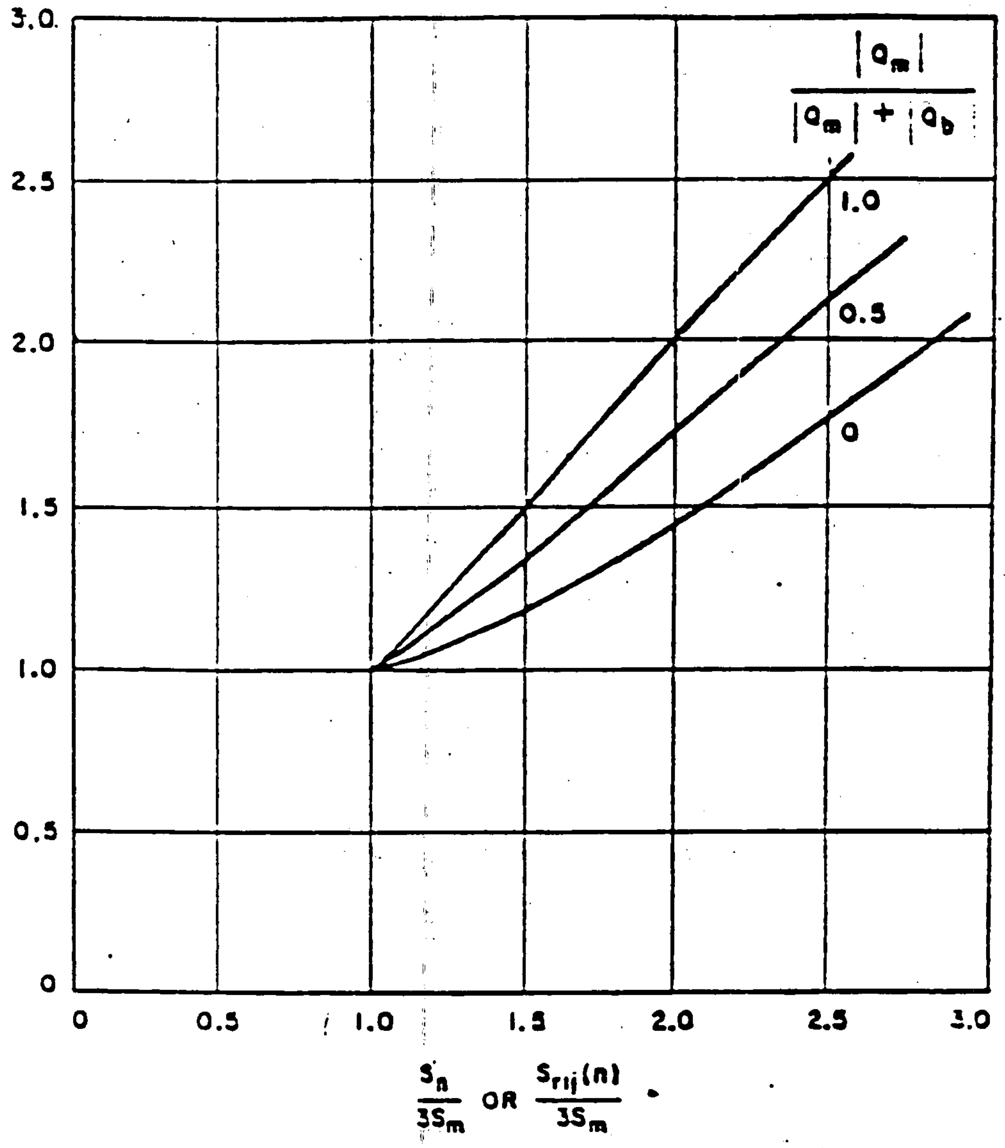

FIGURE F-105(a) USAS B31.7 ELASTIC-PLASTIC CORRECTION FACTOR, K_ε

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Checked by: [illegible] 11/26/96
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Figure 2

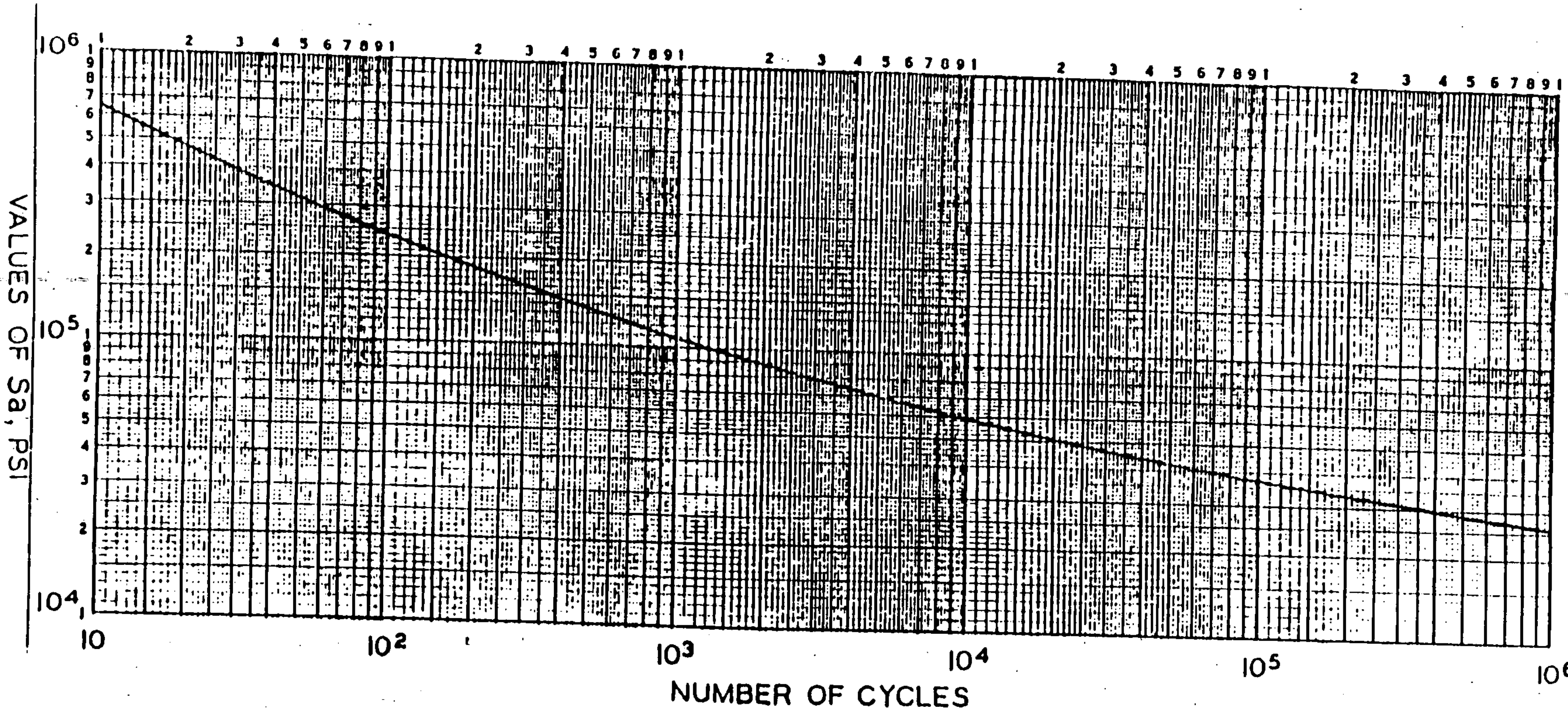

FIGURE F-106(b) ALLOWABLE AMPLITUDE OF ALTERNATING STRESS INTENSITY, S_a, FOR AUSTENITIC STAINLESS STEELS, NICKEL-IRON-CHROMIUM, NICKEL-CHROME-IRON, AND NICKEL-COPPER ALLOYS WITH METAL TEMPERATURES NOT EXCEEDING 800° F, $E = 26(10)^6$ psi.

4.0 REFERENCES

1. B&W Calculation No. 32-1128224-02, Revision 2, "Revised HPI Nozzle Usage Factor," SI File No. DUKE-11Q-263-B.

2. E-mail transmittal from mflangel@dpcmail.dukepower.com (Duke) to Art Deardorff (SI), "fwd: PKZipped Files from G L Armentrout @ Oconee," 10/29/96, 9:50 am, SI File No. DUKE-11Q-263-I.

3. Duke Power Co. Drawing, Calc. No. OSC-1323-06, Sheet 1 of 1, Rev. D19, "Reactor Building -- Unit 2, Piping Analysis Isometric, System 51, Problem 2-51-24, HPI West Coolant Loop/North & South Leg," pages: 6(1)30 and 6(1)31.1, 8/25/95, SI File No. DUKE-11Q-262-2.

4. a. Duke Power Co. Drawing, Calc. No. OSC-1324-06, Sheet 3 of 5, Rev. D18, "Reactor Building -- Unit 2, Piping Analysis Isometric, System 53, Problem 2-53-15, HP Inj. Sys. East Coolant Loop N. Leg," page 62, 8/25/95, SI File No. DUKE-11Q-262-2
   b. Duke Power Co. Drawing, Calc. No. OSC-1324-06, Sheet 4 of 5, Rev. D18, "Reactor Building -- Unit 2, Piping Analysis Isometric, System 53, Problem 2-53-15, HP Inj. Sys. East Coolant Loop S. Leg," page 63, 8/25/95, SI File No. DUKE-11Q-262-2

5. B&W Document No. 51-1235058-00, "Fatigue Usage Summary," Release Date 11-8-94, SI File No. DUKE-11Q-217.

6. FAX transmittal from Geary Armentrout (Duke) to Gary Stevens (SI), 4 pages total, 11/8/96, SI File No. DUKE-11Q-263-I.

7. ASME Nuclear Power Piping, USAS B31.7 - 1969.[1]

8. E-mail transmittal from gla8363@pdrc.dukepower.com (Duke) to Denise Curd (SI), "HPI Emergency Injection Lines; Ec/Eh Values," 3/13/97, 4:32 pm, SI File No. DUKE-11Q-103, attached as Appendix E.

Notes: (1) The Reference 1 analysis used the 1968 DRAFT edition. As this edition was not available, the 1969 Edition was used instead.

APPENDIX A

Piping Loads - Nozzle Location
(3 pages total)

Revision	0			
Preparer/Date	DAC 11/24/96			
Checker/Date	[signature] 11/26/96			
File No. **DUKE-11Q-303-5**			Page No. A0 of A3	

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1IMPELL CORPORATION PAGE 1
SUPERPIPE VERSION 22E 05/31/90; SYSTEM: IBM-VM/MVS 10-26-96 12:46:48

OCONEE NUCLEAR STATION UNIT 2
OSC-1323-06 REV D24
PROBLEM 2-51-24
AS-BUILD NSM ON-22975 CONFIGURATION

RESPONSE SPECTRUM ANALYSIS NO. 1 (OBXY). FORCES, MOMENTS AND STRESSES ALONG PIPE RUNS (CONTD.)

RUN NAME	SOP NO.	DCP NAME	COMP TYPE	AXIAL FORCE (LB)	Y FORCE (LB)	Z FORCE (LB)	TORS MOMENT (LB.FT)	YY MOMENT (LB.FT)	ZZ MOMENT (LB.FT)	M/Z (PSI)
RUN1A										
	81	160T	VALV	52.83	45.88	49.03	60.58	49.18	120.44	N/A
	82	161	VALV	52.83	45.88	49.03	60.58	38.27	111.52	N/A
	83	162	VALV	52.83	45.92	49.09	60.58	34.23	107.63	N/A
	84	165	VALV	52.81	46.26	49.62	60.63	30.68	102.49	N/A
	85	167	VALV	52.82	46.30	49.69	60.63	32.51	96.40	N/A
	86L	170	VALV	65.35	57.34	63.19	65.87	70.88	98.30	N/A
	86W	170	AWTT	65.35	57.34	63.19	65.87	70.88	98.30	1011.31
	86R	170	STRP	65.42	57.61	63.65	65.87	70.88	98.30	1011.31
	87L	175A	STRP	65.42	57.61	63.65	65.87	118.73	112.83	1294.38
	87R	175A	STRP	65.48	57.69	63.87	65.87	118.73	112.83	563.36
	88L	175B	STRP	65.48	57.69	63.87	65.87	160.41	137.21	705.63
	88R	175B	NONS	65.48	57.69	63.87	65.87	160.41	137.21	N/A
	89L	175C	NONS	65.48	57.69	63.87	65.87	188.50	156.83	N/A
	89R	175C	NONS	65.48	57.69	63.87	65.87	188.50	156.83	N/A
	90	175D	NONS	65.48	57.69	63.87	65.87	272.63	222.90	N/A
RN2A										
	134	280T	VALV	61.23	82.50	240.59	191.51	69.21	52.18	N/A
	135	281	VALV	61.23	82.50	240.59	191.51	107.39	67.09	N/A
	136	282	VALV	61.24	82.58	240.67	191.51	137.26	76.41	N/A
	137	285	VALV	61.19	83.24	241.25	191.36	185.96	91.84	N/A
	138	287	VALV	61.19	83.32	241.32	191.36	262.33	116.50	N/A
	139L	290	VALV	52.47	99.15	259.57	207.54	434.38	168.03	N/A
	139W	290	AWTT	52.47	99.15	259.57	207.54	434.38	168.03	3738.48
	139R	290	STRP	52.56	99.58	260.06	207.54	434.38	168.03	3738.48
	140L	300A	STRP	52.56	99.58	260.06	207.54	662.00	253.51	5415.58
	140R	300A	STRP	52.64	99.67	260.21	207.54	662.00	253.51	2357.07
	141L	300B	STRP	52.64	99.67	260.21	207.54	841.98	321.77	2951.63
	141R	300B	NONS	52.64	99.67	260.21	207.54	841.98	321.77	N/A
	142L	300C	NONS	52.64	99.67	260.21	207.54	960.50	366.86	N/A
	142R	300C	NONS	52.64	99.67	260.21	207.54	960.50	366.86	N/A
	143	300D	NONS	52.64	99.67	260.21	207.54	1310.14	500.21	N/A

RESPONSE SPECTRUM ANALYSIS NO. 2 (OBZY). FORCES, MOMENTS AND STRESSES ALONG PIPE RUNS

RUN NAME	SOP NO.	DCP NAME	COMP TYPE	AXIAL FORCE (LB)	Y FORCE (LB)	Z FORCE (LB)	TORS MOMENT (LB.FT)	YY MOMENT (LB.FT)	ZZ MOMENT (LB.FT)	M/Z (PSI)
RN1A										
	81	160T	VALV	66.14	51.67	41.95	48.52	40.32	141.68	N/A
	82	161	VALV	66.14	51.67	41.95	48.52	30.45	133.25	N/A
	83	162	VALV	66.15	51.72	42.00	48.52	26.70	129.70	N/A
	84	165	VALV	66.21	52.15	42.37	48.51	23.30	125.20	N/A
	85	167	VALV	66.22	52.20	42.41	48.51	24.99	120.29	N/A
	86L	170	VALV	84.24	60.02	51.79	50.82	62.78	129.33	N/A
	86W	170	AWTT	84.24	60.02	51.79	50.82	62.78	129.33	1117.93
	86R	170	STRP	84.48	60.34	52.04	50.82	62.78	129.33	1117.93
	87L	175A	STRP	84.48	60.34	52.04	50.82	105.91	150.29	1398.58
	87R	175A	STRP	84.69	60.42	52.09	50.82	105.91	150.29	608.72
	88L	175B	STRP	84.69	60.42	52.09	50.82	141.18	176.73	739.83
	88R	175B	NONS	84.69	60.42	52.09	50.82	141.18	176.73	N/A
	89L	175C	NONS	84.69	60.42	52.09	50.82	164.60	197.10	N/A
	89R	175C	NONS	84.69	60.42	52.09	50.82	164.60	197.10	N/A
	90	175D	NONS	84.69	60.42	52.09	50.82	234.07	264.88	N/A

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RUN NAME	SOP NO.	DCP NAME	COMP TYPE	AXIAL FORCE (LB)	Y FORCE (LB)	Z FORCE (LB)	TORS MOMENT (LB.FT)	YY MOMENT (LB.FT)	ZZ MOMENT (LB.FT)	M/Z (PSI)
RN2A										
	134	280T	VALV	50.41	76.18	173.67	132.58	53.49	47.62	N/A
	135	281	VALV	50.41	76.18	173.67	132.58	72.92	61.97	N/A
	136	282	VALV	50.42	76.26	173.74	132.58	92.83	70.76	N/A
	137	285	VALV	50.51	76.86	174.24	132.45	126.73	85.21	N/A
	138	287	VALV	50.53	76.93	174.30	132.45	181.06	108.16	N/A
	139L	290	VALV	53.69	89.35	188.86	145.98	306.42	157.66	N/A
	139W	290	AWTT	53.69	89.35	188.86	145.98	306.42	157.66	2743.89
	139R	290	STRP	54.09	89.75	189.24	145.98	306.42	157.66	2743.89
	140L	300A	STRP	54.09	89.75	189.24	145.98	472.56	235.09	4015.10
	140R	300A	STRP	54.45	89.83	189.31	145.98	472.56	235.09	1747.53
	141L	300B	STRP	54.45	89.83	189.31	145.98	603.75	296.75	2196.73
	141R	300B	NONS	54.45	89.83	189.31	145.98	603.75	296.75	N/A
	142L	300C	NONS	54.45	89.83	189.31	145.98	690.09	337.45	N/A
	142R	300C	NONS	54.45	89.83	189.31	145.98	690.09	337.45	N/A
	143	300D	NONS	54.45	89.83	189.31	145.98	944.68	457.75	N/A

STATIC ANALYSIS NO. 4 (FPTH). FORCES, MOMENTS AND STRESSES ALONG PIPE RUNS (CONTD.)

RUN NAME	SOP NO.	DCP NAME	COMP TYPE	AXIAL FORCE (LB)	Y FORCE (LB)	Z FORCE (LB)	TORS MOMENT (LB.FT)	YY MOMENT (LB.FT)	ZZ MOMENT (LB.FT)	M/Z (PSI)
RUN1A										
	81	160T	VALV	204.54	-291.84	142.80	-188.07	242.91	1353.14	N/A
	82	161	VALV	204.54	-291.84	142.80	-188.07	287.54	1444.34	N/A
	83	162	VALV	204.54	-291.84	142.80	-188.07	309.10	1488.41	N/A
	84	165	VALV	204.54	-291.84	142.80	-188.07	341.09	1553.78	N/A
	85	167	VALV	204.54	-291.84	142.80	-188.07	388.68	1651.05	N/A
	86L	170	VALV	204.54	-291.84	142.80	-188.07	483.88	1845.62	N/A
	86W	170	AWTT	204.54	-291.84	142.80	-188.07	483.88	1845.62	15021.87
	86R	170	STRP	204.54	-291.84	142.80	-188.07	483.88	1845.62	15021.87
	87L	175A	STRP	204.54	-291.84	142.80	-188.07	611.03	2105.47	17240.40
	87R	175A	STRP	204.54	-291.84	142.80	-188.07	611.03	2105.47	7503.69
	88L	175B	STRP	204.54	-291.84	142.80	-188.07	710.69	2309.14	8263.98
	88R	175B	NONS	204.54	-291.84	142.80	-188.07	710.69	2309.14	N/A
	89L	175C	NONS	204.54	-291.84	142.80	-188.07	776.14	2442.89	N/A
	89R	175C	NONS	204.54	-291.84	142.80	-188.07	776.14	2442.89	N/A
	90	175D	NONS	204.54	-291.84	142.80	-188.07	968.77	2836.58	N/A
RN2A										
	134	280T	VALV	200.11	-71.87	-136.33	549.82	490.47	460.29	N/A
	135	281	VALV	200.11	-71.87	-136.33	549.82	447.87	482.75	N/A
	136	282	VALV	200.11	-71.87	-136.33	549.82	427.28	493.61	N/A
	137	285	VALV	200.11	-71.87	-136.33	549.82	396.75	509.70	N/A
	138	287	VALV	200.11	-71.87	-136.33	549.82	351.31	533.66	N/A
	139L	290	VALV	200.11	-71.87	-136.33	549.82	260.42	581.58	N/A
	139W	290	AWTT	200.11	-71.87	-136.33	549.82	260.42	581.58	6594.37
	139R	290	STRP	200.11	-71.87	-136.33	549.82	260.42	581.58	6594.37
	140L	300A	STRP	200.11	-71.87	-136.33	549.82	139.03	645.57	6732.76
	140R	300A	STRP	200.11	-71.87	-136.33	549.82	139.03	645.57	2930.36
	141L	300B	STRP	200.11	-71.87	-136.33	549.82	43.89	695.73	3027.70
	141R	300B	NONS	200.11	-71.87	-136.33	549.82	43.89	695.73	N/A
	142L	300C	NONS	200.11	-71.87	-136.33	549.82	-18.59	728.67	N/A
	142R	300C	NONS	200.11	-71.87	-136.33	549.82	-18.59	728.67	N/A
	143	300D	NONS	200.11	-71.87	-136.33	549.82	-202.49	825.62	N/A

LOAD CASE NO. 4 (STRS). FORCES, MOMENTS AND STRESSES ALONG PIPE RUNS (CONTD.)

RUN NAME	SOP NO.	DCP NAME	COMP TYPE	AXIAL FORCE (LB) (LB)	Y FORCE (LB) (LB)	Z FORCE (LB) (LB)	TORS MOMENT (LB.FT) (LB.FT)	YY MOMENT (LB.FT) (LB.FT)	ZZ MOMENT (LB.FT) (LB.FT)	M/Z (PSI) (PSI)
RN1A										
	81	160T	VALV	716.74	62.24	40.18	54.31	481.56	1721.80	N/A
	82	161	VALV	716.74	62.24	40.18	54.31	494.40	1702.21	N/A
	83	162	VALV	716.74	62.24	40.18	54.31	500.60	1692.75	N/A
	84	165	VALV	716.74	62.24	40.18	54.31	509.80	1678.71	N/A
	85	167	VALV	716.74	62.24	40.18	54.31	523.49	1657.82	N/A
	86L	170	VALV	716.74	62.24	40.18	54.31	550.88	1616.03	N/A
	86W	170	AWTT	716.74	62.24	40.18	54.31	550.88	1616.03	12524.34
	86R	170	STRP	716.74	62.24	40.18	54.31	550.88	1616.03	12524.34

A2

	87L	175A	STRP	716.74	62.24	40.18	54.31	587.45	1560.22	12229.80
	87R	175A	STRP	716.74	62.24	40.18	54.31	587.45	1560.22	5322.88
	88L	175B	STRP	716.74	62.24	40.18	54.31	616.12	1516.48	5226.27
	88R	175B	NONS	716.74	62.24	40.18	54.31	616.12	1516.48	N/A
	89L	175C	NONS	716.74	62.24	40.18	54.31	634.94	1487.75	N/A
	89R	175C	NONS	716.74	62.24	40.18	54.31	634.94	1487.75	N/A
	90	175D	NONS	716.74	62.24	40.18	54.31	690.36	1403.20	N/A
RN2A										
	134	280T	VALV	353.56	-86.08	-315.48	-234.61	654.56	308.76	N/A
	135	281	VALV	353.56	-86.08	-315.48	-234.61	549.67	336.84	N/A
	136	282	VALV	353.56	-86.08	-315.48	-234.61	498.99	350.41	N/A
	137	285	VALV	353.56	-86.08	-315.48	-234.61	423.80	370.54	N/A
	138	287	VALV	353.56	-86.08	-315.48	-234.61	311.93	400.50	N/A
	139L	290	VALV	353.56	-86.08	-315.48	-234.61	88.15	460.41	N/A
	139W	290	AWTT	353.56	-86.08	-315.48	-234.61	88.15	460.41	3843.41
	139R	290	STRP	353.56	-86.08	-315.48	-234.61	88.15	460.41	3843.41
	140L	300A	STRP	353.56	-86.08	-315.48	-234.61	-210.72	540.44	4587.65
	140R	300A	STRP	353.56	-86.08	-315.48	-234.61	-210.72	540.44	1996.72
	141L	300B	STRP	353.56	-86.08	-315.48	-234.61	-444.97	603.16	2506.28
	141R	300B	NONS	353.56	-86.08	-315.48	-234.61	-444.97	603.16	N/A
	142L	300C	NONS	353.56	-86.08	-315.48	-234.61	-598.80	644.35	N/A
	142R	300C	NONS	353.56	-86.08	-315.48	-234.61	-598.80	644.35	N/A
	143	300D	NONS	353.56	-86.08	-315.48	-234.61	-1051.60	765.58	N/A

APPENDIX B

Reproduced Original Nozzle
Fatigue Analysis
(9 Pages total)

Table 1
Primary + Secondary Stress Intensities
At Juncture #8

	Iteration	Pressure	Pressure Stress		Thermal Expansion Stress		Stress Report Thermal Stress		Total Stress Intensity (ksi)	
			Inside	Outside	Inside	Outside	Inside	Outside	Inside	Outside
	3	2200	4.84	1.32	13.63	19.24	63.7	-58.2	82.17	-37.64
	6	2200	4.84	1.32	13.63	19.24	77.5	-70.8	95.97	-50.24
Test	8	2200	4.84	1.32	13.63	19.24	78.8	-71.9	97.27	-51.34
40 Cycles	15	2200	4.84	1.32	13.63	19.24	69.3	-63	87.77	-42.44
	30	2200	4.84	1.32	13.63	19.24	7.7	-6.9	26.17	13.66
	1211	2200	4.84	1.32	13.63	19.24	-0.4	0.3	18.07	20.86
Heatup	1491	2200	4.84	1.32	13.63	19.24	0	0	18.47	20.56
240 Cycles	42021	2200	4.84	1.32	13.63	19.24	0	0	18.47	20.56
	27976	2200	4.84	1.32	13.63	19.24	-0.7	0.6	17.77	21.16
	5060	2200	4.84	1.32	13.63	19.24	86	-78.3	104.47	-57.74
	5063	2200	4.84	1.32	13.63	19.24	73.1	-66.8	91.57	-46.24
	5072	2200	4.84	1.32	13.63	19.24	97.9	-89.3	116.37	-68.74
Rapid Dprz	5124	2100	4.62	1.26	13.63	19.24	33	-29.7	51.25	-9.20
40 Cycles	5237	1800	3.96	1.08	13.63	19.24	11.5	-10.4	29.09	9.92
	6059	1000	2.2	0.6	13.63	19.24	0.4	-0.4	16.23	19.44
	6307	800	1.76	0.48	0.00	0.00	0.4	-0.4	2.16	0.08
	6338	700	1.54	0.42	0.00	0.00	-7.7	7	-6.16	7.42
	6850	600	1.32	0.36	0.00	0.00	-3.5	3.1	-2.18	3.46
	A	1500	3.3	0.9	13.63	19.24	103.7	-94.6	120.63	-74.46
	B	1100	2.4	0.7	0.00	0.00	-8.7	7.9	-6.30	8.60
	OBE	0	0	0	0.00	0.00	0	0	1.24	1.76
	2OBE	0	0	0	0.00	0.00	0	0	2.49	3.51

HPI Loads	Thermal Expansion	OBE
Fx (lb)	-255	31
Fy (lb)	-365	-264
Fz (lb)	-111	73
Mx (ft-lb)	2226	186
My (ft-lb)	-914	161
Mz (ft-lb)	-1043	-106

Prepared by: DAC 11/24/96
Checked by: [illegible] 11/26/96
File No: DUKE-110-303-5 Rev: 0
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Table 2
Peak Stress Intensities
At Juncture #8 - Inside

	Iteration	Pressure	Pressure Stress	Thermal Expansion Stress	Stress Report Thermal Stress	Total Stress (ksi)	Iteration
Test	3	2200	5.5	17.44	109	131.94	Test
Test	6	2200	5.5	17.44	115	137.94	Test
Test	8	2200	5.5	17.44	113.3	136.24	Test
Test	15	2200	5.5	17.44	95	117.94	Test
Test	30	2200	5.5	17.44	8.7	31.64	Test
Test	1211	2200	5.5	17.44	-0.4	22.54	Test
Heatup	1491	2200	5.5	17.44	0	22.94	Heatup
Heatup	42021	2200	5.5	17.44	0	22.94	Heatup
Heatup	27976	2200	5.5	17.44	-0.8	22.14	Heatup
Dpz	5060	2200	5.5	17.44	147.4	170.34	Dpz
Dpz	5063	2200	5.5	17.44	143.3	166.24	Dpz
Dpz	5072	2200	5.5	17.44	117.3	140.24	Dpz
Dpz	5124	2100	5.25	17.44	39.9	62.59	Dpz
Dpz	5237	1800	4.5	17.44	14.2	36.14	Dpz
Dpz	6059	1000	2.5	17.44	0.5	20.44	Dpz
Dpz	6307	800	2	0.00	0.5	2.50	Dpz
Dpz	6338	700	1.75	0.00	-9.6	-7.85	Dpz
Dpz	6850	600	1.5	0.00	-1.3	0.20	Dpz
	A	1500	3.8	17.44	156.24	177.48	A
	B	1100	2.75	0.00	-10.81	-8.06	B
	OBE	0	0	0.00	0	1.59	OBE
	2OBE	0	0	0.00	0	3.18	2OBE

Maximum Peak Stress Intensity Range		
	Value	Transient
Max	170.34	Dpz
Min	-7.85	Dpz
Peak (ksi)	**178.19**	
Corresponding Primary + Bending Range		
	Inside	Outside
Max	116.37	-68.7398
Min	-6.16	7.42
Mem+Ben	**122.53**	
3Sm	**51.30**	
Mem+Ben >3Sm		
Kf	1.77	
Sn/3Sm	2.39	
1a: Qm	23.81	
1a: Qb	92.55	
1b: Qm	0.63	
1b: Qb	-6.79	
Qm/Qm+Qb	0.19	
	From Fig. F-105(a)	
	Qm/Qm+Qb	21
	Sn/3Sm	141
Ke	**1.82**	
Sa (no E)	197.94	
Salt	**189.69**	

R 3

Second Maximum Peak Stress Intensity Range				
	Value	Iteration		
Max	137.94	Test		
Min	0.00	Zero Load		
Peak (ksi)	**137.94**			
Corresponding Primary + Bending Range				
	Inside	Outside	Iteration	
Max	97.27	-51.3398	8	
Min	0.00	0	0	
Mem+Ben	**97.27**			
3Sm	**51.30**			
Mem+Ben >3Sm				
Kf	1.71			
Sn/3Sm	1.90			
1a: Qm	22.96			
1a: Qb	74.30			
1b: Qm	0.00			
1b: Qb	0.00			
Qm/Qm+Qb	0.24			
	From Fig. F-105(a)			
	Qm/Qm+C	26		
	Sn/3Sm	92		
Ke	**1.51**			
Sa (no E)	125.89			
Salt	**120.87**			

HPI - OBE Maximum Peak Stress Intensity Range				
	Value	Iteration		
Max	179.08	A+OBE		
Min	-9.65	B-OBE		
Peak (ksi)	**188.73**			
Corresponding Primary + Bending Range				
	Inside	Outside	Iteration	
Max	121.87	-72.70	A+OBE	
Min	-7.54	6.84	B-OBE	
Mem+Ben	**129.42**			
3Sm	**51.30**			
Mem+Ben >3Sm				
Kf	1.78			
Sn/3Sm	2.52			
1a: Qm	24.58			
1a: Qb	97.29			
1b: Qm	-0.35			
1b: Qb	-7.19			
Qm/Qm+Qb	0.19			
	From Fig. F-105(a)			
	Qm/Qm+C	22		
	Sn/3Sm	155		
Ke	**1.93**			
Sa (no E)	222.17			
Salt	**213.55**			

R5

HPI Maximum Peak Stress Intensity Range			
	Value	Iteration	
Max	177.48	A	
Min	-8.06	B	
Peak (ksi)	**185.54**		
Corresponding Primary + Bending Range			
	Inside	Outside	Iteration
Max	120.63	-74.46	A
Min	-6.30	8.60	B
Mem+Ben	**126.93**		
3Sm	**51.30**		
Mem+Ben >3Sm			
Kf	1.79		
Sn/3Sm	2.47		
1a: Qm	23.08		
1a: Qb	97.54		
1b: Qm	1.15		
1b: Qb	-7.45		
Qm/Qm+Qb	0.17		
	From Fig. F-105(a)		
	Qm/Qm+C	20	
	Sn/3Sm	150	
Ke	**1.88**		
Sa (no E)	212.82		
Salt	**204.56**		

	OBE Maximum Peak Stress Intensity Range				
		Value	Iteration		
	Max	1.59	OBE		
	Min	-1.59	OBE		
	Peak (ksi)	**3.18**			
	Corresponding Primary + Bending Range				
		Inside	Outside	Iteration	
	Max	1.24	1.76	OBE	
	Min	-1.24	-1.76	OBE	
	Mem+Ben	**2.49**			
	3Sm	**51.30**			
	Mem+Ben < 3Sm				
	Sa (no E)	1.59			
	Salt	**1.61**			

Transient	Nreq
A	40
A+OBE	30
Dpz	40
OBE	610
Test	40

		Fig F-106(b)		
Transient Pair	**Salt**	**N**	**Nreq**	**U**
Dpz	189.69	**180**	40	0.222222
Dpz				
Test	120.87	**750**	40	0.053333
Zero Load				
A+OBE	213.55	**145**	30	0.206897
B-OBE				
A	204.56	**155**	40	0.258065
B				
OBE	1.61	**1.00E+21**	610	6.1E-19
OBE				
			Total Usage	0.740517

APPENDIX C

Reconciled Nozzle Fatigue Analysis
(with Full Power Thermal Piping Loads)
(9 Pages total)

	Revision	0	1		
	Preparer/Date	DAC 11/26/96	DAC 4/1/97		
	Checker/Date	[signature] 11/26/96	[signature] 4/1/97		
	File No. **DUKE-11Q-303-5**			Page No. C0 of C9	

Table 1
Primary + Secondary Stress Intensities
At Juncture #8

	Iteration	Pressure	Pressure Stress		Thermal Expansion Stress		Stress Report Thermal Stress		Total Stress Intensity (ksi)	
			Inside	Outside	Inside	Outside	Inside	Outside	Inside	Outside
Test 40 Cycles	3	2200	4.84	1.32	12.94	18.27	63.7	-58.2	81.48	-38.61
	6	2200	4.84	1.32	12.94	18.27	77.5	-70.8	95.28	-51.21
	8	2200	4.84	1.32	12.94	18.27	78.8	-71.9	96.58	-52.31
	15	2200	4.84	1.32	12.94	18.27	69.3	-63	87.08	-43.41
	30	2200	4.84	1.32	12.94	18.27	7.7	-6.9	25.48	12.69
	1211	2200	4.84	1.32	12.94	18.27	-0.4	0.3	17.38	19.89
Heatup	1491	2200	4.84	1.32	12.94	18.27	0	0	17.78	19.59
240 Cycles	42021	2200	4.84	1.32	12.94	18.27	0	0	17.78	19.59
	27976	2200	4.84	1.32	12.94	18.27	-0.7	0.6	17.08	20.19
Rapid Dprz 40 Cycles	5060	2200	4.84	1.32	12.94	18.27	86	-78.3	103.78	-58.71
	5063	2200	4.84	1.32	12.94	18.27	73.1	-66.8	90.88	-47.21
	5072	2200	4.84	1.32	12.94	18.27	97.9	-89.3	115.68	-69.71
	5124	2100	4.62	1.26	12.94	18.27	33	-29.7	50.56	-10.17
	5237	1800	3.96	1.08	12.94	18.27	11.5	-10.4	28.40	8.95
	6059	1000	2.2	0.6	12.94	18.27	0.4	-0.4	15.54	18.47
	6307	800	1.76	0.48	0.00	0.00	0.4	-0.4	2.16	0.08
	6338	700	1.54	0.42	0.00	0.00	-7.7	7	-6.16	7.42
	6850	600	1.32	0.36	0.00	0.00	-3.5	3.1	-2.18	3.46
	A	1500	3.3	0.9	12.94	18.27	103.7	-94.6	119.94	-75.43
	B	1100	2.4	0.7	0.00	0.00	-8.7	7.9	-6.30	8.60
	OBE	0	0	0	0.00	0.00	0	0	7.70	10.87
	2OBE	0	0	0	0.00	0.00	0	0	15.39	21.73

HPI Loads	Thermal Expansion	OBE
Fx (lb)	225.4	107.05
Fy (lb)	321.61	134.18
Fz (lb)	157.37	321.79
Mx (ft-lb)	605.9	253.74
My (ft-lb)	673.36	1615.2
Mz (ft-lb)	2320.23	678.05

Prepared by: DAC 3/28/97
Checked by: [illegible] 4/1/97
File No: DUKE-11Q-303-[illegible] Rev: 1
Page 01-C9 of C9

Table 2
Peak Stress Intensities
At Juncture #8 - Inside

	Iteration	Pressure	Pressure Stress	Thermal Expansion Stress	Stress Report Thermal Stress	Total Stress (ksi)	Iteration
Test	3	2200	5.5	16.56	109	131.06	Test
Test	6	2200	5.5	16.56	115	137.06	Test
Test	8	2200	5.5	16.56	113.3	135.36	Test
Test	15	2200	5.5	16.56	95	117.06	Test
Test	30	2200	5.5	16.56	8.7	30.76	Test
Test	1211	2200	5.5	16.56	-0.4	21.66	Test
Heatup	1491	2200	5.5	16.56	0	22.06	Heatup
Heatup	42021	2200	5.5	16.56	0	22.06	Heatup
Heatup	27976	2200	5.5	16.56	-0.8	21.26	Heatup
Dpz	5060	2200	5.5	16.56	147.4	169.46	Dpz
Dpz	5063	2200	5.5	16.56	143.3	165.36	Dpz
Dpz	5072	2200	5.5	16.56	117.3	139.36	Dpz
Dpz	5124	2100	5.25	16.56	39.9	61.71	Dpz
Dpz	5237	1800	4.5	16.56	14.2	35.26	Dpz
Dpz	6059	1000	2.5	16.56	0.5	19.56	Dpz
Dpz	6307	800	2	0.00	0.5	2.50	Dpz
Dpz	6338	700	1.75	0.00	-9.6	-7.85	Dpz
Dpz	6850	600	1.5	0.00	-1.3	0.20	Dpz
	A	1500	3.8	16.56	156.24	176.60	A
	B	1100	2.75	0.00	-10.81	-8.06	B
	OBE	0	0	0.00	0	9.85	OBE
	2OBE	0	0	0.00	0	19.71	2OBE

Maximum Peak Stress Intensity Range			
	Value	Transient	
Max	169.46	Dpz	
Min	-7.85	Dpz	
Peak (ksi)	**177.31**		
Corresponding Primary + Bending Range			
	Inside	Outside	
Max	115.68	-69.7098	
Min	-6.16	7.42	
Mem+Ben	**121.84**		
3Sm	**51.30**		
Mem+Ben >3Sm			
Kf	1.77		
Sn/3Sm	2.38		
1a: Qm	22.99		
1a: Qb	92.70		
1b: Qm	0.63		
1b: Qb	-6.79		
Qm/Qm+Qb	0.18		
	From Fig. F-105(a)		
	Qm/Qm+Qb	21	
	Sn/3Sm	140	
Ke	**1.82**		
Sa (no E)	196.26		
Salt	**188.09**		

	Second Maximum Peak Stress Intensity Range							
		Value	Iteration					
	Max	137.06	Test					
	Min	0.00	Zero Load					
	Peak (ksi)	**137.06**						
	Corresponding Primary + Bending Range							
		Inside	Outside	Iteration				
	Max	96.58	-52.3098	8				
	Min	0.00	0	0				
	Mem+Ben	**96.58**						
	3Sm	**51.30**						
	Mem+Ben >3Sm							
	Kf	1.71						
	Sn/3Sm	1.88						
	1a: Qm	22.14						
	1a: Qb	74.45						
	1b: Qm	0.00						
	1b: Qb	0.00						
	Qm/Qm+Qb	0.23						
		From Fig. F-105(a)						
		Qm/Qm+C	25					
		Sn/3Sm	91					
	Ke	**1.50**						
	Sa (no E)	124.16						
	Salt	**119.21**						

HPI - OBE Maximum Peak Stress Intensity Range			
	Value	Iteration	
Max	186.46	A+OBE	
Min	-17.91	B-OBE	
Peak (ksi)	**204.37**		
Corresponding Primary + Bending Range			
	Inside	Outside	Iteration
Max	127.64	-64.56	A+OBE
Min	-14.00	-2.27	B-OBE
Mem+Ben	**141.64**		
3Sm	**51.30**		
Mem+Ben >3Sm			
Kf	1.75		
Sn/3Sm	2.76		
1a: Qm	31.54		
1a: Qb	96.10		
1b: Qm	-8.13		
1b: Qb	-5.87		
Qm/Qm+Qb	0.28		
	From Fig. F-105(a)		
	Qm/Qm+C	31	
	Sn/3Sm	179	
Ke	**2.19**		
Sa (no E)	271.74		
Salt	**261.19**		

	HPI Maximum Peak Stress Intensity Range								
		Value	Iteration						
	Max	176.60	A						
	Min	-8.06	B						
	Peak (ksi)	**184.66**							
	Corresponding Primary + Bending Range								
		Inside	Outside	Iteration					
	Max	119.94	-75.43	A					
	Min	-6.30	8.60	B					
	Mem+Ben	**126.24**							
	3Sm	**51.30**							
	Mem+Ben >3Sm								
	Kf	1.79							
	Sn/3Sm	2.46							
	1a: Qm	22.26							
	1a: Qb	97.69							
	1b: Qm	1.15							
	1b: Qb	-7.45							
	Qm/Qm+Qb	0.17							
		From Fig. F-105(a)							
		Qm/Qm+C	19						
		Sn/3Sm	149						
	Ke	**1.86**							
	Sa (no E)	210.33							
	Salt	**202.17**							

C6

	OBE Maximum Peak Stress Intensity Range				
		Value	Iteration		
	Max	9.85	OBE		
	Min	-9.85	OBE		
	Peak (ksi)	**19.71**			
	Corresponding Primary + Bending Range				
		Inside	Outside	Iteration	
	Max	7.70	10.87	OBE	
	Min	-7.70	-10.87	OBE	
	Mem+Ben	**15.39**			
	3Sm	**51.30**			
	Mem+Ben < 3Sm				
	Sa (no E)	9.85			
	Salt	**9.95**			

Transient	Nreq
A	40
A+OBE	30
Dpz	40
OBE	610
Test	40

		Fig F-106(b)		
Transient Pair	**Salt**	**N**	**Nreq**	**U**
Dpz	188.09	**191**	40	0.209424
Dpz				
Test	119.21	**755**	40	0.05298
Zero Load				
A+OBE	261.19	**81**	30	0.37037
B-OBE				
A	202.17	**159**	40	0.251572
B				
OBE	9.95	**1.00E+21**	610	6.1E-19
OBE				
			Total Usage	0.884347

APPENDIX D

Reconciled Nozzle Fatigue Analysis
(with Stratified Stress Piping Loads)
(9 Pages total)

/DAG

	Revision	0	1		
	Preparer/Date	DAC 11/26/96	DAC 4/1/97		
	Checker/Date	[signature] 11/26/96	[signature] 4/1/97		
	File No. **DUKE-11Q-303-5**			Page No. D0 of D9	

Table 1
Primary + Secondary Stress Intensities
At Juncture #8

	Iteration	Pressure	Pressure Stress		Thermal Expansion Stress		Stress Report Thermal Stress		Total Stress Intensity (ksi)	
			Inside	Outside	Inside	Outside	Inside	Outside	Inside	Outside
Test 40 Cycles	3	2200	4.84	1.32	9.05	12.77	63.7	-58.2	77.59	-44.11
	6	2200	4.84	1.32	9.05	12.77	77.5	-70.8	91.39	-56.71
	8	2200	4.84	1.32	9.05	12.77	78.8	-71.9	92.69	-57.81
	15	2200	4.84	1.32	9.05	12.77	69.3	-63	83.19	-48.91
	30	2200	4.84	1.32	9.05	12.77	7.7	-6.9	21.59	7.19
	1211	2200	4.84	1.32	9.05	12.77	-0.4	0.3	13.49	14.39
Heatup	1491	2200	4.84	1.32	9.05	12.77	0	0	13.89	14.09
240 Cycles	42021	2200	4.84	1.32	9.05	12.77	0	0	13.89	14.09
	27976	2200	4.84	1.32	9.05	12.77	-0.7	0.6	13.19	14.69
Rapid Dprz 40 Cycles	5060	2200	4.84	1.32	9.05	12.77	86	-78.3	99.89	-64.21
	5063	2200	4.84	1.32	9.05	12.77	73.1	-66.8	86.99	-52.71
	5072	2200	4.84	1.32	9.05	12.77	97.9	-89.3	111.79	-75.21
	5124	2100	4.62	1.26	9.05	12.77	33	-29.7	46.67	-15.67
	5237	1800	3.96	1.08	9.05	12.77	11.5	-10.4	24.51	3.45
	6059	1000	2.2	0.6	9.05	12.77	0.4	-0.4	11.65	12.97
	6307	800	1.76	0.48	0.00	0.00	0.4	-0.4	2.16	0.08
	6338	700	1.54	0.42	0.00	0.00	-7.7	7	-6.16	7.42
	6850	600	1.32	0.36	0.00	0.00	-3.5	3.1	-2.18	3.46
	A	1500	3.3	0.9	9.05	12.77	103.7	-94.6	116.05	-80.93
	B	1100	2.4	0.7	0.00	0.00	-8.7	7.9	-6.30	8.60
	OBE	0	0	0	0.00	0.00	0	0	7.70	10.87
	2OBE	0	0	0	0.00	0.00	0	0	15.39	21.73

HPI Loads	Thermal Expansion	OBE
Fx (lb)	738.24	107.05
Fy (lb)	88.66	-134.18
Fz (lb)	324.94	-321.79
Mx (ft-lb)	241.65	253.74
My (ft-lb)	605.07	1615.2
Mz (ft-lb)	1607.03	678.05

- The 2.1e6 cycles of CYCL - cyclic stratified stress [2] are not included, as they proved to be insignificant

Prepared by: DAC 4/1/97
Checked by: [signature] 4/1/97
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Table 2
Peak Stress Intensities
At Juncture #8 - Inside

	Iteration	Pressure	Pressure Stress	Thermal Expansion Stress	Stress Report Thermal Stress	Total Stress (ksi)	Iteration
Test	3	2200	5.5	11.58	109	126.08	Test
Test	6	2200	5.5	11.58	115	132.08	Test
Test	8	2200	5.5	11.58	113.3	130.38	Test
Test	15	2200	5.5	11.58	95	112.08	Test
Test	30	2200	5.5	11.58	8.7	25.78	Test
Test	1211	2200	5.5	11.58	-0.4	16.68	Test
Heatup	1491	2200	5.5	11.58	0	17.08	Heatup
Heatup	42021	2200	5.5	11.58	0	17.08	Heatup
Heatup	27976	2200	5.5	11.58	-0.8	16.28	Heatup
Dpz	5060	2200	5.5	11.58	147.4	164.48	Dpz
Dpz	5063	2200	5.5	11.58	143.3	160.38	Dpz
Dpz	5072	2200	5.5	11.58	117.3	134.38	Dpz
Dpz	5124	2100	5.25	11.58	39.9	56.73	Dpz
Dpz	5237	1800	4.5	11.58	14.2	30.28	Dpz
Dpz	6059	1000	2.5	11.58	0.5	14.58	Dpz
Dpz	6307	800	2	0.00	0.5	2.50	Dpz
Dpz	6338	700	1.75	0.00	-9.6	-7.85	Dpz
Dpz	6850	600	1.5	0.00	-1.3	0.20	Dpz
	A	1500	3.8	11.58	156.24	171.62	A
	B	1100	2.75	0.00	-10.81	-8.06	B
	OBE	0	0	0.00	0	9.85	OBE
	2OBE	0	0	0.00	0	19.71	2OBE

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Maximum Peak Stress Intensity Range			
	Value	Transient	
Max	164.48	Dpz	
Min	-7.85	Dpz	
Peak (ksi)	**172.33**		
Corresponding Primary + Bending Range			
	Inside	Outside	
Max	111.79	-75.2074	
Min	-6.16	7.42	
Mem+Ben	**117.95**		
3Sm	**51.30**		
Mem+Ben >3Sm			
Kf	1.78		
Sn/3Sm	2.30		
1a: Qm	18.29		
1a: Qb	93.50		
1b: Qm	0.63		
1b: Qb	-6.79		
Qm/Qm+Qb	0.15		
	From Fig. F-105(a)		
	Qm/Qm+Qb	17	
	Sn/3Sm	132	
Ke	**1.74**		
Sa (no E)	182.58		
Salt	**174.98**		

Second Maximum Peak Stress Intensity Range				
	Value	Iteration		
Max	132.08	Test		
Min	0.00	Zero Load		
Peak (ksi)	**132.08**			
Corresponding Primary + Bending Range				
	Inside	Outside	Iteration	
Max	92.69	-57.8074	8	
Min	0.00	0	0	
Mem+Ben	**92.69**			
3Sm	**51.30**			
Mem+Ben >3Sm				
Kf	1.72			
Sn/3Sm	1.81			
1a: Qm	17.44			
1a: Qb	75.25			
1b: Qm	0.00			
1b: Qb	0.00			
Qm/Qm+Qb	0.19			
	From Fig. F-105(a)			
	Qm/Qm+C	21		
	Sn/3Sm	83		
Ke	**1.43**			
Sa (no E)	114.11			
Salt	**109.56**			

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HPI - OBE Maximum Peak Stress Intensity Range			
	Value	Iteration	
Max	181.47	A+OBE	
Min	-17.91	B-OBE	
Peak (ksi)	**199.39**		
Corresponding Primary + Bending Range			
	Inside	Outside	Iteration
Max	123.74	-70.06	A+OBE
Min	-14.00	-2.27	B-OBE
Mem+Ben	**137.74**		
3Sm	**51.30**		
Mem+Ben >3Sm			
Kf	1.76		
Sn/3Sm	2.69		
1a: Qm	26.84		
1a: Qb	96.90		
1b: Qm	-8.13		
1b: Qb	-5.87		
Qm/Qm+Qb	0.25		
	From Fig. F-105(a)		
	Qm/Qm+Q	28	
	Sn/3Sm	171	
Ke	**2.10**		
Sa (no E)	254.81		
Salt	**244.92**		

HPI Maximum Peak Stress Intensity Range			
	Value	Iteration	
Max	171.62	A	
Min	-8.06	B	
Peak (ksi)	**179.68**		
Corresponding Primary + Bending Range			
	Inside	Outside	Iteration
Max	116.05	-80.93	A
Min	-6.30	8.60	B
Mem+Ben	**122.35**		
3Sm	**51.30**		
Mem+Ben >3Sm			
Kf	1.80		
Sn/3Sm	2.38		
1a: Qm	17.56		
1a: Qb	98.49		
1b: Qm	1.15		
1b: Qb	-7.45		
Qm/Qm+Qb	0.13		
	From Fig. F-105(a)		
	Qm/Qm+Q	16	
	Sn/3Sm	141	
Ke	**1.79**		
Sa (no E)	196.79		
Salt	**189.15**		

OBE Maximum Peak Stress Intensity Range				
	Value	Iteration		
Max	9.85	OBE		
Min	-9.85	OBE		
Peak (ksi)	**19.71**			
Corresponding Primary + Bending Range				
	Inside	Outside	Iteration	
Max	7.70	10.87	OBE	
Min	-7.70	-10.87	OBE	
Mem+Ben	**15.39**			
3Sm	**51.30**			
Mem+Ben < 3Sm				
Sa (no E)	9.85			
Salt	**9.95**			

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Transient	Nreq
A	40
A+OBE	30
Dpz	40
OBE	610
Test	40

		Fig F-106(b)		
Transient Pair	**Salt**	**N**	**Nreq**	**U**
Dpz	174.98	**236**	40	0.169492
Dpz				
Test	109.56	**984**	40	0.04065
Zero Load				
A+OBE	244.92	**95**	30	0.315789
B-OBE				
A	189.15	**189**	40	0.21164
B				
OBE	9.95	**1.00E+21**	610	6.1E-19
OBE				
			Total Usage	0.737572

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Appendix E

Email transmittal from gla8363@prdc.dukepower.com (Duke) to Denise Curd (SI), "HPI Emergency Injection Lines; Ec/Eh Values"

(3 pages total)

/DAG

From: Denise Curd
To: Denise Curd
Subject: HPI Emergency Injection Lines: Ec/Eh Values

===NOTE===============3/13/97==4:32pm======================================
CC:
mail @ c2uu (g l armentrout) (gla8363@prdc.dukepower.com), mail @ c2uu
(Lawrence M Llibre) (lml6895@prdc.dukepower.com), mail @ c2uu
(jmd8363@prdc.dukepower.com), mail @ c2uu (paw4981@prdc.dukepower.com),
ail @ c2uu (tdb2719@prdc.dukepower.com), mail @ c2uu
vpp533c@prdc.dukepower.com), mail @ c2uu (Steve G Crews)
(sgc3091@prdc.dukepower.com)

From: G L Armentrout gla8363@dukepower.com

Oconee Service Water Project/Pipe Stress Complex ON02SW

Office (864)885-4322 FAX (864)885-4417 Pager 778-3947

Subject: HPI Emergency Injection Lines: Ec/Eh Values

<denise>:dcurd@structint.com

Denise

This note supersedes the note sent to you on 02/25/97. Please use it to aid in the Class I evaluation of the RCS branch lines.

It is requested that whenever you reference this note in your calculations, that a hardcopy be attached to those calculations.

Please acknowledge receipt of this note. If you have any questions, please let me know.

Thanks

Geary

*** Forwarding note from VPP533C --PRDC 03/13/97 13:54 ***

To: GLA8363 --PRDC

: Vijay Patel

Oconee Mod Engineering

Office 885-4169 Fax 885-4417 Oconee Complex ON02MO

Subject: HPI Emergency Injection Lines: Ec/Eh Values

Geary :

I Concur with the above Conclusion.

Thanks

Vijay

*** Forwarding note from GLA8363 --PRDC 03/13/97 12:20 ***

To: VPP533C --PRDC Vijay P. Patel

*** Resending note of 03/11/97 18:23

From: G L Armentrout gla8363@dukepower.com

To: VPP533C --PRDC Vijay P. Patel

From: G L Armentrout gla8363@dukepower.com

Oconee Service Water Project/Pipe Stress Complex ON02SW

Office (864)885-4322 FAX (864)885-4417 Pager 778-3947

Subject: HPI Emergency Injection Lines: Ec/Eh Values

This note will document how Superpipe considered the Ec/Eh values for the various load cases used in the Class I Comparative Analysis done for the PI Emergency Injection Lines (Calculation OSC-1323-06, Volume A, Analysis Problem 51-24). This note will be forwarded to Structural Integrity (SI), as information, to aid in the Class I Evaluation of the RCS Branch Lines.

Obviously, the Ec/Eh value is only applicable to thermal load cases. The individual thermal load cases, identified as THRM are shown on pages (1)11.1

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Checked by: [initials] 4/1/97
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through 6(1)12.2 of OSC-1323-06, Vol. A. The individual thermal load cases are STRD, FPTH, DLEK and DEST. These pages have already been sent to SI. Therefore the load case definitions will not be restated. As stated on page --- of the Superpipe Manual, "The computed stresses are multiplied by Ec/Eh for all loadings of THRM type." The operative words are "computed stresses" (i.e., M/Z), the individual moments are NOT multiplied by Ec/Eh, in these individual load case summaries (flagged as Static Analyses in the Superpipe printout).

However, please note the following comments:

1) Thermal load case STRD, which used the stratification movements, however was run at 70 degrees. Therefore Ec/Eh equaled 1. Using B31.7 values and the design temperature of 650 degrees, Ec/Eh should have been equal to 1.127.

2) The other thermal cases were thermal expansion load cases, therefore Ec/Eh was considered for the specified temperature ranges. However, the Young's Modulus values were taken from the B31.1 Code and not the B31.7 Code for the Class I piping. The differences are tabulated below:

Load Case	Ec/Eh B31.1	Ec/Eh B31.7	Percentage Increase
FPTH	1.069	1.102	3%
DLEK	1.064	1.093	3%
DEST	1.089	1.127	3%

Superpipe's Results Set Combination (COMB) option, which was used in the subject analysis problem does multiply the moment results by Ec/Eh. The applicable case names are provided on page 6(1)12.3 of OSC-1323-06, Vol. A (also earlier sent to SI).

In conclusion, if the individual static analyses from the Superpipe analysis are used, then the moment results must be multiplied by the appropriate Ec/Eh values. These static analyses are listed below as they appear in the Superpipe Output along w/ the Ec/Eh from the B31.7 code.

	Ec/Eh B31.7
STATIC ANALYSIS NO. 3 (STRD)	1.127
STATIC ANALYSIS NO. 4 (FPTH)	1.102
STATIC ANALYSIS NO. 5 (DLEK)	1.093
STATIC ANALYSIS NO. 6 (DEST)	1.127

However, if moments are taken from Superpipe's Results Set Combination (COMB) option, then the moment results should be increased by an additional 3%, as earlier discussed. These combined load cases are listed below as they appear in the Superpipe Output.

LOAD CASE NO. 3 (SRAT)
LOAD CASE NO. 4 (STRS)
LOAD CASE NO. 5 (CYCL)
LOAD CASE NO. 6 (STRD)
LOAD CASE NO. 7 (STRP)
LOAD CASE NO. 8 (STRN)
LOAD CASE NO. 9 (EQ10)
LOAD CASE NO. 10 (SRP)
LOAD CASE NO. 11 (SRN)

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Only a very small portion of the total thermal moment loads on the nozzles is from stratification load case (STRD), therefore the actual percentage increase approaches the value of 3%.

Geary

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