LOFT TECHNICAL REPORT LTR 125-7

RE&C INTERNAL REPORT RE-A-78-150

MARCH 26, 1979

LOFT CIS ANALYSIS

4"-WH-237-E OUTSIDE CONTAINMENT PENETRATION S-17B

J. E. Moha

MASTER

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DEPARTMENT OF ENERGY

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LOFT TECHNICAL REPORT LTR 125-7

RE&C Report # RE-A-78-150

DATE MARCH 26, 1979 *dh*

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RESEARCH, ENGINEERING AND CONSTRUCTION REPORT ENGINEERING ANALYSIS DIVISION

APPLIED MECHANICS BRANCH

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LOFT CIS ANALYSIS

4"-WH-237-E OUTSIDE CONTAINMENT PENETRATION S-17B

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LOFT TECHNICAL REPORT
LOFT PROGRAM

FORM EG&G-229
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ECG
RSB Mgr.

ABSTRACT

A stress analysis was performed on the 4"-WH-237-E piping system outside containment penetration S-17B. Deadweight, thermal expansion, and seismic loads were considered. The results indicate that this piping will meet ASME Section III, Class 2 requirements.

DISPOSITION OF RECOMMENDATIONS

The line analysed herein will be listed in the master Containment Isolation System technical report, LTR 128-5. This master LTR will be released after the completion of the 56 subtier LTRs. This master LTR will list all the CIS lines, P&ID drawings and the seismic analysis LTRs.

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I. SCOPE

This document constitutes the stress report required by Subarticle NCA-3350 of the ASME Boiler and Pressure Vessel Code, Section III, "Nuclear Power Plant Components", 1977 through Winter 1977 Addenda*. The piping system analyzed, to be installed as part of the "Loss-of-Fluid-Test" (LOFT) Reactor, was the 4"-WH-237-E outside containment penetration S-17B.

*Hereafter referred to as the Code^[1].

II. INTRODUCTION

The piping system was analyzed according to the procedures specified in Subsection NC-3600 of the Code and found acceptable. The governing conditions, engineering assumptions, and analytical techniques used in completing the analysis are described in the following pages. All loading conditions and design data used in performing the analysis were obtained from the P-1 specification^[2]. The design specification is to be released at a later date.

III. PIPING SYSTEM DESCRIPTION

The high level radioactive waste (WH) system transports wastes that are anticipated to contain radioactive nuclides or chemicals that exceed the limits for waste disposal to surface ponds. These wastes are transported to storage tanks located in a below-grade concrete building.

The purposes of this analysis were to 1) determine the loads imposed on the containment penetration and 2) assure containment isolation integrity. As a result, not all of the main piping system or branch piping may have been analyzed due to its negligible effect on the two primary purposes of this analysis.

1. STRUCTURAL DESCRIPTION

Figure 1 is an isometric plot of the Class 2 piping system analyzed in this report. The data points and elements are identified on the plot and a listing of the geometric data used in performing the system's structural analysis appears in Appendix A.

2. MATERIAL AND GEOMETRIC DATA

The piping has the following design parameters:

O.D. (inches)	4.500	6.625
Thickness (inches)	0.237	0.280
Weight (lbs/inch)	1.36	2.62
Material	ASTM A312, Type 304 or 304L Stainless Steel	ASTM A312 Type 304 or 304L Stainless Steel
E_{cold} (10^6 psi)	28.16	28.16

LOFT CIS ANALYSIS - 4, -WH-237-E OUTSIDE NUPIE MATHEMATICAL MODEL

LEGEND

- / - NODE LOCATION
- o - MASSPOINT LOCATION
- ← - SPRING HANGER
- - SADDLE
- ← - RIGID SUPPORT
- ≡ - ANCHOR
- ≡ - ELASTO JOINT
- ≡ - FLEXIBLE ANCHOR
- ≡ - VALVE

ROTATION ABOUT Y-AXIS = +6.4026.
X-Z PLANE TILT = +5.4026.

SEE REFERENCE 4.

Figure 1. Piping System Computer Model Plot

S (100°F) (psi)	15600	15600
S _y (psi)	25000	25000
α (10 ⁻⁶ in./in.°F)	9.16	9.16

The expansion coefficients and thermal conductivities of the materials are defined in Tables I-4.0 and I-5.0 of the Code.

IV. DESIGN AND SERVICE CONDITIONS

Listed in the following sections are the various design and service conditions used in analyzing the piping. This information was obtained from the design specification.

1. DESIGN CONDITIONS

Class 2

Design Pressure - 150 psi

Design Temperature- 100°F

2. LEVEL A SERVICE CONDITIONS

Level A service conditions, dealing mainly with the stress range due to thermal expansion, are based on the operating temperature(s) given below:

Class 2

Operating Pressure 50 psi

Operating Temperature 100°F

3. LEVEL B SERVICE CONDITIONS

The only Level B service condition resulting in significant dynamic loads for the piping system is the Operating Basis Earthquake (OBE).

4. LEVEL C SERVICE CONDITIONS

The only significant Level C service condition which affects the piping system is the Safe Shutdown Earthquake (SSE).

5. LEVEL D SERVICE CONDITIONS

The SSE plus Loss-of-Coolant Accident (LOCA) response envelopes all other Level D service responses for LOFT and will be used as the basis for Level D service conditions analysis.

6. TEST CONDITIONS

Cold Hydrostatic Test - Design Pressure x 1.25

Cold Leakage Test - Design Pressure Only

Hot Leakage Test - Design Pressure and Level A Service Temperature(s).

V. PIPING SYSTEM STRUCTURAL ANALYSIS

The piping system was analyzed for the various structural loads described in Section IV using the computer code NUPIPE-II, developed by Nuclear Services Corporation. This computer program is described in Appendix B. All limiting assumptions made in performing the analysis are listed in the following subsections.

1. WEIGHT ANALYSIS

An analysis for normal weight loading was performed for the system; the piping uniform weights used are listed in Section III.2 of this report. The weights and C.G.'s of the valves and operators are given in Table I. The results of the weight analysis are contained in Appendix C of this report.

2. THERMAL EXPANSION ANALYSIS

The piping system addressed in this report was analyzed for the steady-state temperature conditions as outlined in Section IV.2. The results of this analysis are contained in Appendix D.

3. SEISMIC ANALYSES

The piping system was analyzed for the effects of the Operating Basis Earthquake (OBE) and the Safe Shutdown Earthquake (SSE). For this analysis, OBE is to be considered one-half the magnitude of the SSE. The SSE response spectra is shown in Figure 2. This response spectra, multiplied by conservative directional intensity factors, was applied in all three directions simultaneously. Any seismic differential anchor movement effects present on the piping were taken into account. The results of the seismic analyses are contained in Appendix E.

FIGURE 2
SSE - SEISMIC RESPONSE SPECTRA ENVELOPE

1% DAMPING

TABLE I.PIPING SYSTEM VALVE DESIGN WEIGHTS
AND CENTERS OF GRAVITY

<u>Valve</u>	<u>Flooded Weight</u>	(Distance from <u>C.G. axis of Pipe</u>)
CV-P11-58	250 lbs.	14"

VI. ASME BOILER AND PRESSURE VESSEL CODE, SECTION III, STRESS ANALYSIS

A stress analysis of the Class 2 piping addressed in this report, per rules of Subsection NC-3600 of the Code, was performed using the results obtained from the analyses described in Section V of this report.

1. MINIMUM THICKNESS CHECK

The Code requires verification that the piping minimum wall thickness is satisfactory. The thickness was checked against Equation (1) of NC-3641.1:

$$t_M = \frac{P D_o}{2 (S + P_y)} + A$$

where t_M = Minimum required wall thickness

P = Internal design pressure

D_o = Outside diameter

S = Allowable stress

$y = .4$ or $\frac{d}{d + D_o}$ if $D_o/t_M < 6$ (per Code)

A = Corrosion allowance (.08).

Results of this calculation are contained in Table II.

TABLE II.

MINIMUM THICKNESS PARAMETERS				
<u>Pressure (psi)</u>	<u>O.D. (inches)</u>	<u>S (psi)</u>	<u>t_M (inches)</u>	<u>t_{actual} (inches)</u>
150	4.500	15600	0.102	0.237
150	6.625	15600	0.112	0.280

Since the actual thicknesses are all greater than the t_M calculated, the system meets the requirements of NC-3641.1.

2. DESIGN, LEVEL A, AND LEVEL B SERVICE CONDITIONS STRESS ANALYSIS

The loading conditions, defined as Design, Level A, and Level B in Section IV.1, 2, and 3, were used in performing a stress analysis of the piping system per the rules given in Subsection NC-3650 of the Code. The computer program NUPIPE-II was used for this analysis. The results of Equations (8), (9), (10), and (11) are detailed in Appendix F. Test conditions are encompassed by this stress analysis.

3. LEVEL C SERVICE CONDITIONS STRESS ANALYSIS

The only loading which was postulated as a Level C service condition is the SSE. NC-3611.2 (c) requires that Equation (9) of NC-3652.2 be satisfied with an allowable of $1.8 S_h$. These results, as calculated using NUPIPE-II, are contained in Appendix G.

4. LEVEL D SERVICE CONDITIONS STRESS ANALYSIS

There were no Level D service conditions specified for this piping.

VII. COMPONENT SUPPORT ANALYSIS

Any component supports designed and built by EG&G Idaho, Inc. have been analyzed in accordance with the AISC Manual of Steel Construction^[3]. The analysis of these component supports would be contained in Appendix I. All component supports which have been supplied by a commercial manufacturer carry loads which are less than the manufacturer's stated load capacity. A summary of sustained loads on all piping supports is contained in Table III.

TABLE III

LOADS ON PIPING SUPPORTS

<u>Support Type</u>	<u>Support No.</u>	<u>Deadweight</u>	<u>Thermal</u>	<u>OBE</u>	<u>SSE</u>	<u>Rated Load</u>
Rod	S1-Y	117	3	25	50	1400
Rod	S2-Y	359	-9	64	128	1400
Rod	S3-Y	130	230	137	274	1400
Rod	S4-Y	321	1	50	100	1400

VIII. SPECIAL CONSIDERATIONS

No special considerations had to be taken into account for this piping.

IX. CONCLUSIONS

The piping system addressed in this report was analyzed for the loads and operating conditions given in the design specification using the techniques described herein. All stresses have been found to be within limits established by Section III of the ASME Boiler and Pressure Vessel Code.

X. REFERENCES

1. American Society of Mechanical Engineers, ASME Boiler & Pressure Vessel Code, Section III, Division 1, "Nuclear Power Plant Components", Subsection NC, 1977 Edition, Winter 1977 Addenda.
2. Line Designation Tables, ANC-Specification P-1, Revision 2, January 17, 1973.
3. American Institute of Steel Construction, Manual of Steel Construction, Seventh Edition, pp 5-6 to 5-24, 1973.
4. Computer plot based on sketches made at LOFT by Applied Mechanics personnel during June, 1978.

APPENDIX A
BASIC DATA, INPUT PARAMETERS

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 LOFT CIS ANALYSIS - 4"-WH-237-E OUTSIDE S-17B

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PROGRAM CONTROL CARD

CARDTYPE	NCHECK	DAMP	CODE	GL08	DYN	THEATA	INTOUT	STORE
CONTROL	0	0	2.	0.	0.	0.0000	0.	4.

CARDTYPE	NPR	MPIPS	UNITS	EIGSAV
CONTROL	10	0	ENGLISH	0

FLEXIBILITY ANALYSIS CONTROL CARDS

CARDTYPE	NCASE	MODE	TLOAD	CHODE	CFREQ	SPEC	SAVE	CYCLE	TITLE
FLEXAN	1	1	3.	0.	0.	0.00	1.	0.	DEADWEIGHT
FLEXAN	2	1	2.	0.	0.	0.00	1.	0.	THERMAL EXPANSION PLUS ANCHOR MOVEMENTS
FLEXAN	3	1	11.	30.	50.	1.00	1.	0.	SSE RESPONSE SPECTRUM - 1% DAMPING
MODFLEX	4	301	1.	0.	0.	0.00	1.	0.	OBE RESPONSE SPECTRUM - ONE-HALF SSE

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SEISMIC RESPONSE SPECTRA - SET 1

X-EARTHQUAKE		Y-EARTHQUAKE		Z-EARTHQUAKE	
PERIOD (SEC)	ACCELERATION (G)	PERIOD (SEC)	ACCELERATION (G)	PERIOD (SEC)	ACCELERATION (G)
0.000	.342	0.000	.228	0.000	.342
.010	.342	.010	.228	.010	.342
.250	1.460	.250	.973	.250	1.460
.800	.637	.800	.425	.800	.637
1.400	.342	1.400	.228	1.400	.342
2.200	.217	2.200	.145	2.200	.217

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*** INPUT DATA ***

CARDTYPE	I1	I2	DELTA(1)	DELTA(2)	DELTA(3)	DELTA(4)	DELTA(5)	DELTA(6)
XSECTN	0	1	.450E+01	.237E+00	.163E+02	.282E+02	.150E+03	0.
XSECTN	0	2	.663E+01	.280E+00	.315E+02	.282E+02	.150E+03	0.
OPVAL	1	1	.282E+02	.340E+02	0.	0.	.150E+03	0.
CHECK MAGNITUDE OF ENTRIES ON ABOVE OPVAL CARD ***								
ANCHUR	0	5	0.	0.	0.	.100E+01	0.	0.
MASSPT	0	5	.100E+01	.100E+01	.100E+01	0.	0.	0.
RUN	5	10	.250E+01	0.	0.	.100E+01	.100E+01	0.
MASSPT	0	10	.100E+01	.100E+01	.100E+01	0.	0.	0.
RUN	10	15	.250E+01	0.	0.	.100E+01	.100E+01	0.
RESTRAINT	0	15	0.	.200E+05	0.	0.	0.	0.
MASSPT	0	15	.100E+01	.100E+01	.100E+01	0.	0.	0.
RUN	15	20	.200E+01	0.	0.	.100E+01	.100E+01	0.
MASSPT	0	20	.100E+01	.100E+01	.100E+01	0.	0.	0.
VALVE	20	25	.120E+01	0.	0.	.100E+01	.100E+01	0.
MASSPT	0	25	.100E+01	.100E+01	.100E+01	0.	0.	0.
RUN	25	30	.100E+01	0.	0.	.100E+01	.100E+01	0.
MASSPT	0	30	.100E+01	.100E+01	.100E+01	0.	0.	0.
FGRUN	30	35	.120E+01	0.	0.	.100E+01	.100E+01	0.
MASSPT	0	35	.100E+01	.100E+01	.100E+01	0.	0.	0.
RUN	35	40	.300E+01	0.	0.	.100E+01	.100E+01	0.
MASSPT	0	40	.100E+01	.100E+01	.100E+01	0.	0.	0.
REDUCER	40	45	.670E+00	0.	0.	.100E+01	.100E+01	0.
MASSPT	0	45	.100E+01	.100E+01	.100E+01	0.	0.	0.
RUN	45	50	.300E+01	0.	0.	.200E+01	.100E+01	0.
RESTRAINT	0	50	0.	.200E+05	0.	0.	0.	0.

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MASSPT

0

50

.100E+01

.100E+01

.100E+01

C.

0.

0.

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CARDTYPE	I1	I2	DELTA(1)	DELTA(2)	DELTA(3)	DELTA(4)	DELTA(5)	DELTA(6)
ELBOW	50	55	0.	0.	0.	.200E+01	.100E+01	0.
MASSPT	0	55	.100E+01	.100E+01	.100E+01	0.	0.	0.
RUN	55	60	0.	0.	.300E+01	.200E+01	.100E+01	0.
MASSPT	0	60	.100E+01	.100E+01	.100E+01	0.	0.	0.
RUN	60	65	0.	0.	.300E+01	.200E+01	.100E+01	0.
MASSPT	0	65	.100E+01	.100E+01	.100E+01	0.	0.	0.
RUN	65	70	0.	0.	.300E+01	.200E+01	.100E+01	0.
MASSPT	0	70	.100E+01	.100E+01	.100E+01	0.	0.	0.
RUN	70	75	0.	0.	.300E+01	.200E+01	.100E+01	0.
MASSPT	0	75	.100E+01	.100E+01	.100E+01	0.	0.	0.
RUN	75	80	0.	0.	.300E+01	.200E+01	.100E+01	0.
RESTRAINT	0	80	0.	.200E+05	0.	0.	0.	0.
MASSPT	0	80	.100E+01	.100E+01	.100E+01	0.	0.	0.
ELBOW	80	85	0.	0.	0.	.200E+01	.100E+01	0.
MASSPT	0	85	.100E+01	.100E+01	.100E+01	0.	0.	0.
RUN	85	90	0.	.200E+01	0.	.200E+01	.100E+01	0.
MASSPT	0	90	.100E+01	.100E+01	.100E+01	0.	0.	0.
RUN	90	95	0.	.200E+01	0.	.200E+01	.100E+01	0.
MASSPT	0	95	.100E+01	.100E+01	.100E+01	0.	0.	0.
ELBOW	95	100	0.	0.	0.	.200E+01	.100E+01	0.
MASSPT	0	100	.100E+01	.100E+01	.100E+01	0.	0.	0.
RUN	100	105	0.	0.	.500E+00	.200E+01	.100E+01	0.
MASSPT	0	105	.100E+01	.100E+01	.100E+01	0.	0.	0.
ANCHOR	0	105	0.	0.	0.	.200E+01	0.	0.
RUN	25	110	0.	.260E+00	.148E+01	.200E+01	.100E+01	0.

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CARDTYPE	I1	I2	*** INPUT DATA ***											
			DELTA(1)	DELTA(2)	DELTA(3)	DELTA(4)	DELTA(5)	DELTA(6)						
RESTRAINT	0	110	0.	.200E+05	0.	0.	0.	0.						
MASSPT	0	110	.100E+01	.100E+01	.100E+01	0.	0.	0.						
CWEIGHT	0	110	0.	.250E+03	0.	0.	0.	0.						
STRESS7	0	0	0.	0.	0.	0.	0.	0.						
9CASES		0	1	0	3	0	0	0	0	0	0	0	0	0
10CASES		0	0	0	0	0	0	0	0	0	0	0	0	0
CKNODES		0	0	0	0	0	0	0	0	0	0	0	0	0
ALLDONE		0	0	0	0	0	0	0	0	0	0	0	0	0

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APPENDIX B
COMPUTER PROGRAM DESCRIPTION

The NUPIPE-II computer program performs linear elastic analysis of three-dimensional piping systems subject to thermal, deadweight, seismic, and other static and dynamic loads. The NUPIPE-II program is also designed to perform stress and fatigue analyses in accordance with the ASME Boiler and Pressure Vessel Code, Section III, Nuclear Power Plant Components, 1974 Edition through the Summer 1975 Addenda; and the ANSI B31.1 Code, 1967 and Summer 1973 versions. Piping systems of more than one classification can be analyzed.

NUPIPE-II utilizes the finite element method of analysis with special features incorporated to accommodate specific requirements of piping system analysis. In accordance with the finite element method, the continuous piping is mathematically idealized as an assembly of elastic structural members connecting discrete nodal points. Nodal points are placed in such a manner as to isolate particular types of piping elements, such as straight runs of pipe, elbows, valves, etc., for which force-deformation characteristics can be categorized. Nodal points are also placed at all discontinuities, such as piping supports, concentrated weights, branch lines, and changes in cross-section. System loads such as weights, equivalent thermal forces, and earthquake inertia forces are applied at the nodal points. For the deadweight and dynamic time-history and response spectra analyses, distributed weight properties of the piping as well as concentrated weights, such as valves, pumps, or snubbers, can be considered. A lumped mass model of the piping system is used for all dynamic analyses. Both translational and rotational degrees-of-freedom may be considered.

For further information concerning NUPIPE-II capabilities or analytical procedures, contact Applied Mechanics Branch.

APPENDIX C
WEIGHT ANALYSIS RESULTS

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SUPPORT REACTIONS FOR LOAD CASE NO. 1

DEADWEIGHT

NODE	TYPE	REACTION (LBS OR IN-LBS)	DIRECTION
5	FORCE	-2.	X COORD
5	FORCE	37.	Y COORD
5	FORCE	-4.	Z COORD
5	MOMENT	-82.	X COORD
5	MOMENT	457.	Y COORD
5	MOMENT	892.	Z COORD
15	FORCE	117.	Y COORD
50	FORCE	359.	Y COORD
80	FORCE	139.	Y COORD
105	FORCE	2.	X COORD
105	FORCE	257.	Y COORD
105	FORCE	4.	Z COORD
105	MOMENT	3271.	X COORD
105	MOMENT	-52.	Y COORD
105	MOMENT	112.	Z COORD
110	FORCE	321.	Y COORD

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LUFT CIS ANALYSIS - 4"-WH-237-E OUTSIDE S-17B

INTERNAL FORCES AND DEFLECTIONS FOR LOAD CASE NO. 1

DEADWEIGHT

MEMBER	END	FORCES (LBS)			MOMENTS (IN-LBS)			DEFLECTIONS (IN)			ROTATIONS (RAD)		
		FX	FY	FZ	MX	MY	MZ	DX	DY	DZ	RX	RY	RZ
RUN	5	-2.	37.	-4.	-62.	457.	892.	.000	-.000	.000	.0000	-.0000	-.0000
	10	2.	4.	4.	62.	-331.	-399.	.000	-.002	.001	.0000	-.0001	-.0001
RUN	10	-2.	-4.	-4.	-62.	331.	399.	.000	-.002	.001	.0000	-.0001	-.0001
	15	2.	45.	4.	62.	-205.	-1128.	.000	-.006	.003	.0000	-.0001	-.0002
RUN	15	-2.	72.	-4.	-62.	205.	1128.	.000	-.006	.003	.0000	-.0001	-.0002
	20	2.	-40.	4.	62.	-105.	218.	.000	-.012	.006	.0000	-.0001	-.0003
VALVE	20	-2.	40.	-4.	-62.	105.	-218.	.000	-.012	.006	.0000	-.0001	-.0003
	25	2.	-20.	4.	62.	-44.	650.	.000	-.016	.008	.0000	-.0001	-.0003
RUN	25	-2.	44.	-4.	-905.	44.	-650.	.000	-.016	.008	.0000	-.0001	-.0003
	30	2.	-28.	4.	905.	6.	1082.	.000	-.016	.009	.0001	-.0001	-.0002
FGRUN	30	-2.	28.	-4.	-905.	-6.	-1082.	.000	-.016	.009	.0001	-.0001	-.0002
	35	2.	-8.	4.	905.	67.	1341.	.000	-.021	.011	.0002	-.0001	-.0001
RUN	35	-2.	8.	-4.	-905.	-67.	-1341.	.000	-.021	.011	.0002	-.0001	-.0001
	40	2.	41.	4.	905.	218.	756.	.000	-.021	.015	.0004	-.0001	.0001
REDUCE	40	-2.	-41.	-4.	-905.	-218.	-756.	.000	-.021	.015	.0004	-.0001	.0001
	45	2.	52.	4.	905.	251.	385.	.000	-.020	.015	.0004	-.0001	.0001
RUN	45	-2.	-52.	-4.	-905.	-251.	-385.	.000	-.020	.015	.0004	-.0001	.0001
	50	2.	122.	4.	905.	365.	-1965.	.000	-.018	.017	.0005	-.0001	.0001
ELBOW	50	-2.	236.	-4.	-905.	-365.	1965.	.000	-.018	.017	.0005	-.0001	.0001
	55	2.	-199.	4.	1054.	365.	-8.	-.000	-.022	.018	.0005	-.0000	-.0000
RUN	55	-2.	199.	-4.	-1054.	-365.	8.	-.000	-.022	.018	.0005	-.0000	-.0000
	60	2.	-128.	4.	5476.	314.	-8.	-.001	-.035	.018	.0004	-.0000	-.0000
RUN	60	-2.	128.	-4.	-5476.	-314.	8.	-.001	-.035	.018	.0004	-.0000	-.0000
	65	2.	-34.	4.	8394.	226.	-8.	-.001	-.044	.018	.0001	-.0000	-.0000
RUN	65	-2.	34.	-4.	-8394.	-226.	8.	-.001	-.044	.018	.0001	-.0000	-.0000
	70	2.	61.	4.	7910.	133.	-5.	-.001	-.039	.018	.0003	-.0000	-.0000
RUN	70	-2.	-61.	-4.	-7910.	-133.	5.	-.001	-.039	.018	.0003	-.0000	-.0000
	75	2.	155.	4.	-4025.	50.	-8.	-.001	-.023	.016	-.0006	.0000	-.0000

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 LOFT CIS ANALYSIS - 4"-HH-237-E OUTSIDE S-178

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MEMBER	END	FORCES (LBS)			MOMENTS (IN-LBS)			DEFLECTIONS (IN)			ROTATIONS (RAD)		
		FX	FY	FZ	MX	MY	MZ	DX	DY	DZ	RX	RY	RZ
RUN	75	-2.	-155.	-4.	4025.	-50.	6.	-.001	-.023	.018	-.0006	.0000	-.0000
	80	2.	226.	4.	1122.	-16.	-8.	-.001	-.006	.018	-.0006	.0000	-.0000
ELBOW	80	-2.	-96.	-4.	-1122.	16.	6.	-.001	-.006	.018	-.0006	.0000	-.0000
	85	2.	133.	4.	2118.	-36.	16.	-.000	-.001	.013	-.0004	.0000	-.0000
RUN	85	-2.	-133.	-4.	-2118.	36.	-16.	-.000	-.001	.013	-.0004	.0000	-.0000
	90	2.	173.	4.	2055.	-36.	53.	-.000	-.001	.007	-.0004	.0000	-.0000
RUN	90	-2.	-173.	-4.	-2055.	36.	-53.	-.000	-.001	.007	-.0004	.0000	-.0000
	95	2.	212.	4.	1992.	-36.	90.	-.000	-.001	.002	-.0003	.0000	-.0000
ELBOW	95	-2.	-212.	-4.	-1992.	36.	-90.	-.000	-.001	.002	-.0003	.0000	-.0000
	100	2.	249.	4.	4031.	-60.	112.	.000	-.000	-.000	-.0000	.0000	-.0000
RUN	100	-2.	-249.	-4.	-4031.	60.	-112.	.000	-.000	-.000	-.0000	.0000	-.0000
	105	2.	257.	4.	3271.	-52.	112.	-.000	-.000	-.000	-.0000	.0000	-.0000
RUN	25	0.	-24.	-0.	844.	0.	0.	.000	-.016	.008	.0000	-.0001	-.0003
	110	-0.	71.	0.	-0.	-0.	-0.	-.001	-.016	.008	.0000	-.0001	-.0003

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APPENDIX D
THERMAL EXPANSION ANALYSIS RESULTS

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NUPIPE-IIM - NUCLEAR SERVICES CORPORATION PIPING ANALYSIS PROGRAM - VERSION 1.1

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LOFT CIS ANALYSIS - 4"-WH-237-E OUTSIDE S-170

SUPPORT REACTIONS FOR LOAD CASE NO. 2

THERMAL EXPANSION PLUS ANCHOR MOVEMENTS

NODE	TYPE	REACTION (LBS OR IN-LBS)	DIRECTION
5	FORCE	22.	X COORD
5	FORCE	-1.	Y COORD
5	FORCE	22.	Z COORD
5	MOMENT	-28.	X COORD
5	MOMENT	-2015.	Y COORD
5	MOMENT	-4.	Z COORD
15	FORCE	3.	Y COORD
50	FORCE	-9.	Y COORD
80	FORCE	230.	Y COORD
105	FORCE	-22.	X COORD
105	FORCE	-224.	Y COORD
105	FORCE	-22.	Z COORD
105	MOMENT	-1330.	X COORD
105	MOMENT	1580.	Y COORD
105	MOMENT	-765.	Z COORD
110	FORCE	1.	Y COORD

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LOFT CIS ANALYSIS - 4"-WH-237-E OUTSIDE S-178

INTERNAL FORCES AND DEFLECTIONS FOR LOAD CASE NO. 2

THERMAL EXPANSION PLUS ANCHOR MOVEMENTS

MEMBER	END	FORCES (LBS)			MOMENTS (IN-LBS)			DEFLECTIONS (IN)			ROTATIONS (RAD)		
		FX	FY	FZ	MX	MY	MZ	DX	DY	DZ	RX	RY	RZ
RUN	5	22.	-1.	22.	-28.	-2015.	-4.	-.000	-.000	-.000	.0000	.0000	-.0000
	10	-22.	1.	-22.	28.	1361.	-31.	.008	-.000	-.004	.0000	.0002	-.0000
RUN	10	22.	-1.	22.	-28.	-1361.	31.	.008	-.000	-.004	.0000	.0002	-.0000
	15	-22.	1.	-22.	28.	706.	-66.	.017	-.000	-.014	.0000	.0004	-.0000
RUN	15	22.	2.	22.	-28.	-706.	66.	.017	-.000	-.014	.0000	.0004	-.0000
	20	-22.	-2.	-22.	28.	183.	-14.	.024	-.000	-.024	.0000	.0005	-.0000
VALVE	20	22.	2.	22.	-28.	-183.	14.	.024	-.000	-.024	.0000	.0005	-.0000
	25	-22.	-2.	-22.	28.	-131.	17.	.028	-.001	-.031	.0000	.0005	-.0000
RUN	25	22.	3.	22.	-46.	131.	-17.	.028	-.001	-.031	.0000	.0005	-.0000
	30	-22.	-3.	-22.	46.	-393.	55.	.031	-.001	-.036	.0000	.0004	-.0000
FGRUN	30	22.	3.	22.	-46.	393.	-55.	.031	-.001	-.036	.0000	.0004	-.0000
	35	-22.	-3.	-22.	46.	-707.	101.	.035	-.001	-.042	.0000	.0004	-.0000
RUN	35	22.	3.	22.	-46.	707.	-101.	.035	-.001	-.042	.0000	.0004	-.0000
	40	-22.	-3.	-22.	46.	-1492.	217.	.046	-.001	-.054	.0000	.0002	-.0000
REDUCE	40	22.	3.	22.	-46.	1492.	-217.	.046	-.001	-.054	.0000	.0002	-.0000
	45	-22.	-3.	-22.	46.	-1667.	242.	.048	-.001	-.055	.0000	.0001	-.0000
RUN	45	22.	3.	22.	-46.	1667.	-242.	.048	-.001	-.055	.0000	.0001	-.0000
	50	-22.	-3.	-22.	46.	-2256.	329.	.055	-.000	-.058	.0000	.0001	-.0000
ELBGW	50	22.	-5.	22.	-46.	2256.	-329.	.055	-.000	-.058	.0000	.0001	-.0000
	55	-22.	5.	-22.	46.	-2257.	279.	.057	-.001	-.055	.0000	-.0002	.0001
RUN	55	22.	-5.	22.	-96.	2257.	-279.	.057	-.001	-.055	.0000	-.0002	.0001
	60	-22.	5.	-22.	96.	-1671.	279.	.051	-.000	-.048	.0000	-.0003	.0001
RUN	60	22.	-5.	22.	-244.	1671.	-279.	.051	-.000	-.048	.0000	-.0003	.0001
	65	-22.	5.	-22.	244.	-889.	279.	.040	-.002	-.038	.0001	-.0003	.0001
RUN	65	22.	-5.	22.	-442.	889.	-279.	.040	-.002	-.038	.0001	-.0003	.0001
	70	-22.	5.	-22.	442.	-108.	279.	.028	-.005	-.027	.0001	-.0003	.0001
RUN	70	22.	-5.	22.	-639.	108.	-279.	.028	-.005	-.027	.0001	-.0003	.0001
	75	-22.	5.	-22.	639.	-674.	279.	.016	-.008	-.017	.0001	-.0003	.0001

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 LOFT CIS ANALYSIS - 4"-WH-237-E OUTSIDE S-178

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MEMBER	END	FORCES (LBS)			MOMENTS (IN-LBS)			DEFLECTIONS (IN)			ROTATIONS (RAD)		
		FX	FY	FZ	MX	MY	MZ	DX	DY	DZ	RX	RY	RZ
RUN	75	22.	-5.	22.	-837.	-674.	-279.	.016	-.006	-.017	.0001	-.0003	.0001
	80	-22.	5.	-22.	985.	1260.	279.	.008	-.011	-.010	.0001	-.0003	.0001
ELBOW	80	22.	224.	22.	-985.	-1260.	-279.	.008	-.011	-.010	.0001	-.0003	.0001
	85	-22.	-224.	-22.	836.	1455.	84.	.004	-.010	-.006	.0001	-.0002	.0001
RUN	85	22.	224.	22.	-836.	-1455.	-84.	.004	-.010	-.006	.0001	-.0002	.0001
	90	-22.	-224.	-22.	509.	1455.	242.	.003	-.006	-.004	.0001	-.0002	.0001
RUN	90	22.	224.	22.	-509.	-1455.	-242.	.003	-.006	-.004	.0001	-.0002	.0001
	95	-22.	-224.	-22.	182.	1455.	567.	.001	-.002	-.002	.0001	-.0001	.0001
ELBOW	95	22.	224.	22.	-182.	-1455.	-567.	.001	-.002	-.002	.0001	-.0001	.0001
	100	-22.	-224.	-22.	2003.	1651.	763.	-.000	.000	.001	.0000	-.0000	.0000
RUN	100	22.	224.	22.	-2003.	-1651.	-763.	-.000	.000	.001	.0000	-.0000	.0000
	105	-22.	-224.	-22.	1330.	1586.	763.	.000	.000	.000	.0000	-.0000	.0000
RUN	25	0.	-1.	0.	10.	-0.	-0.	.028	-.031	-.031	.0000	.0005	-.0000
	110	-0.	1.	-0.	0.	0.	0.	.036	-.000	-.026	.0000	.0005	-.0000

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APPENDIX E
SEISMIC ANALYSES RESULTS

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NUPIPE-IIH - NUCLEAR SERVICES CORPORATION PIPING ANALYSIS PROGRAM - VERSION 1.1
LOFT CIS ANALYSIS - 4"-WH-237-E OUTSIDE S-176

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SUPPORT REACTIONS FOR LOAD CASE NO. 3

SSE RESPONSE SPECTRUM - 1% DAMPING
COMBINED RESULT FOR MODE 1 THRU 10 BY RMS SUMMATION

SPECTRA SET = 1

NODE	TYPE	REACTIONS (LBS OR IN-LBS)	DIRECTION
5	FORCE	126.	X COORD
5	FORCE	9.	Y COORD
5	FORCE	292.	Z COORD
5	MOMENT	806.	X COORD
5	MOMENT	15067.	Y COORD
5	MOMENT	192.	Z COORD
15	FORCE	50.	Y COORD
50	FORCE	128.	Y COORD
80	FORCE	274.	Y COORD
105	FORCE	165.	X COORD
105	FORCE	268.	Y COORD
105	FORCE	518.	Z COORD
105	MOMENT	12745.	X COORD
105	MOMENT	1978.	Y COORD
105	MOMENT	6180.	Z COORD
110	FORCE	100.	Y COORD

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LOFT CIS ANALYSIS - 4"-NH-237-6 OUTSIDE S-170
 INTERNAL FORCES AND DEFLECTIONS FOR LOAD CASE NO. 3

SSE RESPONSE SPECTRUM - 1% DAMPING

COMBINED RESULT FOR MODE 1 THRU 10 BY RMS SUMMATION

SPECTRA SET = 1

MEMBER	END	FX	FORCES (LBS)	FZ	MX	MOMENTS (IN-LBS)	MY	MZ	DEFLECTIONS (IN)	DX	DY	DZ	KUTATIONS (RAD)	KX	KY	KZ
RUN	5	126.	9.	292.	600.	15067.	192.	359.	.000	.000	.000	.000	.0000	.0000	.0000	.0000
RUN	10	126.	9.	292.	600.	6355.	359.	359.	.000	.000	.000	.027	.0001	.0016	.0000	.0000
RUN	15	126.	9.	278.	600.	2186.	630.	359.	.000	.000	.003	.083	.0002	.0019	.0001	.0001
RUN	20	126.	39.	254.	600.	2186.	630.	449.	.000	.000	.003	.083	.0002	.0019	.0001	.0001
RUN	25	126.	33.	229.	600.	8157.	449.	449.	.000	.000	.006	.123	.0003	.0013	.0001	.0001
RUN	30	98.	27.	114.	494.	12092.	890.	890.	.000	.000	.007	.141	.0003	.0011	.0001	.0001
RUN	35	98.	27.	114.	494.	10767.	977.	1002.	.000	.000	.009	.150	.0004	.0011	.0001	.0001
RUN	40	98.	22.	134.	494.	8900.	1002.	1002.	.000	.000	.009	.150	.0004	.0005	.0001	.0001
RUN	45	98.	19.	171.	494.	3156.	1034.	1034.	.000	.000	.007	.120	.0005	.0013	.0001	.0001
RUN	50	98.	34.	227.	494.	2039.	1019.	1019.	.000	.000	.006	.109	.0005	.0014	.0001	.0001
RUN	55	97.	34.	227.	494.	5247.	1198.	1198.	.000	.000	.006	.109	.0005	.0014	.0001	.0001
RUN	60	94.	106.	277.	684.	7135.	1405.	1405.	.009	.012	.012	.066	.0005	.0007	.0003	.0003
RUN	65	74.	76.	316.	3494.	6841.	1405.	1405.	.025	.024	.024	.066	.0002	.0003	.0003	.0003
RUN	70	52.	49.	364.	6174.	6921.	1405.	1405.	.038	.035	.035	.066	.0002	.0003	.0003	.0003
RUN	75	79.	61.	413.	7343.	6076.	1405.	1405.	.041	.037	.037	.066	.0002	.0003	.0003	.0003
RUN	80	79.	61.	413.	7343.	6076.	1405.	1405.	.041	.037	.037	.066	.0002	.0003	.0003	.0003
RUN	85	117.	76.	458.	7509.	3554.	1405.	1405.	.034	.028	.028	.066	.0004	.0003	.0003	.0003

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80

117.

76.

458.

7617.

959.

1485.

.026

.014

.066

.0007

.0003

.0005

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NOPIPE-IIM - NUCLEAR SERVICES CORPORATION PIPING ANALYSIS PROGRAM - VERSION 1.1
 LOFT CIS ANALYSIS - 4"-WH-237-E OUTSIDE S-173

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MEMBER	END	FORCES (LBS)			MOMENTS (IN-LBS)			DEFLECTIONS (IN)			ROTATIONS (RAD)		
		FX	FY	FZ	MX	MY	MZ	DX	DY	DZ	RX	RY	RZ
ELBOW	80	141.	273.	487.	7617.	955.	1485.	.026	.014	.066	.0007	.0003	.0005
	85	141.	273.	487.	5725.	1204.	539.	.019	.005	.055	.0015	.0003	.0005
RUN	85	154.	272.	504.	5725.	1204.	539.	.019	.005	.055	.0015	.0003	.0005
	90	154.	272.	504.	2126.	1204.	2267.	.011	.005	.031	.0015	.0003	.0005
RUN	90	165.	270.	515.	2126.	1204.	2267.	.011	.005	.031	.0015	.0003	.0005
	95	163.	270.	515.	9633.	1204.	4679.	.004	.005	.009	.0014	.0003	.0004
ELBOW	95	165.	268.	518.	9633.	1204.	4679.	.004	.005	.009	.0014	.0003	.0004
	100	165.	268.	518.	11956.	2426.	6160.	.000	.000	.000	.0000	.0000	.0000
RUN	100	165.	268.	518.	11956.	2426.	6160.	.000	.000	.000	.0000	.0000	.0000
	105	165.	268.	518.	12745.	1978.	6160.	.000	.000	.000	.0000	.0000	.0000
RUN	25	79.	42.	296.	556.	1413.	248.	.000	.007	.141	.0003	.0011	.0001
	110	79.	42.	296.	0.	0.	0.	.020	.005	.142	.0003	.0011	.0001

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 LOFT CIS ANALYSIS - 4"-WH-237-E OUTSIDE S-178

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SYSTEM ACCELERATION FOR LOAD CASE NO. 3

SSE RESPONSE SPECTRUM - 1% DAMPING
 COMBINED RESULT FOR MODE 1 THRU 10 BY RMS SUMMATION

SPECTRA SET = 1

POINT NO.	X-DIRECTION (G)	Y-DIRECTION (G)	Z-DIRECTION (G)
5	.000	.000	.000
10	.004	.057	.259
15	.007	.157	.707
20	.010	.293	.907
25	.011	.300	1.075
30	.012	.443	1.136
35	.012	.489	1.145
40	.013	.411	.919
45	.014	.556	.842
50	.014	.210	.627
55	.049	.262	.308
60	.357	.459	.588
65	.593	.573	.307
70	.662	.521	.587
75	.631	.316	.586
80	.602	.122	.589
85	.465	.045	.491
90	.262	.045	.253
95	.077	.045	.079
100	.001	.001	.000
105	.000	.000	.000
110	.290	.290	1.062

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 LOFT CIS ANALYSIS - 4"-WH-237-E OUTSIDE S-173

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SUPPORT REACTIONS FOR LOAD COMBINATION CASE NO. 4

QBE RESPONSE SPECTRUM - ONE-HALF SSE

NODE	TYPE	REACTIONS (LBS OR IN-LBS)	DIRECTION
5	FORCE	63.	X C00K0
5	FORCE	2.	Y C00K0
5	FORCE	146.	Z C00K0
5	MOMENT	303.	X C00K0
5	MOMENT	7533.	Y C00K0
5	MOMENT	96.	Z C00K0
15	FORCE	22.	Y C00K0
50	FORCE	64.	Y C00K0
80	FORCE	137.	Y C00K0
105	FORCE	83.	X C00K0
105	FORCE	134.	Y C00K0
105	FORCE	259.	Z C00K0
105	MOMENT	6372.	X C00K0
105	MOMENT	989.	Y C00K0
105	MOMENT	3060.	Z C00K0
110	FORCE	50.	Y C00K0

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LOFT CIS ANALYSIS - 4"-WH-237-E OUTSIDE S-178

INTERNAL FORCES AND DEFLECTIONS FOR LOAD CASE NO. 4

OBE RESPONSE SPECTRUM - ONE-HALF SSE

MEMBER	END	FORCES (LBS)			MOMENTS (IN-LBS)			DEFLECTIONS (IN)			ROTATIONS (RAD)		
		FX	FY	FZ	MX	MY	MZ	UX	UY	UZ	RX	RY	RZ
RUN	5	63.	5.	146.	303.	7533.	96.	.000	.000	.000	.0000	.0000	.0000
	10	63.	5.	146.	303.	3177.	179.	.000	.000	.014	.0001	.0008	.0000
RUN	10	63.	5.	139.	303.	3177.	179.	.000	.000	.014	.0001	.0008	.0000
	15	63.	5.	139.	303.	1094.	315.	.000	.001	.041	.0001	.0009	.0001
RUN	15	63.	19.	127.	303.	1094.	315.	.000	.001	.041	.0001	.0009	.0001
	20	63.	19.	127.	303.	4079.	223.	.000	.003	.062	.0002	.0007	.0001
VALVE	20	63.	17.	115.	303.	4079.	225.	.000	.003	.062	.0002	.0007	.0001
	25	63.	17.	115.	303.	5722.	445.	.000	.004	.070	.0002	.0008	.0001
RUN	25	49.	14.	57.	247.	6040.	488.	.000	.004	.070	.0002	.0006	.0001
	30	49.	14.	57.	247.	5363.	501.	.000	.004	.075	.0002	.0006	.0001
FCRUN	30	49.	11.	67.	247.	5383.	501.	.000	.004	.075	.0002	.0006	.0001
	35	49.	11.	67.	247.	4450.	532.	.000	.005	.075	.0002	.0006	.0001
RUN	35	49.	9.	86.	247.	4450.	532.	.000	.005	.075	.0002	.0006	.0001
	40	49.	9.	86.	247.	1578.	517.	.000	.004	.060	.0002	.0007	.0001
REDUCE	40	49.	11.	96.	247.	1578.	517.	.000	.004	.060	.0002	.0007	.0001
	45	49.	11.	96.	247.	1019.	510.	.000	.003	.055	.0002	.0007	.0001
RUN	45	49.	17.	113.	247.	1019.	510.	.000	.003	.055	.0002	.0007	.0001
	50	49.	17.	113.	247.	2624.	599.	.000	.003	.037	.0003	.0007	.0001
ELBOW	50	49.	59.	127.	247.	2624.	599.	.000	.003	.037	.0003	.0007	.0001
	55	49.	59.	127.	342.	3567.	742.	.004	.006	.033	.0002	.0004	.0001
RUN	55	47.	53.	138.	342.	3567.	742.	.004	.006	.033	.0002	.0004	.0001
	60	47.	53.	138.	1747.	3420.	742.	.012	.012	.033	.0002	.0003	.0001
RUN	60	37.	38.	138.	1747.	3420.	742.	.012	.012	.033	.0002	.0003	.0001
	65	37.	38.	138.	3087.	3461.	742.	.019	.018	.033	.0001	.0001	.0002
RUN	65	26.	24.	182.	3087.	3461.	742.	.019	.018	.033	.0001	.0001	.0002
	70	26.	24.	182.	3672.	3035.	742.	.020	.019	.033	.0001	.0001	.0002
RUN	70	39.	31.	207.	3672.	3035.	742.	.020	.019	.033	.0001	.0001	.0002
	75	39.	31.	207.	1754.	1777.	742.	.017	.014	.033	.0002	.0001	.0002
RUN	75	58.	38.	229.	3754.	1777.	742.	.017	.014	.033	.0002	.0001	.0002
	80	58.	38.	229.	3808.	477.	742.	.013	.007	.033	.0003	.0002	.0002

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MEMBER	END	FORCES (LBS)			MOMENTS (IN-LBS)			DEFLECTIONS (IN)			ROTATIONS (RAD)		
		FX	FY	FZ	MX	MY	MZ	UX	UY	UZ	RX	RY	RZ
ELBOW	86	70.	157.	243.	3808.	477.	742.	.013	.007	.033	.0003	.0002	.0012
	85	70.	137.	243.	2862.	602.	270.	.009	.002	.027	.0003	.0002	.0003
RUN	85	77.	136.	252.	2862.	602.	270.	.009	.002	.027	.0008	.0002	.0003
	90	77.	136.	252.	1163.	602.	1134.	.005	.002	.016	.0008	.0002	.0003
RUN	90	81.	135.	257.	1363.	602.	1134.	.005	.002	.016	.0006	.0002	.0003
	95	81.	135.	257.	4341.	602.	2339.	.002	.003	.004	.0007	.0001	.0002
ELBOW	95	83.	134.	259.	4341.	602.	2339.	.002	.003	.004	.0007	.0001	.0002
	100	83.	134.	259.	5978.	1213.	3080.	.000	.000	.000	.0000	.0000	.0000
RUN	100	83.	134.	259.	5978.	1213.	3080.	.000	.000	.000	.0000	.0000	.0000
	105	83.	134.	259.	6372.	989.	3080.	.000	.000	.000	.0000	.0000	.0000
RUN	25	40.	21.	148.	270.	705.	124.	.000	.004	.070	.0002	.0006	.0001
	110	40.	21.	148.	0.	0.	0.	.010	.003	.071	.0002	.0006	.0001

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APPENDIX F
DESIGN, LEVEL A, AND LEVEL B SERVICE
CONDITIONS STRESS ANALYSIS RESULTS

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ASME SECTION III CLASS 2 OR ANSI B31.1.2 STRESS SUMMARY

MEMBER	NODE	STRESS INTENSIF FACTOR	SUSTAINED STRESS 10.8 (PSI)	OCCASIONAL STRESS 12.9 (PSI)	EXPANSION STRESS 14.10 (PSI)	SUSTAINED PLUS EXPANSION STRESS 14.11 (PSI)
RUN	5	1.000	1009.	338.	598.	1609.
	10	1.000	868.	1611.	402.	1269.
RUN	10	1.000	868.	1611.	402.	1269.
	15	1.000	1051.	1438.	218.	1261.
RUN	15	1.000	1051.	1400.	218.	1261.
	20	1.000	788.	1997.	55.	841.
RUN	25	1.000	1042.	2038.	41.	1083.
	30	1.000	1129.	2729.	118.	1247.
FGRUN	30	1.000	1129.	2729.	118.	1247.
	35	1.000	1191.	2918.	211.	1402.
RUN	35	1.000	1191.	2918.	211.	1402.
	40	1.000	1367.	1563.	448.	1812.
REDUCE	40	2.000	1244.	1908.	842.	2136.
	45	2.000	1162.	1679.	998.	2159.
RUN	45	1.000	1002.	1134.	178.	1193.
	50	1.000	1135.	1440.	257.	1393.
ELBOW	50	2.269	1309.	1618.	503.	1892.
	55	2.269	1103.	1805.	502.	1885.
RUN	55	1.000	1014.	1427.	297.	1271.
	60	1.000	1508.	1948.	193.	1699.
RUN	60	1.000	1508.	1948.	193.	1699.
	65	1.000	1335.	2365.	118.	1951.
RUN	65	1.000	1335.	2365.	118.	1951.
	70	1.000	1730.	2324.	88.	1860.
RUN	70	1.000	1780.	2384.	88.	1860.
	75	1.000	1342.	1618.	125.	1467.
RUN	75	1.000	1342.	1618.	125.	1467.
	80	1.000	1014.	1455.	133.	1198.

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ASME SECTION III CLASS 2 OR ANSI B31.1-6 STRESS SUMMARY

MEMBER	NODE	STRESS INTENSIF FACTOR	SUSTAINED STRESS EQ. 8 (PSI)	OCCASIONAL STRESS EQ. 7 (PSI)	EXPANSION STRESS EQ. 10 (PSI)	SUSTAINED PLUS EXPANSION STRESS EQ. 11 (PSI)
ELBOW	80	2.269	1103.	1899.	415.	1519.
	85	2.269	1194.	1898.	438.	1724.
RUN	90	1.000	1127.	1458.	189.	1316.
	95	1.000	1120.	1506.	176.	1296.
RUN	90	1.000	1120.	1506.	176.	1296.
	95	1.000	1113.	1723.	177.	1290.
ELBOW	95	2.269	1271.	2519.	401.	1673.
	100	2.269	1862.	2973.	672.	2354.
RUN	100	1.000	1343.	2113.	305.	1648.
	105	1.000	1257.	2082.	249.	1506.
RUN	25	1.000	933.	1670.	2.	935.
	110	1.000	835.	833.	0.	835.

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APPENDIX G
LEVEL C SERVICE CONDITIONS
STRESS ANALYSIS RESULTS

MEMBER	NODE	STRESS INTENSIF FACTOR	SUSTAINED STRESS EQ. 10 (PSI)	OCCASIONAL STRESS EQ. 10 (PSI)	EXPANSION STRESS EQ. 10 (PSI)	SUSTAINED PLUS EXPANSION STRESS EQ. 11 (PSI)
RUN	5	1.000	1009.	5467.	0.	1009.
RUN	10	1.000	866.	2756.	0.	866.
RUN	15	1.000	1051.	1746.	0.	1051.
RUN	20	1.000	1051.	1746.	0.	1051.
RUN	25	1.000	1042.	4631.	0.	1042.
RUN	30	1.000	1129.	4329.	0.	1129.
FORUN	35	1.000	1129.	4329.	0.	1129.
RUN	40	1.000	1191.	3649.	0.	1191.
RUN	45	1.000	1191.	3649.	0.	1191.
RUN	50	1.000	1191.	3649.	0.	1191.
RUN	55	1.000	1067.	3447.	0.	1067.
REDUCE	60	2.000	1244.	2733.	0.	1244.
RUN	65	2.000	1162.	2197.	0.	1162.
RUN	70	1.000	1002.	1265.	0.	1002.
ELBOW	75	2.269	1309.	2346.	0.	1309.
RUN	80	1.000	1014.	1640.	0.	1014.
RUN	85	1.000	1506.	2389.	0.	1506.
RUN	90	1.000	1035.	2694.	0.	1035.
RUN	95	1.000	1635.	2694.	0.	1635.
RUN	100	1.000	1720.	2694.	0.	1720.
RUN	105	1.000	1780.	2694.	0.	1780.
RUN	110	1.000	1342.	2244.	0.	1342.
RUN	115	1.000	1342.	2244.	0.	1342.
RUN	120	1.000	1342.	2244.	0.	1342.

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ASME SECTION III CLASS 2 OR ANSI B31.1-B STRESS SUMMARY

MEMBER	NODE	STRESS INTENSIFY FACTOR	SUSTAINED STRESS EQ.8 (PSI)	OCCASIONAL STRESS EQ.9 (PSI)	EXPANSION STRESS EQ.10 (PSI)	SUSTAINED PLUS EXPANSION STRESS EQ.11 (PSI)
ELBOW	80	2.269	1103.	2609.	0.	1103.
	85	2.269	1294.	2422.	0.	1294.
RUN	85	1.000	1127.	1739.	0.	1127.
	90	1.000	1120.	1496.	0.	1120.
RUN	90	1.000	1120.	1496.	0.	1120.
	95	1.000	1113.	2339.	0.	1113.
ELBOW	95	2.269	1271.	3147.	0.	1271.
	100	2.269	1662.	4265.	0.	1662.
RUN	100	1.000	1343.	2684.	0.	1343.
	105	1.000	1257.	2669.	0.	1257.
RUN	25	1.000	983.	1156.	0.	983.
	110	1.000	888.	888.	0.	888.

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APPENDIX H
LEVEL D SERVICE CONDITIONS
STRESS ANALYSIS RESULTS

Level D service conditions do not apply to this line.

APPENDIX I
COMPONENT SUPPORT ANALYSIS RESULTS

This system contains no supports which require analysis.