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STRESS ANALYSIS OF LOFT EMERGENCY CORE COOLANT
-SYSTEM MODIFICATION (LEFT AND RIGHT SIDE)

C. Kido

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STRESS ANALYSIS OF LOFT EMERGENCY CORE COOLANT
SYSTEM MODIFICATION (LEFT AND RIGHT SIDE)

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**LOFT TECHNICAL REPORT
LOFT PROGRAM**FORM EG&G 220
(Rev. 12-76)

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Stress Analysis of LOFT Emergency Core Coolant System		RE-D-77-209
Modification (Left and Right Side)		LTR 113-40
AUTHOR	GWA NO.	
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ABSTRACT

A stress analysis has been performed on proposed modifications to the Emergency Core Coolant System right and left side. For the right side thermal expansion and seismic loads were considered. Results of a previous report using dead weight, design LOCE, and LOCA loads were treated as valid and not repeated here. For the left side LOCE loading only was considered. The results of a previous analysis using dead weight, thermal, and LOCE loads were treated as valid and again not repeated here. Review of the analyses indicated that both proposed modifications pass the requirements of the ASME Boiler and Pressure Vessel Code Section III for Class 1 and 2 piping.

It was originally proposed to reconfigure the ECC left and right side injection lines to accomodate penetrations in the Primary System hot and cold leg. The penetrations would facilitate the installation of thermocouple-pitot probe rakes to measure ECC injection properties. Subsequently, only the left side configuration was reanalyzed in LTR 113-41 which supersedes this analysis.

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1.0 INTRODUCTION

Stress analysis of the LOFT ECC right and left side configurations, Figures 1, 2, 3, and 4, 5 respectively has been completed by the Applied Mechanics Branch. The results of two previous analyses of the system, References (1) and (2), respectively, served as a basis for this study. Rather than duplicate the entire analysis, a cursory method was sought.

1.1 Assumptions for Right Side, with Respect to Reference (1):

- A. Considered only that portion of the ECC system from reference point A03 to reactor
- B. Changed Elements 1 through 8 to reflect the new configuration
- C. Assumed the same loading conditions and response spectra as before
- D. compared thermal and seismic (SSE) results for both configurations to determine if the differences were significant and if additional analyses were required.

1.2 Assumptions for Left Side, with Respect to Reference (2):

- A. Used the same model as before with the exception of Elements 1 through 8, which were changed to reflect the new configuration.
- B. Assumed the same load conditions and response spectra as before
- C. Compared LOCE results for both configurations to determine if the differences were significant and if additional analyses were required.

1.3 Purpose and Requirements

The purpose of the analysis was to determine if local stresses conform to the requirements of Subsection NB-3650, Class 1, and NC-3650, Class 2, Reference (3). Operating and design conditions used in this analysis were the same as those in References (1) and (2), respectively, and thus were not repeated here. The stress free temperature for the pipe was taken as 70°F.

2.0 METHOD OF ANALYSIS

2.1 Computer Program, SAP IV

SAP IV, Reference (4), a computer program for the static and dynamic response of linear systems was used to determine the forces and moments in the pipe.

2.1.1 ECC Right Side

Thermal expansion values were obtained by the static method of analysis. Seismic stresses were obtained by the response spectrum method of dynamic analysis. As SSE (Safe Shutdown Earthquake) is defined to be twice OBE (Operating Basis Earthquake) levels, only SSE was considered. In the interest of economy, the thermal expansion and SSE seismic load cases were considered to be the most significant conditions applied to the ECC right side. By comparing these stress results with those of the previous analysis, Reference (1), it could be determined what effect the piping modification had on the static and dynamic behavior of the system. Since the thermal and seismic stress results did not change significantly, it was considered unnecessary to repeat any additional static (deadweight) or dynamic (LOCE and LOCA) analyses.

2.1.2 ECC Left Side

Review of the previous analysis, Reference (2), indicated that maximum moments occurred during LOCE loads. Hence, only LOCE stresses were considered. LOCE analysis was accomplished by the response spectrum method of dynamic analysis. By comparing these results with those of the previous analyses, Reference (2), it could be determined what effect the piping modification had on the dynamic behavior of the system. Since the stress results did not change significantly, it was considered unnecessary to repeat any additional dynamic (LOCA and SSE) analysis. Thermal expansion and deadweight conditions were considered insignificant and were not repeated.

2.2 Computer Model

Due to limitations in the size of the computer program, the ECC system has been divided and analyzed as two separate models. Information for model (1), representing the ECC right side, is contained in Figures 1, 2, and 3. Information for model (2); representing the ECC left side, is contained in Figures 4 and 5.

2.2.1 ECC Right Side, Model (1)

Figure 1, shows the computer model for the ECC right side used as input into the SAP IV program. Nodes and elements are indicated or can be obtained from the SAP IV computer output, Appendix A. Note that only Elements 1 through 8 differ from the original model (Ref. 1).

The LOFT ECC right side is a large system, which was divided into three subsystems in the previous analysis:

- A. Reactor to point A06
- B. Points A06, A03 to floor penetrations
- C. Point A03 to reactor.

As the new modification affected only the third subsystem, analysis for the other subsystems was not repeated here.

2.2.2 ECC Left Side, Model (2)

Figure 4 shows the computer model for the ECC left side used as input into the SAP IV program. SAP IV output is contained in Appendix B. Note that only Elements 1 through 8 differed from the original model. Beam and boundary elements were used to represent valve operators and piping supports, respectively.

2.3 Computer Runs

2.3.1 ECC Right Side, Appendix A

The ECC right side modification was analyzed for the effects of thermal expansion and SSE seismic loads. Input information was taken from

design conditions and the Mobile Test Assembly (MTA) seismic response spectra contained in Reference (1).

2.3.2 ECC Left Side, Appendix B

The ECC left side modification was analyzed for the effects of LOCE loads. Input information was taken directly from design conditions and the Mobile Test Assembly (MTA) LOCE response spectra contained in Reference (2).

2.4 ASME Code, Section III Piping Analysis

2.4.1 Load Classifications

For the Model (1) right side analysis, thermal loads were considered as normal conditions and SSE as emergency conditions.

For the Model (2) left side analysis, LOCE loads were considered as upset conditions.

2.4.2 Class 1 Piping Analysis

The analyses for both new configurations followed the procedures outlined in References (1) and (2) for the right and left side, respectively. Computer programs, SAP IV and INEL-PIPE, were used to investigate the right side. The left side was analyzed, based on Equation 9 from Subsection NB-3652 of the ASME Code to calculate allowable stresses. This provided a preliminary check prior to a complete Class 1 analysis.

2.4.3 Class 2 Piping Analysis

The procedures outlined in References (1) and (2) were used to investigate the right and left side, respectively. INEL-PIPE II program was used to combine resultant moments in developing corresponding Class 2 stress levels. The left side was analyzed using Equations 8, 9, and 11 from Subsection NB-3652 of the ASME Code to calculate allowable moments and stresses.

2.5 Hanger Analysis

Analysis of the hangers and restraints for Class 1 and 2 piping was not repeated.

3.0 RESULTS AND CONCLUSIONS

3.1 ECC Right Side Piping

Table 1 (seismic) and Table 2 (thermal) list those elements with moments greater than the original. The larger values do not exceed allowable limits and the new configuration is structurally adequate.

3.1.1 Class 1 Piping

Below is a summary of maximum resultant moments and stresses for Class 1 piping subjected to thermal and seismic loading. The allowable limit is not exceeded, indicating that further analysis is not necessary.

Element	Old Configuration		New Configuration		Allowable Stresses*
	M _{RES} (in-lb)	S _{RES} (in-lb)	M _{RES} (in-lb)	S _{RES} (psi)	
Thermal 9I	6148	1043	3825	648	3.0 S _m = 50100
	7J	6031	1023	509	
Seismic 69I	71454	6754	60144	5685	2.25 S _m = 37600
	69J	70004	6617	59987	

* Based on allowable stress, 16700 psi for SST piping, ASME SA-376, Grade TP-316

3.1.2 Class 2 Piping

Below is a summary of maximum resultant moments and stresses for Class 2 piping subjected to thermal and seismic loading. The allowable stress is not exceeded. Further analysis is not necessary.

Element	Old Configuration		New Configuration		Allowable Stress *
	M _{RES} (in-lb)	S _{RES} (in-lb)	M _{RES} (in-lb)	S _{RES} (psi)	
Thermal 29I	5281	837	3851	654	S _A = 27675
	29J	5718	972	4149	
Seismic 57I	61026	5769	16079	1520	1.8 S _H = 30060
	57J	66873	6321	15542	

* Based on allowable stress, 16700 psi for SST piping, ASME SA-376, Grade TP-316

3.2 ECC Left Side Piping

3.2.1 Class 1 Piping

A comparison of new and old results, disclosed that the new resultant moments did not exceed the old values for Class 1 piping. Hence further analysis was not necessary as the preliminary check has already been satisfied in Reference (2).

3.2.2 Class 2 Piping

Below is a summary of maximum resultant moments and stresses for Class 2 piping subjected to LOCE loading. The allowable stress is not exceeded. Further analysis is not necessary.

Element	Old Configuration		New Configuration		Max. Allow. Moment *
	M_{RES} (in-lb)	S_{RES} (psi)	M_{RES} (in-lb)	S_{RES} (psi)	
4" 79I	24317	8243	11449	3881	119906
Sch J	12519	4243	17103	5737	119906
160 80I	12519	4243	17103	5737	119906
Low J	51321	17336	25699	8701	119906
Pressure					

* Based on allowable stress, 16700 psi for SST piping, ASME SA-376, Grade TP-316.

4.0 COMPUTER CODE CONTROL

In order to conform with recent ERDA-ID requests for computer configuration control, Appendix C contains microfiche listings or paper copies of computer codes used in this analysis. All codes have not been placed under control.

5.0 REFERENCES

1. J. W. Muffett, Stress Analysis of LOFT Emergency Core Coolant System (Right Side), LTR 113-36, June 1977.

5.0 REFERENCES (CONTD)

2. M. E. Nitzel, LOFT Emergency Core Coolant (ECC) Left Side Reanalysis, LTR 113-33, October 26, 1976.
3. American Society of Mechanical Engineers, ASME Boiler and Pressure Vessel Code, Section III, Division I, "Nuclear Power Plant Components", Subsections NB and NC, 1974.
4. Klaus-Jurgen Bathe, et al, "SAP IV, A Structural Analysis Program for Static and Dynamic Response of Linear Systems", Earthquake Engineering Research Center, Berkeley, California, June 1973.
5. Aerojet Nuclear Company (ANC) Drawing 204286, LOFT Emergency Core Coolant, Right Side.
6. Aerojet Nuclear Company (ANC) Drawing 204283, LOFT Emergency Core Coolant, Left Side.

FIGURE 1

ECC - RIGHT SIDE

ECC-RIGHT SIDE FIGURE 2

LTR113 40

10

FIGURE 3

ECC RIGHT SIDE - ISOMETRIC
A03 TO REACTOR

LTR113 40

ECC SYSTEM

RELOCATED
HANGER
H10

LEFT SIDE

ECC MODIFICATION

[TAKEN FROM REF. (6)
DRAWING 204283]

FIGURE 5

LTR113 40

ELEMENT NUMBER	SYSTEM		I OR C - END				J - END			
	N-(NEW)	O-(OLD)	Tx	My	Mz	RES Mr	Tx	My	Mz	RES Mr
39	O						40700	9660	(11000)	43253
	N						1960	1240	11400	11633
40	O		40700	9660	(11000)	43253				
	N		1960	1240	11400	11633				
46	O		(6980)	11100	62700	64298				
	N		9980	768	11500	15245				
48	O		(8740)	7460	63900	64039	(8740)	1760	38700	39714
	N		10200	758	3220	10723	10200	375	13800	17164
49	O		(8740)	7460	63900	64039	(8680)	7740	27300	29674
	N		10200	375	13800	17164	10200	155	15700	18723
50	O		12990	(13600)	9290	24400	15300	(14900)	8910	22447
	N		5430	18200	342	18995	6720	18100	749	19321
51	O		15300	8910	(14900)	22447				
	N		6730	749	18100	19325				
63	O						7380	(16700)	66200	68672
	N						659	17300	36000	39947
64	O						(16700)	8600	69600	72080
	N						17300	2210	39600	43270
65	O						(10900)	15300	67200	69776
	N						13400	13300	41300	45411
66	O		7330	(17500)	67200	69777	7330	(17500)	68000	70597
	N		693	18900	41300	45424	693	20000	47300	51359
67	O		7330	(17500)	68000	70597	7330	(17200)	68200	70716
	N		693	20000	47300	51359	693	20100	49400	53337

TABLE 1 SEISMIC LOADING - RIGHT SIDE

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ELEMENT NUMBER	SYSTEM		I & C - END				J - END			
	N-(NEW)	O-(OLD)	Tx	My	Mz	RES MR	Tx	My	Mz	RES MR
68	O		20800	64600	(17900)	70187	44300	50700	(22000)	70831
	N		19500	47000	21000	55048	36700	37200	24800	57843
69	O		44300	50800	(22000)	70902	44300	48800	(27600)	71454
	N		36700	37200	24800	57843	36700	37100	29900	60144
70	O		22400	59100	(30100)	70004	4680	60100	(29100)	66938
	N		19600	46800	32000	59987	990	49100	30800	57969
71	O		4720	(29100)	60100	60941	4720	(27900)	58800	65254
	N		989	30800	49100	57969	989	29600	49100	56487
72	O		(27900)	4720	58800	65254	(27900)	5310	57600	64221
	N		29600	989	48100	56487	29600	2780	47100	55698
73	O		(27900)	5310	57600	64221	(27900)	6010	57000	63744
	N		29600	2780	47100	55698	29600	4040	46600	55354
74	O		(27900)	6010	57000	63746	(27900)	7200	56500	63423
	N		29600	4040	46600	55354	29600	5770	46200	55171
75	O		(16800)	(23400)	56500	63420	(16800)	(14900)	50900	55633
	N		17500	24600	46200	55189	17500	15500	41300	47457
76	O		4770	(21900)	50900	55616	4770	(6240)	29500	30528
	N		1050	23400	41300	47480	1050	6560	22000	22981
77	O		4770	(6240)	29500	30528				
	N		1050	6560	22000	22981				
78	O						4770	(12600)	5740	14644
	N						1050	13000	1040	13084
79	O		4770	(12600)	5740	14644	4770	(22100)	(10700)	(25013)
	N		1050	13000	1040	13084	1050	23100	13100	26577

TABLE 1 (CONT'D)

ETRI 13 4

ELEMENT NUMBER	SYSTEM		I R C - END				J - END			
	N-(NEW)	O-(OLD)	T _x	M _y	M _z	RES M _R	T _x	M _y	M _z	RES M _R
80	O		4770	(22100)	(10700)	(25013)	4770	(26900)	(17300)	(32337)
	N		1050	23100	13100	26577	1050	28200	19300	34188
81	O		4770	(26900)	(17300)	(32337)	4770	(30500)	(22100)	(37805)
	N		1050	28200	19300	34188	1050	31800	23700	39674
82	O		19700	20300	(32600)	43102	30500	7100	(50000)	43367
	N		17000	16500	34600	41933	23700	954	32500	40235
83	O		30500	7100	(30000)	43367	30500	20900	(19600)	41848
	N		23700	954	32500	40235	23700	846	23100	33106
84	O		30500	20900	(19600)	41848	30500	20900	(15300)	43451
	N		23700	846	23100	33106	23700	832	19100	30450
15 85	O		30500	20900	(5300)	43451	30500	21200	(4950)	37473
	N		23700	832	19100	30450	23700	922	9450	25531
86	O		30500	21200	(4950)	37473				
	N		23700	922	9450	25531				
88	O						30500	8100	(2950)	31695
	N						23700	1740	13100	27135
89	O		30500	8100	(2950)	31695				
	N		23700	1740	13100	27135				
90	O						(767)	33800	(1080)	33824
	N						2560	24000	1920	24212
91	O						(767)	10900	40500	41948
	N						2560	10600	24700	27000

TABLE I (CONT'D)

ELEMENT NUMBER	SYSTEM N-(NEW) O-(OLD)	I OR C - END				J - END			
		Tx	My	Mz	RES MR	Tx	My	Mz	RES MR
16	O N					-1252.58 -678.11	(8.14) 177.34	-1803.46 -1229.72	2195 1242
17	O N	-1252.58 -678.11	(8.14) 177.34	-1803.46 -1229.72	2195 1242				
19	O N					-1252.58 -678.11	2993.03 2259.07	(-804.65) -841.43	3342 2417
20	O N	-1252.58 -678.11	2993.03 2259.07	(-804.65) -841.31	3342 2417	-1252.58 -678.11	3216.90 2415.20	(-729.74) -812.31	3528 2554
24	O N	1363.54 -678.11	(1167.78) 2415.20	1697.03 -812.31	2470 2554	1363.54 -678.11	(2187.69) 2780.54	-3037.16 -744.16	3983 2883
25 (BEND)	O N	-1252.58 -678.11	(554.45) 744.16	3740.75 2780.54	3983 2883	{ -960.30 -347.66	(915.11) 917.29	3916.62 2886.17	4135 3048
28 (BEND)	O N					-1252.60 -678.20	(89.15) 563.25	5130.76 3749.97	5282 3852
29	O N	-1252.59 -678.12	5130.76 3749.97	(-89.33) -563.34	5282 3852	-1252.59 -678.12	5579.99 4063.27	(60.99) -504.91	5719 4150
37	O N					1577.47 946.63	(-276.24) -290.74	-1824.55 -956.83	2477 1377
38	O N	1577.47 946.63	(-276.24) -290.74	-1824.55 -956.83	2427 1377	1577.47 946.63	(-259.43) -293.87	-1672.81 -857.82	2313 1310
39	O N	1577.47 946.63	(-259.43) -293.87	-1672.81 -857.82	2313 1310	1577.47 946.63	(-242.63) -297.00	-1521.08 -758.80	2204 1249
40	O N	1577.47 946.63	(-242.63) -297.00	-1521.08 -758.80	2204 1249	1577.47 946.63	(-225.82) -300.13	-1369.34 -659.79	2101 1192

CENTER
OF
BEND

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TABLE 2 THERMAL LOADING - RIGHT SIDE

ELEMENT NUMBER	SYSTEM N-(NEW) O-(OLD)	I OR C - END				J - END			
		T _x	M _y	M _z	RES MR	T _x	M _y	M _z	RES MR
41	O	1577.47	<u>-225.83</u>	-1369.34	2101	1577.47	<u>-209.01</u>	-1217.60	2003
	N	946.63	-300.13	-659.79	1192	946.63	-303.26	-560.78	1141
42	O	1577.47	<u>-209.01</u>	-1217.60	2003	1577.47	<u>-192.21</u>	-1065.86	1913
	N	946.63	-303.26	-560.78	1141	946.63	-306.39	-461.76	1096
43	O	1577.47	<u>-192.21</u>	-1065.86	1913	1577.47	<u>-175.40</u>	-914.12	1831
	N	946.63	-306.39	-461.76	1096	946.63	-309.52	-362.75	1059
44	O	1577.47	<u>-175.40</u>	-914.12	1831	1577.47	<u>-165.94</u>	-828.71	1789
	N	946.63	-309.52	-362.75	1059	946.63	-311.29	-307.11	1042
45 (BEND)	O	1533.28	763.25	<u>-154.94</u>	1719	1684.91	<u>50.45</u>	<u>-142.01</u>	1691
	N	924.37	262.08	-309.68	1009	943.43	-159.79	-314.79	1007
46	O	668.19	<u>-142.01</u>	-1547.57	1691	668.19	<u>-135.25</u>	-1401.47	1558
	N	554.46	-314.79	-786.87	1012	544.46	-299.82	-691.53	929
47	O	620.09	<u>-135.25</u>	-1423.40	1558	620.19	<u>-126.35</u>	-1213.51	1368
	N	520.70	-299.82	-709.66	929	520.66	-277.39	-572.70	822
48	O	669.86	<u>-126.35</u>	-1186.76	1368	669.86	<u>-96.07</u>	-542.99	867
	N	543.90	-277.39	-550.63	822	543.90	-212.05	-130.55	598
49	O	672.36	<u>-96.07</u>	-539.89	867	672.36	<u>-86.68</u>	-342.40	759
	N	544.50	-212.05	-128.03	598	544.50	-192.12	.84	577
50 (BEND)	O	<u>508.33</u>	-462.37	<u>83.85</u>	828	<u>317.73</u>	-505.52	86.42	603
	N	516.53	-136.42	177.39	562	441.02	-247.00	158.97	529
51	O	<u>317.40</u>	<u>-86.42</u>	-505.73	603	<u>317.40</u>	<u>-99.71</u>	-205.33	<u>390</u>
	N	440.86	-158.97	-247.29	529	40.86	-109.64	-51.22	457
52	O	<u>317.40</u>	<u>-99.71</u>	-205.25	<u>390</u>	<u>317.40</u>	-107.18	<u>-36.45</u>	<u>336</u>
	N	440.86	-109.64	-51.22	457	440.86	-81.92	58.93	452

TABLE 2 (CONT'D)

ELEMENT NUMBER	SYSTEM N-(NEW) O-(OLD)	I OR C - END				J - END			
		Tx	My	Mz	RES MR	Tx	My	Mz	RES MR
53	O	(317.40)	-107.18	(-36.45)	(336)	(317.40)	-109.95	(26.15)	(336)
	N	440.86	-81.92	58.93	452	440.86	-71.65	99.78	457
54	O	(-26.15)	-109.95	(317.40)	(336)	(-26.15)	-104.07	(370.51)	(385)
	N	-99.78	-71.65	440.86	457	-99.78	-72.74	475.51	491
55	O	(-26.15)	-104.07	(370.51)	(385)	(-26.15)	-90.62	(491.90)	(500)
	N	-99.78	-72.74	554.72	568	-99.78	-75.25	554.72	568
56	O	(190.69)	-90.62	(-454.18)	(500)	(190.69)	-112.72	(-268.80)	(348)
	N	281.21	-75.25	-488.46	568	281.21	-61.37	-367.49	466
57	O	(317.40)	-112.72	(88.74)	(329)	(317.40)	-115.62	(154.36)	(370)
	N	440.86	-61.37	140.62	466	440.86	-50.60	183.44	480
58	O	(317.40)	-115.62	(154.36)	(370)	(317.40)	-118.48	(218.85)	(403)
	N	440.86	-50.60	183.44	480	440.86	-40.01	225.52	456
59	O	-118.48	(-317.40)	(218.85)	(403)	-118.48	(-320.85)	226.00	(409)
	N	-40.01	-440.86	225.52	456	-40.01	-440.86	224.19	455
60	O	-118.48	(-320.25)	226.00	(409)	-118.48	(-326.13)	240.70	422
	N	-40.01	-430.27	224.19	486	-40.01	-408.47	221.46	466
61	O	-118.48	(-326.13)	240.70	(422)	-118.48	(-332.84)	257.51	(437)
	N	-40.01	-408.47	221.46	466	-40.01	-383.56	218.32	443
62	O	-118.48	(-332.84)	257.51	(437)	-118.48	(-342.24)	281.04	458
	N	-40.01	-383.56	218.32	443	-40.01	-348.68	213.94	411
63	O	-118.48	(-342.24)	281.04	458				
	N	-40.01	-348.68	213.94	411				
70	O	(16.48)	-414.52	-120.60	432				
	N	44.49	-192.05	-18.24	197				

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TABLE 2 (CONT'D)

ELEMENT NUMBER	SYSTEM N-(NEW) O-(OLD)	I OR C - END				J - END			
		Tx	My	Mz	RES MR	Tx	My	Mz	RES MR
78	O N					-150.45 -34.05	<u>-136.17</u> 146.08	487.75 175.44	528 230.
79	O N	-150.45 -34.05	<u>-136.17</u> 146.08	487.75 175.44	528 230	-150.45 -34.05	<u>-142.88</u> 170.99	504.55 172.31	545 245
80	O N	-150.45 -34.05	<u>-142.88</u> 170.99	504.55 172.31	545 245	-150.45 -34.05	<u>-146.24</u> 183.44	512.96 170.74	554 252
81	O N	-150.45 -34.05	<u>-146.24</u> 183.44	512.96 170.74	554 252	-150.45 -34.05	<u>-148.59</u> 192.16	518.84 169.65	560 258
82 (BEND)	O N	263.45 95.33	480.39 142.71	<u>124.77</u> -220.13	561 279	528.92 167.77	160.53 32.18	<u>61.58</u> -266.52	556 316
61 83	O N	528.92 167.77	-160.53 -32.18	<u>-61.58</u> -266.52	556 316	528.92 167.77	-177.76 -28.97	<u>93.96</u> 368.01	565 405
84	O N	528.92 167.77	-177.76 -28.97	<u>93.96</u> 368.01	565 405	528.92 167.77	-184.90 -27.64	<u>158.44</u> 410.09	582 443
85	O N	528.92 167.77	-184.90 -27.64	<u>158.44</u> 410.09	582 443	528.92 167.77	-202.55 -24.35	<u>317.77</u> 514.05	649 541
86	O N	528.92 167.77	-202.55 -24.35	<u>317.77</u> 514.05	649 541	528.92 167.77	-217.67 -21.53	<u>454.33</u> 603.17	730 626
87	O N	528.92 167.77	-217.67 -21.53	<u>454.33</u> 603.17	730 626	528.92 167.77	-224.36 -20.29	<u>514.72</u> 642.57	771 664
88	O N	528.92 167.77	-224.36 -20.29	<u>514.72</u> 642.57	771 664	528.92 167.77	-242.88 -16.84	<u>681.94</u> 751.69	896 770.37
89	O N	528.92 167.77	-242.88 -16.84	<u>681.94</u> 751.69	896 770.37	528.92 167.77	-259.65 -13.71	<u>833.37</u> 850.50	1020 867

TABLE 2 (CONT'D)

ELEMENT NUMBER	SYSTEM N-(NEW) O-(OLD)	I OR C - END				J - END			
		T _x	M _y	M _z	RES M _R	T _x	M _y	M _z	RES M _R
90	O	528.92	259.65	-833.37	1020				
	N	167.77	13.71	-850.50	867				
100	O					-2798.99	-1868.73	771.82	3442
	N					-1745.19	-1127.58	790.50	2223
101	O	-2798.99	-1868.73	771.82	3442	-2798.99	-2248.09	-791.63	3676
	N	-1745.19	-1127.58	790.50	2223	-1745.19	-1286.66	-2320.04	2903
102	O	-2798.99	-2248.09	-791.63	3676	-2798.99	-2595.83	-2224.80	4418
	N	-1745.19	-1286.66	-2320.04	2903	-1745.19	-1432.48	-3722.12	4353
20									

TABLE 2 (CONT'D)

APPENDIX A

ECC RIGHT SIDE

- (1) Seismic Loading (SSE)
- (2) Thermal Expansion

SED M...

SEISMIC

EL NO	END	TX	MY	MZ	RES-MR	END	TX	MY	MZ	RES-MR
1	I	376.	1330.	955.	1680.	J	376.	722.	410.	911.
2	I	376.	722.	410.	911.	J	376.	366.	98.	534.
3	I	153.	177.	203.	310.	J	127.	113.	260.	311.
4	I	127.	113.	260.	311.	J	127.	416.	273.	514.
5	I	120.	295.	710.	778.	J	295.	149.	743.	813.
6	I	295.	743.	149.	813.	J	295.	513.	185.	620.
7	I	295.	513.	185.	620.	J	295.	124.	250.	406.
8	I	204.	119.	231.	330.	J	163.	59.	155.	232.
9	I	163.	131.	102.	233.	J	163.	134.	193.	286.
10	I	193.	163.	134.	286.	J	193.	182.	106.	286.
11	I	193.	182.	106.	286.	J	193.	124.	134.	266.
12	I	124.	134.	193.	266.	J	124.	132.	300.	350.
13	I	124.	132.	300.	350.	J	124.	126.	580.	606.
14	I	124.	126.	580.	606.	J	124.	124.	753.	773.
15	I	124.	124.	753.	773.	J	124.	126.	837.	855.
16	I	124.	126.	837.	855.	J	124.	135.	859.	878.
17	I	124.	135.	859.	878.	J	124.	150.	824.	847.
18	I	124.	150.	824.	847.	J	124.	172.	769.	798.
19	I	124.	172.	769.	798.	J	124.	199.	752.	788.
20	I	124.	199.	752.	788.	J	124.	206.	759.	796.
21	I	0.	25.	15.	29.	J	0.	11.	7.	13.
22	I	0.	11.	7.	13.	J	0.	4.	3.	5.
23	I	0.	4.	3.	5.	J	0.	0.	0.	0.
24	I	149.	212.	757.	800.	J	149.	227.	793.	838.
25	I	355.	752.	375.	912.	J	611.	597.	814.	1180.
26	I	611.	597.	814.	1180.	J	611.	658.	1760.	1976.
27	I	658.	611.	1760.	1976.	J	658.	666.	804.	1234.
28	I	390.	913.	1240.	1588.	J	293.	1020.	1530.	1862.
29	I	293.	1530.	1020.	1862.	J	293.	1850.	1200.	2224.
30	I	2420.	602.	1220.	2776.	J	2420.	493.	2610.	3593.
31	I	2420.	493.	2610.	3593.	J	2420.	463.	5040.	5610.
32	I	2420.	463.	5040.	5610.	J	2420.	667.	9920.	10233.
33	I	2420.	667.	9920.	10233.	J	2420.	1020.	7310.	7767.
34	I	1100.	5490.	1160.	5718.	J	1960.	3000.	891.	3693.
35	I	1960.	891.	3000.	3693.	J	1960.	255.	458.	2029.
36	I	1960.	255.	458.	2029.	J	1960.	316.	3190.	3757.
37	I	1960.	316.	3190.	3757.	J	1960.	759.	6040.	6395.
38	I	1960.	759.	6040.	6395.	J	1960.	1080.	8780.	9061.
39	I	1960.	1080.	8780.	9061.	J	1960.	1240.	11400.	11634.
40	I	1960.	1240.	11400.	11634.	J	1960.	1240.	13800.	13994.
41	I	1960.	1240.	13800.	13994.	J	1960.	1080.	16200.	16354.
42	I	1960.	1080.	16200.	16354.	J	1960.	762.	18400.	18520.
43	I	1960.	762.	18400.	18520.	J	1960.	323.	20500.	20596.
44	I	1960.	323.	20500.	20596.	J	1960.	70.	21700.	21788.
45	I	1190.	18400.	174.	18439.	J	6340.	13900.	768.	15297.
46	I	9980.	768.	11500.	15246.	J	9980.	788.	7390.	12443.
47	I	10200.	788.	7050.	12424.	J	10200.	758.	2990.	10656.
48	I	10200.	758.	3220.	10723.	J	10200.	375.	13800.	17165.
49	I	10200.	375.	13300.	17165.	J	10200.	155.	15700.	18723.
50	I	5430.	18200.	342.	18996.	J	6720.	18100.	749.	19322.
51	I	6730.	749.	18100.	19325.	J	6730.	403.	16800.	18102.
52	I	6730.	403.	16800.	18102.	J	6730.	398.	15600.	16994.
53	I	6730.	398.	15600.	16994.	J	6730.	445.	15100.	16538.
54	I	15100.	445.	6730.	16538.	J	15100.	210.	6480.	16433.
55	I	15100.	210.	6480.	16433.	J	15100.	738.	6340.	16394.
56	I	15500.	738.	5480.	16457.	J	15500.	497.	4410.	16123.
57	I	6430.	497.	4500.	16079.	J	6930.	576.	13900.	15542.
58	I	6430.	576.	13900.	15542.	J	6930.	659.	13200.	14923.
59	I	659.	6930.	13200.	14923.	J	659.	5880.	8870.	10562.
60	I	659.	5880.	8870.	10562.	J	659.	6010.	5400.	1106.

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61	I	659.	8940.	13800.	16456.
62	I	659.	14000.	27200.	30599.
63	I	659.	17300.	36000.	39947.
64	I	17300.	11200.	39600.	43270.
65	I	13400.	18900.	41300.	45411.
66	I	693.	20000.	47300.	51359.
67	I	693.	47000.	21000.	55048.
68	C	19500.	37200.	24800.	57843.
69	C	36700.	46600.	32000.	59987.
70	C	19600.	30800.	49100.	57969.
71	I	989.	48100.	56487.	56487.
72	I	29600.	2780.	47100.	55698.
73	I	29600.	2780.	46600.	55354.
74	I	29600.	4040.	46600.	55354.
75	I	17500.	24600.	46200.	55171.
76	I	1050.	23400.	41300.	47457.
77	I	1050.	6560.	22000.	22981.
78	I	1050.	3450.	10900.	11481.
79	I	1050.	13000.	1040.	13084.
80	I	1050.	23100.	13100.	26577.
81	I	1050.	28200.	19300.	34188.
82	C	17000.	16500.	34600.	41933.
83	I	23700.	954.	32500.	40235.
84	I	23700.	846.	23100.	33106.
85	I	23700.	832.	19100.	30450.
86	I	23700.	922.	9450.	25531.
87	I	23700.	1140.	1770.	23793.
88	I	23700.	1280.	3150.	23943.
89	I	23700.	1740.	13100.	27135.
90	C	15100.	18500.	4010.	24214.
91	I	2560.	1920.	24000.	24212.
92	I	683.	511.	621.	1055.
93	I	696.	463.	574.	1014.
94	C	335.	615.	362.	788.
95	I	291.	169.	518.	618.
96	I	291.	133.	416.	525.
97	I	153.	356.	312.	497.
98	I	148.	243.	363.	461.
99	I	148.	118.	207.	280.
100	I	148.	350.	88.	390.
101	I	148.	611.	176.	653.
102	I	148.	1040.	407.	1127.

END-OF-FILE ENCOUNTERED, FILENAME -
 ERROR NUMBER 65 DETECTED BY INPC=
 CALLED FROM POYN AT LINE 5

TAPE11
 AT ADDRESS 000145

61	I	659.	8940.	13800.	16456.
62	I	659.	14000.	27200.	30599.
63	I	659.	17300.	36000.	39947.
64	I	17300.	11200.	39600.	43270.
65	I	13400.	18900.	41300.	45411.
66	I	693.	20000.	47300.	51359.
67	I	693.	47000.	21000.	55048.
68	C	19500.	37200.	24800.	57843.
69	C	36700.	46600.	32000.	59987.
70	C	19600.	30800.	49100.	57969.
71	I	989.	48100.	56487.	56487.
72	I	29600.	2780.	47100.	55698.
73	I	29600.	2780.	46600.	55354.
74	I	29600.	4040.	46600.	55354.
75	I	17500.	24600.	46200.	55171.
76	I	1050.	23400.	41300.	47457.
77	I	1050.	6560.	22000.	22981.
78	I	1050.	3450.	10900.	11481.
79	I	1050.	13000.	1040.	13084.
80	I	1050.	23100.	13100.	26577.
81	I	1050.	28200.	19300.	34188.
82	C	17000.	16500.	34600.	41933.
83	I	23700.	954.	32500.	40235.
84	I	23700.	846.	23100.	33106.
85	I	23700.	832.	19100.	30450.
86	I	23700.	922.	9450.	25531.
87	I	23700.	1140.	1770.	23793.
88	I	23700.	1280.	3150.	23943.
89	I	23700.	1740.	13100.	27135.
90	C	15100.	18500.	4010.	24214.
91	I	2560.	1920.	24000.	24212.
92	I	683.	511.	621.	1055.
93	I	696.	463.	574.	1014.
94	C	335.	615.	362.	788.
95	I	291.	169.	518.	618.
96	I	291.	133.	416.	525.
97	I	153.	356.	312.	497.
98	I	148.	243.	363.	461.
99	I	148.	118.	207.	280.
100	I	148.	350.	88.	390.
101	I	148.	611.	176.	653.
102	I	148.	1040.	407.	1127.

THE

PIPE FORCES AND MOMENTS

ELEMENT NUMBER	ELEMENT TYPE	LOAD CASE	STATION	AXIAL FORCE	Y-AXIS SHEAR	Z-AXIS SHEAR	TORSIONAL MOMENT	Y-AXIS MOMENT	Z-AXIS MOMENT
1	TANGENT	1	END-I	117.560	-12.943	-69.391	-1068.72	1060.30	-1894.41
			END-J	117.560	-12.943	-69.391	-1068.72	401.09	-1771.45
2	TANGENT	1	END-I	117.560	-12.943	-69.391	-1068.72	401.09	-1771.45
			END-J	117.560	-12.943	-69.391	-1068.72	10.42	-1698.58
3	BEND	1	END-I	117.560	17.602	-68.358	-1068.72	727.45	-1534.96
			CENTER	95.574	-70.681	-68.358	-361.44	980.07	-1403.04
			END-J	17.602	-117.560	-68.358	317.31	658.57	-935.21
4	TANGENT	1	END-I	17.595	117.560	68.360	317.20	-658.57	935.25
			END-J	17.595	117.560	68.360	317.20	-402.35	494.61
5	BEND	1	END-I	17.587	-68.361	117.560	317.15	-494.65	-402.35
			CENTER	-35.902	-60.775	117.560	81.08	-75.27	-81.41
			END-J	-68.361	-17.589	117.560	210.70	388.20	113.34
6	TANGENT	1	END-I	-68.361	117.560	17.590	210.70	113.34	-388.20
			END-J	-68.361	117.560	17.590	210.70	275.86	-1474.38
7	TANGENT	1	END-I	-68.360	117.560	17.595	210.59	275.86	-1474.39
			END-J	-68.360	117.560	17.595	210.59	572.50	-3456.40
8	BEND	1	END-I	-68.358	-117.560	-17.602	210.20	-572.50	3456.43
			CENTER	-131.462	-34.798	-17.602	-287.08	-628.14	3835.05
			END-J	-117.567	68.345	-17.602	-678.08	-315.88	3751.69
9	TANGENT	1	END-I	-117.560	-12.943	69.391	-678.11	-3266.52	-1872.08
			END-J	-117.560	-12.943	69.391	-678.11	-2850.18	-1794.43
10	TANGENT	1	END-I	69.391	117.560	12.943	-1794.43	678.11	2850.18
			END-J	69.391	117.560	12.943	-1794.43	784.89	1880.31
11	TANGENT	1	END-I	-69.391	117.560	-12.943	1794.43	784.89	-1880.31
			END-J	-69.391	117.560	-12.943	1794.43	678.11	-2850.18
12	TANGENT	1	END-I	-117.560	-12.943	69.391	-678.11	-2850.18	-1794.43
			END-J	-117.560	-12.943	69.391	-678.11	-2598.29	-1747.44
13	TANGENT	1	END-I	-117.560	-12.943	69.391	-678.11	-2598.29	-1747.44
			END-J	-117.560	-12.943	69.391	-678.11	-1834.99	-1605.07
14	TANGENT	1	END-I	-117.560	-12.943	69.391	-678.11	-1834.99	-1605.07
			END-J	-117.560	-12.943	69.391	-678.11	-1141.08	-1475.64
15	TANGENT	1	END-I	-117.560	-12.943	69.391	-678.11	-1141.08	-1475.64
			END-J	-117.560	-12.943	69.391	-678.11	-516.57	-1359.15
16	TANGENT	1	END-I	-117.560	-12.943	69.391	-678.11	-516.57	-1359.15
			END-J	-117.560	-12.943	69.391	-678.11	177.34	-1229.72

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PIPE FORCES AND MOMENTS

ELEMENT NUMBER	ELEMENT TYPE	LOAD CASE	STATION	AXIAL FORCE	Y-AXIS SHEAR	Z-AXIS SHEAR	TORSIONAL MOMENT	Y-AXIS MOMENT	Z-AXIS MOMENT
17	TANGENT	1	END-I	-117.560	-12.943	69.391	-678.11	177.34	-1229.72
			END-J	-117.560	-12.943	69.391	-678.11	871.25	-1100.29
18	TANGENT	1	END-I	-117.560	-12.943	69.391	-678.11	871.25	-1100.29
			END-J	-117.560	-12.943	69.391	-678.11	1565.16	-970.86
19	TANGENT	1	END-I	-117.560	-12.943	69.391	-678.11	1565.16	-970.86
			END-J	-117.560	-12.943	69.391	-678.11	2259.07	-841.43
20	TANGENT	1	END-I	-117.560	-12.943	69.391	-678.11	2259.07	-841.43
			END-J	-117.560	-12.943	69.391	-678.11	2415.20	-812.31
21	TANGENT	1	END-I	0.000	.000	-.000	-.00	.00	.00
			END-J	0.000	.000	-.000	-.00	.00	.00
22	TANGENT	1	END-I	0.000	.000	-.000	-.00	.00	.00
			END-J	0.000	.000	-.000	-.00	.00	.00
23	TANGENT	1	END-I	-.000	.000	.000	-.00	.00	.00
			END-J	-.000	.000	.000	-.00	.00	-.00
24	TANGENT	1	END-I	-117.560	-12.943	69.391	-678.11	2415.20	-812.31
			END-J	-117.560	-12.943	69.391	-678.11	2780.54	-744.16
25	BEND	1	END-I	-117.560	-69.391	-12.943	-678.11	744.16	2780.54
			CENTER	-135.165	-19.126	-12.943	-347.66	917.29	2886.17
			END-J	-132.197	34.050	-12.943	23.88	950.79	2868.36
26	TANGENT	1	END-I	-132.194	34.061	-12.943	23.96	950.79	2868.36
			END-J	-132.194	34.061	-12.943	23.96	900.58	2736.23
27	TANGENT	1	END-I	-34.061	132.194	12.943	-900.58	-23.96	-2736.23
			END-J	-34.061	132.194	12.943	-900.58	26.25	-3249.04
28	BEND	1	END-I	-34.061	-132.194	-12.943	-900.58	-26.25	3249.04
			CENTER	-82.049	-109.103	-12.943	-848.01	290.61	3536.96
			END-J	-117.550	-69.408	-12.943	-678.20	563.25	3749.97
29	TANGENT	1	END-I	-117.560	-12.943	69.391	-678.12	3749.97	-563.34
			END-J	-117.560	-12.943	69.391	-678.12	4063.27	-504.91
30	TANGENT	1	END-I	-1.688	-9.901	-1.859	1585.81	-217.45	-722.45
			END-J	-1.688	-9.901	-1.859	1585.81	-225.12	-681.61
31	TANGENT	1	END-I	-1.688	-9.901	-1.859	1585.78	-225.12	-681.69
			END-J	-1.688	-9.901	-1.859	1585.78	-233.37	-637.77
32	TANGENT	1	END-I	-1.688	-9.901	-1.859	1585.71	-233.37	-637.93
			END-J	-1.688	-9.901	-1.859	1585.71	-249.24	-553.39
33	TANGENT	1	END-I	-1.688	-9.901	-1.859	1585.76	-249.24	-553.25
			END-J	-1.688	-9.901	-1.859	1585.76	-265.12	-468.71

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LTR-13 40

PIPE FORCES AND MOMENTS

ELEMENT NUMBER	ELEMENT TYPE	LOAD CASE	STATION	AXIAL FORCE	Y-AXIS SHEAR	Z-AXIS SHEAR	TORSIONAL MOMENT	Y-AXIS MOMENT	Z-AXIS MOMENT
34	BEND	1	END-I	-1.638	-1.859	9.901	1585.78	-468.66	265.12
			CENTER	-2.228	-1.158	9.901	1336.98	-921.01	275.92
			END-J	-2.491	-.313	9.901	946.71	-1258.95	281.19
35	TANGENT	1	END-I	-2.491	-9.901	-.313	946.63	-281.19	-1259.01
			END-J	-2.491	-9.901	-.313	946.63	-284.48	-1154.86
36	TANGENT	1	END-I	-2.491	-9.901	-.313	946.63	-284.48	-1154.86
			END-J	-2.491	-9.901	-.313	946.63	-287.61	-1055.84
37	TANGENT	1	END-I	-2.491	-9.901	-.313	946.63	-287.61	-1055.84
			END-J	-2.491	-9.901	-.313	946.63	-290.74	-956.83
38	TANGENT	1	END-I	-2.491	-9.901	-.313	946.63	-290.74	-956.83
			END-J	-2.491	-9.901	-.313	946.63	-293.87	-857.82
39	TANGENT	1	END-I	-2.491	-9.901	-.313	946.63	-293.87	-857.82
			END-J	-2.491	-9.901	-.313	946.63	-297.00	-758.80
40	TANGENT	1	END-I	-2.491	-9.901	-.313	946.63	-297.00	-758.80
			END-J	-2.491	-9.901	-.313	946.63	-300.13	-659.79
41	TANGENT	1	END-I	-2.491	-9.901	-.313	946.63	-300.13	-659.79
			END-J	-2.491	-9.901	-.313	946.63	-303.26	-560.78
42	TANGENT	1	END-I	-2.491	-9.901	-.313	946.63	-303.26	-560.78
			END-J	-2.491	-9.901	-.313	946.63	-306.39	-461.76
43	TANGENT	1	END-I	-2.491	-9.901	-.313	946.63	-306.39	-461.76
			END-J	-2.491	-9.901	-.313	946.63	-309.52	-362.75
44	TANGENT	1	END-I	-2.491	-9.901	-.313	946.63	-309.52	-362.75
			END-J	-2.491	-9.901	-.313	946.63	-311.29	-307.01
45	BEND	1	END-I	-2.419	-.673	-9.901	754.64	648.76	-311.29
			CENTER	-2.499	.243	-9.901	924.37	262.08	-309.68
			END-J	-2.244	1.127	-9.901	943.43	-159.79	-314.79
46	TANGENT	1	END-I	-1.971	-9.901	1.555	544.46	-314.79	-786.87
			END-J	-1.971	-9.901	1.555	544.46	-299.82	-691.53
47	TANGENT	1	END-I	-1.917	-9.901	1.621	520.60	-299.82	-709.66
			END-J	-1.917	-9.901	1.621	520.60	-277.39	-572.70
48	TANGENT	1	END-I	-1.983	-9.901	1.540	543.90	-277.39	-550.63
			END-J	-1.983	-9.901	1.540	543.90	-212.05	-130.55
49	TANGENT	1	END-I	-1.990	-9.901	1.531	544.50	-212.05	-128.03
			END-J	-1.990	-9.901	1.531	544.50	-192.12	.84
50	BEND	1	END-I	-1.972	1.554	9.901	544.47	-5.48	192.12
			CENTER	-1.236	2.186	9.901	516.53	-136.42	177.39
			END-J	-.315	2.491	9.901	441.02	-247.00	158.97

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LTR 13 40

END-J -1.313 2.491 9.901 441.02 -247.00 158.9

PIPE FORCES AND MOMENTS

ELEMENT NUMBER	ELEMENT TYPE	LOAD CASE	STATION	AXIAL FORCE	Y-AXIS SHEAR	Z-AXIS SHEAR	TORSIONAL MOMENT	Y-AXIS MOMENT	Z-AXIS MOMENT
51	TANGENT	1	END-I END-J	-1.313 -1.313	-9.901 -9.901	2.491 2.491	440.86 440.86	-158.97 -109.64	-247.29 -51.22
52	TANGENT	1	END-I END-J	-1.313 -1.313	-9.901 -9.901	2.491 2.491	440.86 440.86	-109.64 -81.92	-51.22 58.93
53	TANGENT	1	END-I END-J	-1.313 -1.313	-9.901 -9.901	2.491 2.491	440.86 440.86	-81.92 -71.65	58.93 99.78
54	TANGENT	1	END-I END-J	-2.491 -2.491	-9.901 -9.901	-1.313 -1.313	-99.78 -99.78	-71.65 -72.74	440.86 475.51
55	TANGENT	1	END-I END-J	-2.491 -2.491	-9.901 -9.901	-1.313 -1.313	-99.78 -99.78	-72.74 -75.25	475.51 554.72
56	TANGENT	1	END-I END-J	2.239 2.239	-9.901 -9.901	1.136 1.136	281.21 281.21	-75.25 -61.37	-488.46 -367.49
57	TANGENT	1	END-I END-J	-1.313 -1.313	-9.901 -9.901	2.491 2.491	440.86 440.86	-61.37 -50.60	140.62 183.44
58	TANGENT	1	END-I END-J	-1.313 -1.313	-9.901 -9.901	2.491 2.491	440.86 440.86	-50.60 -40.01	183.44 225.52
59	TANGENT	1	END-I END-J	-9.901 -9.901	.313 .313	2.491 2.491	-40.01 -40.01	-440.86 -430.27	225.52 224.19
60	TANGENT	1	END-I END-J	-9.901 -9.901	.313 .313	2.491 2.491	-40.01 -40.01	-430.27 -408.47	224.19 221.46
61	TANGENT	1	END-I END-J	-9.901 -9.901	.313 .313	2.491 2.491	-40.01 -40.01	-408.47 -383.56	221.46 218.32
62	TANGENT	1	END-I END-J	-9.901 -9.901	.313 .313	2.491 2.491	-40.01 -40.01	-383.56 -348.68	218.32 213.94
63	TANGENT	1	END-I END-J	-9.901 -9.901	.313 .313	2.491 2.491	-40.01 -40.01	-348.68 -323.15	213.94 210.73
64	TANGENT	1	END-I END-J	-1.313 -1.313	-9.901 -9.901	2.491 2.491	323.15 323.15	-40.01 -20.58	210.73 287.96
65	TANGENT	1	END-I END-J	-6.871 -6.871	-7.136 -7.136	-2.491 -2.491	-240.32 -240.32	217.01 189.17	-287.96 -208.23
66	TANGENT	1	END-I END-J	-9.901 -9.901	.313 .313	2.491 2.491	-40.01 -40.01	-303.22 -273.32	208.23 204.47
67	TANGENT	1	END-I END-J	-9.901 -9.901	.313 .313	2.491 2.491	-40.01 -40.01	-273.32 -259.05	204.47 202.68

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LTR 13 40

PIPE FORCES AND MOMENTS

ELEMENT NUMBER	ELEMENT TYPE	LOAD CASE	STATION	AXIAL FORCE	Y-AXIS SHEAR	Z-AXIS SHEAR	TORSIONAL MOMENT	Y-AXIS MOMENT	Z-AXIS MOMENT
68	BEND	1	END-I	-9.901	2.491	-.313	-40.01	202.68	259.05
			CENTER	-8.130	6.176	-.313	42.22	199.67	223.62
			END-J	-5.055	8.871	-.313	116.67	164.64	162.12
69	TANGENT	1	END-I	-5.063	-8.866	.313	116.52	-164.74	-162.12
			END-J	-5.063	-8.866	.313	116.52	-161.83	-79.65
70	BEND	1	END-I	-5.055	-8.871	.313	116.66	-161.73	-79.65
			CENTER	-8.126	-6.182	.313	44.49	-192.05	-18.24
			END-J	-9.898	-2.505	.313	-33.79	-191.68	17.21
71	TANGENT	1	END-I	-9.901	.313	2.491	-34.05	17.21	191.63
			END-J	-9.901	.313	2.491	-34.05	24.00	190.78
72	TANGENT	1	END-I	.313	-9.901	-2.491	24.00	-34.05	-190.78
			END-J	.313	-9.901	-2.491	24.00	-43.89	-151.67
73	TANGENT	1	END-I	.313	-9.901	-2.491	24.00	-43.89	-151.67
			END-J	.313	-9.901	-2.491	24.00	-50.12	-126.91
74	TANGENT	1	END-I	.313	-9.901	-2.491	24.00	-50.12	-126.91
			END-J	.313	-9.901	-2.491	24.00	-57.60	-97.21
75	TANGENT	1	END-I	-7.055	-6.954	2.491	-57.10	-25.15	97.21
			END-J	-7.055	-6.954	2.491	-57.10	7.36	187.96
76	TANGENT	1	END-I	-9.901	.313	2.491	-34.05	46.43	187.96
			END-J	-9.901	.313	2.491	-34.05	96.25	181.70
77	TANGENT	1	END-I	-9.901	.313	2.491	-34.05	96.25	181.70
			END-J	-9.901	.313	2.491	-34.05	121.16	178.57
78	TANGENT	1	END-I	-9.901	.313	2.491	-34.05	121.16	178.57
			END-J	-9.901	.313	2.491	-34.05	146.08	175.44
79	TANGENT	1	END-I	-9.901	.313	2.491	-34.05	146.08	175.44
			END-J	-9.901	.313	2.491	-34.05	170.99	172.31
80	TANGENT	1	END-I	-9.901	.313	2.491	-34.05	170.99	172.31
			END-J	-9.901	.313	2.491	-34.05	183.44	170.74
81	TANGENT	1	END-I	-9.901	.313	2.491	-34.05	183.44	170.74
			END-J	-9.901	.313	2.491	-34.05	192.16	169.65
82	BEND	1	END-I	-9.901	2.491	-.313	-34.05	169.65	-192.16
			CENTER	-5.240	8.763	-.313	95.33	142.71	-220.13
			END-J	2.491	9.901	-.313	167.77	32.18	-266.52
83	TANGENT	1	END-I	2.491	-9.901	.313	167.77	-32.18	266.52
			END-J	2.491	-9.901	.313	167.77	-28.97	368.01

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LTR 113 40

PIPE FORCES AND MOMENTS

ELEMENT NUMBER	ELEMENT TYPE	LOAD CASE	STATION	AXIAL FORCE	Y-AXIS SHEAR	Z-AXIS SHEAR	TORSIONAL MOMENT	Y-AXIS MOMENT	Z-AXIS MOMENT	
A-8	84	TANGENT	1	END-I END-J	2.491 2.491	-9.901 -9.901	.313 .313	167.77 167.77	-28.97 -27.64	368.01 410.09
	85	TANGENT	1	END-I END-J	2.491 2.491	-9.901 -9.901	.313 .313	167.77 167.77	-27.64 -24.35	410.09 514.05
	86	TANGENT	1	END-I END-J	2.491 2.491	-9.901 -9.901	.313 .313	167.77 167.77	-24.35 -21.53	514.05 603.17
	87	TANGENT	1	END-I END-J	2.491 2.491	-9.901 -9.901	.313 .313	167.77 167.77	-21.53 -20.29	603.17 642.57
	88	TANGENT	1	END-I END-J	2.491 2.491	-9.901 -9.901	.313 .313	167.77 167.77	-20.29 -16.84	642.57 751.69
	89	TANGENT	1	END-I END-J	2.491 2.491	-9.901 -9.901	.313 .313	167.77 167.77	-16.84 -13.71	751.69 850.50
	90	BEND	1	END-I CENTER END-J	2.491 8.763 9.901	9.901 5.240 -2.491	-.313 -.313 -.313	167.77 127.78 11.83	13.71 -110.26 -169.65	-850.50 -888.13 -894.96
	91	TANGENT	1	END-I END-J	9.901 9.901	.313 .313	-2.491 -2.491	11.83 11.83	894.96 865.07	-169.65 -173.40
	92	TANGENT	1	END-I END-J	-45.945 -45.945	127.461 127.461	-56.849 -56.849	-675.44 -675.44	895.57 661.05	2691.02 2165.20
	93	TANGENT	1	END-I END-J	-47.845 -47.845	127.461 127.461	-55.259 -55.259	-601.70 -601.70	661.05 335.29	2186.84 1435.44
	94	BEND	1	END-I CENTER END-J	-50.758 -126.015 -127.471	-127.461 -54.249 50.734	52.597 52.597 52.597	-523.36 -299.13 716.36	-335.29 876.69 1575.23	-1465.82 39.33 68.44
	95	TANGENT	1	END-I END-J	-127.461 -127.461	-13.256 -13.256	71.882 71.882	716.65 716.65	860.58 1795.04	1321.00 1493.33
	96	TANGENT	1	END-I END-J	-127.461 -127.461	-13.256 -13.256	71.882 71.882	716.65 716.65	1795.04 2729.51	1493.33 1665.66
	97	TANGENT	1	END-I END-J	-146.152 -146.152	-7.291 -7.291	-13.256 -13.256	-103.92 -103.92	-1810.30 -1899.23	2729.51 2778.42
	98	TANGENT	1	END-I END-J	-71.882 -71.882	127.461 127.461	-13.256 -13.256	-1745.19 -1745.19	-756.41 -888.97	2778.42 1503.80
	99	TANGENT	1	END-I END-J	-71.882 -71.882	127.461 127.461	-13.256 -13.256	-1745.19 -1745.19	-888.97 -1021.54	1503.80 229.19
	100	TANGENT	1	END-I END-J	-71.882 -71.882	127.461 127.461	-13.256 -13.256	-1745.19 -1745.19	-1021.54 -1127.58	229.19 -790.50

LTR113 40

PIPE FORCES AND MOMENTS

ELEMENT NUMBER	ELEMENT TYPE	LOAD CASE	STATION	AXIAL FORCE	Y-AXIS SHEAR	Z-AXIS SHEAR	TORSIONAL MOMENT	Y-AXIS MOMENT	Z-AXIS MOMENT
101	TANGENT	1	END-I	-71.882	127.461	-13.256	-1745.19	-1127.58	-790.50
			END-J	-71.882	127.461	-13.256	-1745.19	-1286.66	-2320.04
102	TANGENT	1	END-I	-71.882	127.461	-13.256	-1745.19	-1286.66	-2320.04
			END-J	-71.882	127.461	-13.256	-1745.19	-1432.48	-3722.12

STATIC SOLUTION TIME LOG

EQUATION SOLUTION	=	1.98
DISPLACEMENT OUTPUT	=	.05
STRESS RECOVERY	=	.23

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APPENDIX B

ECC LEFT SIDE

LOCE LOADING

LOCE LOADS

EL NO	END	TX	MY	MZ	RES-MR	END	TX	MY	MZ	RES-MR
1	I	202.	224.	226.	377.	J	202.	73.	144.	259.
2	I	202.	73.	144.	259.	J	202.	32.	122.	238.
3	I	135.	74.	81.	174.	J	97.	18.	51.	111.
4	I	92.	62.	107.	154.	J	10.	138.	164.	215.
5	I	9.	164.	138.	215.	J	9.	167.	157.	229.
6	I	9.	167.	157.	229.	J	9.	142.	191.	238.
7	I	9.	142.	191.	238.	J	9.	86.	202.	220.
8	I	9.	86.	202.	220.	J	9.	34.	215.	216.
9	I	287.	3040.	160.	3059.	J	287.	2380.	119.	2400.
10	I	287.	2380.	119.	2400.	J	287.	704.	176.	780.
11	I	287.	704.	176.	780.	J	287.	2780.	447.	2830.
12	I	287.	252.	447.	588.	J	287.	526.	438.	742.
13	I	287.	526.	438.	742.	J	287.	511.	795.	988.
14	I	287.	511.	795.	988.	J	287.	526.	950.	1123.
15	I	287.	526.	950.	1123.	J	287.	689.	1110.	1338.
16	I	738.	1190.	444.	1469.	J	1180.	1050.	2940.	3337.
17	I	1390.	742.	2950.	3344.	J	1390.	1440.	12400.	12560.
18	I	22900.	12100.	29000.	38882.	J	22900.	12000.	15600.	30196.
19	I	225600.	5000.	11060.	28308.	J	24600.	7930.	9380.	27496.
20	I	24600.	4460.	11500.	27519.	J	24600.	17700.	5620.	30823.
21	I	12300.	26600.	7350.	30214.	J	12300.	32300.	7740.	35419.
22	I	12700.	20300.	10800.	26268.	J	12700.	21200.	10500.	26851.
23	I	2590.	3760.	24900.	25315.	J	2590.	1150.	7220.	7756.
24	I	2590.	1150.	7220.	7756.	J	2590.	2520.	17100.	17478.
25	I	2590.	2520.	17100.	17478.	J	2590.	2630.	16600.	17005.
26	I	2590.	2630.	16600.	17005.	J	2590.	2150.	10900.	11408.
27	I	324.	5430.	1420.	5622.	J	683.	828.	264.	1105.
28	I	686.	264.	828.	1106.	J	686.	3550.	18900.	19243.
29	I	1490.	3550.	18900.	19288.	J	1490.	4680.	24200.	24693.
30	I	6440.	3660.	12800.	14789.	J	6440.	4020.	6450.	9962.
31	I	6440.	4020.	6450.	9962.	J	6440.	10200.	4890.	13016.
32	I	6440.	10200.	4890.	13016.	J	6440.	17200.	15900.	24292.
33	I	6440.	17200.	53100.	56187.	J	6440.	5810.	29900.	31133.
34	I	6440.	5810.	29900.	31133.	J	6440.	7720.	10400.	14465.
35	I	6440.	7720.	10400.	14465.	J	6440.	8490.	6280.	12369.
36	I	1630.	9830.	6100.	11683.	J	7960.	8190.	4200.	12169.
37	I	7960.	8190.	4200.	12169.	J	7960.	11700.	4120.	14739.
38	I	7960.	11700.	4120.	14739.	J	7960.	18300.	6930.	21125.
39	I	8560.	7140.	19400.	22374.	J	8600.	8400.	17000.	20821.
40	I	3880.	18700.	8410.	20868.	J	3880.	28400.	9490.	30194.
41	I	12700.	21200.	10500.	26851.	J	12700.	21900.	13100.	28505.
42	I	12700.	21900.	13100.	28505.	J	12700.	29500.	20500.	31651.
43	I	12700.	20500.	20500.	31651.	J	12700.	15000.	25600.	32275.
44	I	10100.	9300.	11700.	18039.	J	2600.	20000.	11900.	23417.
45	I	2600.	20000.	11900.	23417.	J	2600.	39800.	2710.	39977.
46	I	2600.	39800.	2710.	39977.	J	2600.	62700.	11400.	63781.
47	I	2600.	46900.	68400.	82975.	J	2600.	21600.	29200.	36414.
48	I	2600.	21600.	29200.	36414.	J	2600.	10300.	20700.	23267.
49	I	2600.	10300.	20700.	23267.	J	2600.	16300.	35400.	39059.
50	I	2600.	16300.	35400.	39059.	J	2600.	9700.	39300.	40563.
51	I	2600.	9700.	39300.	40563.	J	2600.	6320.	39400.	39988.
52	I	19400.	20100.	33300.	43466.	J	19400.	23100.	34000.	45453.
53	I	19400.	23100.	34000.	45453.	J	19400.	30200.	38800.	52857.
54	I	12200.	29600.	38800.	50303.	J	12200.	34400.	31100.	47952.
55	I	12200.	34400.	31100.	47952.	J	12200.	27200.	38900.	49009.
56	I	12200.	27200.	38900.	49009.	J	12200.	17500.	50100.	54453.
57	I	4200.	51100.	51100.	54407.	J	4200.	15500.	31900.	35714.
58	I	4930.	15500.	31800.	35718.	J	4930.	13300.	24200.	28051.
59	I	4200.	13300.	24200.	28051.	J	4200.	11000.	17100.	20020.

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40	I	3853.	18700.	18410.	20866.	J	3386.	28400.	4440.	30144.
41	I	12700.	21200.	10500.	26821.	J	12700.	21900.	13100.	28505.
42	I	12700.	21900.	13100.	28505.	J	12700.	20500.	20500.	31651.
43	I	12700.	20500.	20500.	31651.	J	12700.	15000.	25600.	32275.
44	C	10100.	9300.	11700.	18039.	J	2600.	20000.	11900.	23417.
45	I	2600.	20000.	11900.	23417.	J	2600.	39800.	2710.	39977.
46	I	2600.	39800.	2710.	39977.	J	2600.	62700.	11400.	63781.
47	I	2600.	46900.	68400.	82975.	J	2600.	21600.	29200.	36414.
48	I	2600.	21600.	29200.	36414.	J	2600.	10300.	20700.	23267.
49	I	2600.	10300.	20700.	23267.	J	2600.	16300.	35400.	39059.
50	I	2600.	16300.	35400.	39059.	J	2600.	9700.	39300.	40563.
51	I	2600.	9700.	39300.	40563.	J	2600.	6320.	39400.	39988.
52	I	19400.	20100.	33300.	43466.	J	19400.	23100.	34000.	45453.
53	I	19400.	23100.	34000.	45453.	J	19400.	30200.	38800.	52857.
54	I	12200.	29600.	38800.	50303.	J	12200.	34400.	31100.	47952.
55	I	12200.	34400.	31100.	47952.	J	12200.	27200.	38900.	49009.
56	I	12200.	27200.	38900.	49009.	J	12200.	17500.	50100.	54453.
57	I	4200.	18200.	51100.	54407.	J	4200.	15500.	31900.	35714.
58	I	4930.	15500.	31800.	35718.	J	4930.	13300.	24200.	28051.
59	I	4210.	13300.	24300.	28020.	J	4210.	11000.	17300.	20929.
60	I	4220.	11000.	17300.	20931.	J	4220.	8380.	9370.	13260.
61	I	4220.	8380.	9370.	13260.	J	4220.	10500.	14500.	18393.
62	I	4220.	10500.	14500.	18393.	J	4220.	14700.	22900.	27537.
63	I	4210.	14700.	22900.	27536.	J	4210.	31100.	50400.	59373.
64	I	4230.	31100.	50400.	59374.	J	4230.	49700.	79500.	93852.
65	I	15700.	15000.	21200.	30347.	J	15700.	8500.	17000.	24652.
66	I	15700.	8500.	17000.	24652.	J	15700.	14300.	13100.	24952.
67	C	7950.	5900.	30800.	32352.	J	7540.	5860.	6640.	11660.
68	I	7540.	6640.	5860.	11660.	J	7540.	59800.	29700.	67194.
69	C	6250.	5150.	20100.	21670.	J	7750.	1510.	17500.	19199.
70	I	7750.	17500.	1510.	19199.	J	7750.	11600.	1090.	13993.
71	I	7750.	11600.	1090.	13993.	J	7750.	334.	4250.	8845.
72	I	7750.	334.	4250.	8845.	J	7750.	2100.	4530.	9219.
73	I	7750.	2100.	4530.	9219.	J	7750.	3890.	4700.	9863.
74	I	7750.	3890.	4700.	9863.	J	7750.	5690.	4800.	10746.
75	I	7750.	5690.	4800.	10746.	J	7750.	7100.	4840.	11571.
76	I	7100.	7750.	4840.	11571.	J	7100.	5890.	2780.	9635.
77	I	7100.	5890.	2780.	9635.	J	7100.	81.	2480.	7521.
78	I	7100.	81.	2480.	7521.	J	7100.	6710.	5970.	11449.
79	I	7100.	6710.	5970.	11449.	J	7100.	14000.	6790.	17103.
80	I	7100.	14000.	6790.	17103.	J	7100.	24500.	3130.	25699.
81	I	7100.	24500.	3130.	25699.	J	7100.	27400.	1540.	28347.
82	I	2820.	13900.	3560.	14623.	J	2820.	11100.	2110.	11645.
83	I	2820.	11100.	2110.	11645.	J	2820.	2590.	3700.	5325.
84	I	2820.	2590.	3700.	5325.	J	2820.	5940.	10300.	12220.
85	I	2130.	5900.	13500.	14886.	J	2130.	4800.	10900.	12099.
86	I	2130.	4800.	10900.	12099.	J	2130.	3910.	1880.	4833.
87	I	2130.	3910.	1880.	4833.	J	2130.	7120.	3470.	8202.
88	I	2130.	7120.	3470.	8202.	J	2130.	8850.	5990.	10897.

END-OF-FILE ENCOUNTERED, FILENAME - TAPE11
 ERROR NUMBER 05 DETECTED BY INPC- AT ADDRESS 000145
 CALLED FROM POYN AT LINE 5

APPENDIX C

MICROFICHE LISTINGS

- (1) ECC Right Side
Thermal Expansion
Seismic
- (2) ECC Left Side
LOCE Loads