MPR ASSOCIATES, INC.

OYSTER CREEK
NUCLEAR GENERATING STATION

SEISMIC REANALYSIS OF CORE SPRAY SYSTEM PIPING

MPR-777

Prepared for:

GPU Nuclear
Parsippany, New Jersey

September 1983

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TABLE OF CONTENTS

I. INTRODUCTION

A. Purpose

This report presents the results of a seismic reanalysis of the Oyster Creek core spray system piping inside containment. The seismic reanalysis of the core spray piping was performed in response to Section 4.11(1) of NUREG-0822 (Integrated Plant Safety Assessment - Systematic Evaluation Program - Oyster Creek Nuclear Generating Station) which requested in part that licensee (GPU Nuclear/JCP&L) perform seismic reanalysis of two randomly selected small diameter piping systems to demonstrate the adequacy of the original piping and piping support design. The other piping system selected for seismic reanalysis is the liquid poison system piping. Results of the seismic reanalysis of the liquid poison piping are presented in MPR Report MPR-780.

The Oyster Creek Facility Description and Safety Analysis Report (FDSAR) applied earthquake design requirements to two classes of systems and structures: Class I for the more critical equipment required for safe shutdown and Class II for other equipment essential to operation, but not required for shutdown. The core spray system was classified as Class I - Critical Equipment (Page V-3-6 of the FDSAR) under this method.

This classification is not equivalent to one resulting from the more recent classification methods contained in ANSI/ANS-52.1-1978, Nuclear Safety Criteria for the Design of Stationary Boiling Water Reactor Plants, and the 1980 Edition (including Summer 1981 Addenda) of the ASME Code. In accordance with ANSI/ANS-52.1-1978, the core spray system piping is ASME Class 1 piping from the reactor vessel to the second isolation check valve, which is the first check valve outside containment. In accordance with the 1980 Edition (including Summer 1981 Addenda) of the ASME Code, Section III, Subarticle NB-3630, Class 1 piping (Subsection NB) may be analyzed to Class 2 requirements (Subsection NC) provided certain fatigue criteria are met. The core spray piping meets these fatigue criteria.

Therefore, the seismic reanalysis of the core spray system piping inside containment was performed in accordance with the requirements of the 1980 Edition (including Summer 1981 Addenda) of the ASME Code, Section III, Subsection NC for Class 2 Components. The 1980 Edition (including Summer 1981 Addenda) of the ASME

Code was used in the seismic reanalysis of the core spray piping since the equations required for evaluation by this Code are available using an up-to-date computer program, PIPESD. Showing that the core spray piping meets the applicable requirements of the 1980 Edition (including Summer 1981 Addenda) of the ASME Code is considered confirmation of the adequacy of the original piping and piping support design.

II. SUMMARY AND CONCLUSIONS

A. Summary

The core spray system piping was reanalyzed for load combinations including operating basis earthquake (OBE) and safe shutdown earthquake (SSE) in accordance with the requirements of the 1980 Edition (including Summer 1981 Addenda) of the ASME Code, Section III, Subsection NC. Results of these analyses are summarized below.

1. Core Spray System Piping Stresses

Results of stress analyses for the core spray system piping are presented in Tables II-1 and II-2. Table II-1 presents stresses at the highest stressed locations of the core spray system piping due to each load component, i.e., internal pressure, deadweight, and seismic loads during OBE and SSE conditions. Table II-2 tabulates the ratio of the maximum calculated stresses in the core spray system piping to the applicable ASME Code allowables. Load combinations including OBE are evaluated to Level B Service Limits. Load combinations including SSE are evaluated to Level C Service Limits. Use of Level C Service

Limits is conservative for SSE load combinations since Level D Service Limits were used and accepted for piping reanalyses in the Systematic Evaluation Program. As shown in Table II-2, all calculated stresses are below the ASME Code allowable values.

2. Snubber Loads

Loads on the core spray piping snubbers during OBE and SSE conditions are presented in Table II-3. As shown in Table II-3, all calculated snubber loads are below the rated capacity of the snubbers.

B. Conclusion

Based on the results of analyses presented in this report and summarized in Tables II-1 through II-3, the core spray system piping between the reactor vessel nozzles and containment penetrations meets the seismic stress analysis requirements of the 1980 Edition (including Summer 1981 Addenda) of the ASME Code, Section III, Subsection NC for Class 2 Components. This confirms the adequacy of the original piping and piping support design.

TABLE II-1

STRESS ANALYSIS RESULTS FOR INDIVIDUAL
LOAD COMPONENTS

SOUTH LOOP

LOCATION (NOTE 1)	PIPING COMPONENT	PRESSURE STRESS (PSI)	DEADWEIGHT STRESS (PSI)	OCCASSIONAL LOAD STRESS (PSI)	
				OBE	SSE
15	Safe End	4792	1050	4565	7680
25	Elbow	5391	1134	2102	3531
125	Gate Valve	5391	1063	2006	3386
150	Welded Tee	5391	307	2524	4305
155	Check Valve	5391	137	1946	3268

NORTH LOOP

LOCATION (NOTE 1)	PIPING COMPONENT	PRESSURE STRESS (PSI)	DEADWEIGHT STRESS (PSI)	OCCASSIONAL LOAD STRESS (PSI)	
				OBE	SSE
15	Safe End	4792	6334	1501	2545
430	Elbow	5391	1152	2078	3416
125	Gate Valve	5391	689	1074	1789
145	Welded Tee	5391	370	877	1448
155	Check Valve	5391	920	1282	2105

NOTES:

1. Location numbers are shown in Figures IV-1 and IV-2.

TABLE II-2

SUMMARY OF STRESS ANALYSIS RESULTS
ASME CODE SECTION III, SUBSECTION NC
FOR CLASS 2 COMPONENTS

SOUTH LOOP

LOCATION (NOTE 1)	PIPING COMPONENT	EQUATION (9) STRESS RATIO (NOTE 2)	
		OBE	SSE
15	Safe End	0.46	0.40
25	Elbow	0.38	0.30
125	Gate Valve	0.38	0.29
150	Welded Tee	0.36	0.30
155	Check Valve	0.33	0.26

NORTH LOOP

LOCATION (NOTE 1)	PIPING COMPONENT	EQUATION (9) STRESS RATIO (NOTE 2)	
		OBE	SSE
15	Safe End	0.56	0.40
430	Elbow	0.38	0.29
125	Gate Valve	0.32	0.23
150	Welded Tee	0.29	0.21
155	Check Valve	0.34	0.25

NOTES:

1. Location numbers are shown in Figures IV-1 and IV-2.
2. Equation (9) is given in Section III of this report. Allowable stress ratio is 1.0

TABLE II-3

SUMMARY OF SNUBBER REACTION LOADS

SOUTH LOOP

SNUBBER DESIGNATION (NOTE 1)	OBE LOAD (kips)	SSE LOAD (kips)	RATED LOAD (kips)
NZ-3 57	1.0	1.8	10.0
NZ-3 58	0.7	1.3	10.0
NZ-3 59	0.5	1.1	10.0

NORTH LOOP

SNUBBER DESIGNATION (NOTE 1)	OBE LOAD (kips)	SSE LOAD (kips)	RATED LOAD (kips)
NZ-3 52	1.7	2.8	10.0
NZ-3 52	1.8	3.0	10.0
NZ-3 53	0.9	1.4	10.0
NZ-3 54	0.5	0.9	10.0

NOTES:

1. Snubber designations according to General Physics Drawing JCP-19440, Sheets 10 and 11, Rev. 3.

III. DESIGN REQUIREMENTS

A. Applicable Codes

The core spray system piping was originally furnished in accordance with the requirements of the 1955 Edition of the American Standard Code for Pressure Piping, ASA B31.1. The seismic analysis was based on the results of scale-model shaker table tests performed by Brooklyn Polytechnic Institute. In this report, the seismic reanalysis of the core spray system piping will be in accordance with the requirements of the 1980 Edition (including Summer 1981 Addenda) of the ASME Code, Section III, Subsection NC for Class 2 Components.

B. Materials

1.	All Piping	SA-312 Type 316 SST or SA-376 Type 316 SST

C. Drawings

1.	Piping	General Physics Corp. Drawing JCP-19440 Sheet 10, Rev. 3. Sheet 11, Rev. 3. Burns & Roe Drawings 2138-10, Rev. 11. 2139-10, Rev. 11.	
2.	Piping Supports	Bergen-Paterson Drawings 103, Rev. 1 198, Rev. 2 200, Rev. 1 456, Rev. 1 458, Rev. 2	 104, Rev 1 199, Rev 2 201, Rev 1 457, Rev 2 459, Rev 2

D. Loads

The design and operating loads for the core spray system piping are summarized below.

1. Internal Pressure Loads

Po: Design internal pressure load from the reactor vessel safe ends to the check valves.

Pa: Core spray pump actuation pressure load.

2. Deadweight Loads

D: Deadweight load of the piping, including the weight of water in the pipe, and the weight of the valves.

3. Seismic Loads

E: Loads generated by operating basis earthquake (OBE).

E': Loads generated by safe shutdown earthquake (SSE).

4. Thermal Loads

To: Thermal effects and loads generated during normal plant operation.

E. Acceptance Criteria

1. Internal Pressure, Deadweight, and Seismic Loads

The stresses due to load combinations including the OBE shall meet the requirements of Equation (9) of the ASME Code, Section III, Subsection NC.

$$\frac{P_{max} D_o}{4 t_n} + 0.75i \left[\frac{M_A + M_B}{Z}\right] \leq 1.2 \, S_h$$

The stresses due to load combinations including the SSE shall also meet the requirements of Equation (9), except the allowable stress for this condition shall be 1.8 Sh.

The above equation is identical to the equation used in the PIPESD computer program (Version 6.2), based on the 1974 ASME Code.

2. Definition of Terms

D_o	=	Outside diameter of pipe, in.
t_n	=	Nominal wall thickness, in.
Z	=	Section Modulus of pipe, in^3.
i	=	Stress intensification factor.
P	=	Internal design pressure, psi.
P_{max}	=	Peak pressure, psi (design pressure used).
M_A	=	Resultant moment loading on cross section due to weight and other sustained loads, in-lb.
M_B	=	Resultant moment loading on cross section due to occasional loads such as earthquake.
Sh	=	Basic material allowable stress at maximum (hot) temperature.
Sc	=	Basic material allowable stress at minimum (cold) temperature.

3. Allowable Stress Intensity Limits

The allowable stress intensity limits at the maximum (hot) temperature and minimum (cold) temperature for the core spray system piping materials are obtained from Appendix I of Section III of the ASME Code.

Material	Sh at 135°F	Sc 100°F
SA-312 Type 316 SST	18,800	18,800
SA-376 Type 316 SST	18,800	18,800

IV. DESCRIPTION OF ANALYSES

This section of the report describes the analyses that were performed on the core spray system piping. The detailed calculations are given in Appendices A through E. Microfiche of the computer output data is given in Appendix F.

A. Model

The core spray system piping was evaluated using the finite element computer program PIPESD, Version 6.2. The finite element models of the north and south loops are shown in Figures IV-1 and IV-2. Joint coordinates and support locations are summarized in Appendix A.

1. Snubber Supports

The snubber supports indicated in Figures IV-1 and IV-2 are either connected to the piping by a rigid link (i.e., snubber NZ-3 S9) or connected directly to the pipe (i.e., snubber NZ-3 S2). The properties of the snubber supports were specified such that the snubber supports are capable of transmitting only tension/compression loads in the response spectra dynamic analyses. Snubbers provide no support in the pressure or deadweight loading.

2. Spring Supports

The springs hangers indicated in Figures IV-1 and IV-2 were modeled by specifying the preload and spring stiffness. The cold spring preloads used in the core spray system piping analyses are tabulated below and are based on data from the spring hanger drawings listed in Section III.C of this report. (In the PIPESD seismic stress analyses, the cold spring preloads were reduced by the loss in spring load due to the thermal expansion of the pipe and anchor displacements of the pipe ends during heatup of the reactor vessel to normal operating temperature as determined from the spring hanger relaxation analyses.)

Spring Designation (Note 1)	Cold Spring Preload (lbs)	Loss In Preload Due to Thermal Expansion (lbs)	Spring Preload for Analysis (lbs)	Spring Stiffness (lb/in)
South Loop				
NZ-3 H7	3261.0	536.3	2724.7	1282.0
NZ-3 H8	1251.0	115.3	1135.7	410.0
NZ-3 H9	502.0	41.0	461.0	43.8
NZ-3 H10	538.0	67.1	470.9	43.8
North Loop				
NZ-3 H3	2602.0	1028.0	1574.0	964.0
NZ-3 H4	2102.0	964.9	1137.1	726.0

Notes:

(1) Spring designations refer to General Physics Corp. Drawings JCP-19440, Sheets 10 and 11.

3. Valves

As shown in Figures IV-1 and IV-2, the core spray system piping includes three valves in each loop; two check valves and one gate valve. The valve weights and the distance from the valve c.g. to the centerline of the pipe that were used in the analyses are tabulated below.

Designation (Note 1)	Valve Type	Valve Weight (lbs)	Valve C.G. to Centerline of Pipe (inch)
North Loop			
V-20-17	8" gate	1100.0	25.0
NZ-02-A	8" check	750.0	12.0
NZ-02-C	8" check	750.0	12.0
South Loop			
V-20-23	8" gate	1100.0	25.0
NZ-02-B	8" check	750.0	12.0
NZ-02-D	8" check	750.0	12.0

Notes:

(1) Valve designations refer to Burns and Roe Valve List Drawing 2075.

4. Material and Section Properties

Material properties for the core spray system piping are given in Appendix B and summarized below. All core spray system piping materials are Type 316 stainless steel. Properties are evaluated at a temperature of 135°F.

- Modulus of Elasticity -- 27.95×10^6 psi
- Coefficient of Thermal Expansion -- 8.61×10^{-6} in/in/°F
- Poisson's Ratio -- 0.3

Pipe section properties for the core spray system piping are calculated in Appendix B and tabulated below.

Component	O.D. (inch)	t (inch)	Weight (lb/in) (Note 1)
8-inch Sch 80	8.625	0.500	5.264
8 x 6 Sch 80 Reducer	7.625	0.466	4.236
6-inch Sch 80	6.625	0.432	3.322
Safe End/ Thermal Sleeve Transition	6.688	0.612	4.154
Safe End/ Nozzle Transition	7.375	0.554	4.475

Notes:

(1) Includes weight of water in pipe.

B. Loads

The core spray system piping was evaluated for the following loads.

1. Internal Pressure Load, P_o

Normal Operation

P_o = 1250 psig up to check valves

= 285 psig past check valves (core spray pump shutoff head)

2. Deadweight, D

The deadweight consists of weight of the core spray system piping, including weight of water in the pipe, and valve weights. The total weights of the north and south loops are tabulated below.

Loop	Total Piping System Weight (lbs)
North	6417
South	6828

3. Thermal Loads, T_o

Thermal loads result from thermal expansion of the core spray system piping and displacements of the anchors at the ends of the pipe runs (the nozzle safe ends and containment penetrations) during heatup of the reactor to normal operating temperatures. The thermal loads are based on the assumed conditions shown on the following table for normal operating conditions. Calculations of anchor displacements for these conditions are given in Appendix C.

Thermal Load Case	Reactor Vessel Temperature (°F)	Drywell Temperature (°F)	Pipe Temperature (°F) (Note 1)
Normal Operating Conditions	550.0	135.0	135.0

NOTES:

(1) Reference temperature for pipe thermal expansion = 70°F.

Thermal loads (i.e., the forces and moments in the core spray system piping due to thermal expansion of the pipe and anchor displacements) are not evaluated explicitly in Equation (9) of the ASME Code, Section III, Subsection NC. However, the thermal expansion of the pipe and anchor displacements affect the deadweight stresses in that they reduce the springs hanger loads during normal operating conditions as discussed in Section IV.A.2 of this report. The stresses in Equation (9) due to deadweight are determined for the reduced spring hanger loads.

4. Seismic Loads, OBE and SSE

Seismic analysis is performed using the response spectra method. Seismic loads consist of the Operating Basis Earthquake (OBE) and the Safe

Shutdown Earthquake (SSE). Seismic loads are defined by horizontal and vertical response spectra as shown in Figures IV-3 and IV-4 for the OBE and Figures IV-5 and IV-6 for the SSE. The spectra shown on these figures are based on the response spectra generated by Lawrence Livermore Laboratories in the revised Appendix B of NUREG/CR-1981.

Damping values of 1% for OBE and 2% for SSE were used, in accordance with USNRC Regulatory Guide 1.61. Response spectra obtained from NUREG/CR-1981 were extrapolated to obtain values at 1% and 2% damping. The response spectra given in Figures IV-3 through IV-6 envelope the extrapolated response spectra from elevations of 38'-3" to 95'-3" of the reactor building in accordance with Section 3.7.3 of the Standard Review Plan, (NUREG-0800).

The horizontal and vertical spectra for the OBE and SSE conditions have been multiplied by 0.165/0.22, based on a zero period acceleration (ZPA) at the ground of 0.165g's for Oyster Creek versus the ZPA at the ground of 0.22g's used in NUREG/CR-1981. Calculations of the enveloped response spectra are given in Appendix D.

C. Analyses

The seismic analyses of each core spray system piping run inside containment is performed in two PIPESD computer runs as follows:

1. Spring Hanger Relaxation Analyses

The spring hanger relaxation analyses determine the loss in spring preload due to thermal expansion of the core spray system piping and thermal anchor displacements (at the reactor vessel and containment penetration) during heatup of the reactor from cold shutdown (70°F) to normal operating temperature (550°F). Results of the spring hanger relaxation analyses are given in Appendix E and tabulated in Section IV.A.2 of this report. As shown in Appendix E (page 4), the calculated hot loads in spring hangers NZ-3 H3 and NZ-3 H4 on the north loop fall below the manufacturer's recommended working range by 13 and 11 percent, respectively. However, this under load condition is considered acceptable for the following reasons.

a) There is no loss of function of the spring hanger. The maximum displacement out of the working range is calculated to be 0.24 inches. Based on discussions with a Bergen-Patterson representative, the maximum allowable displacement out of the working range is 0.50 inches.

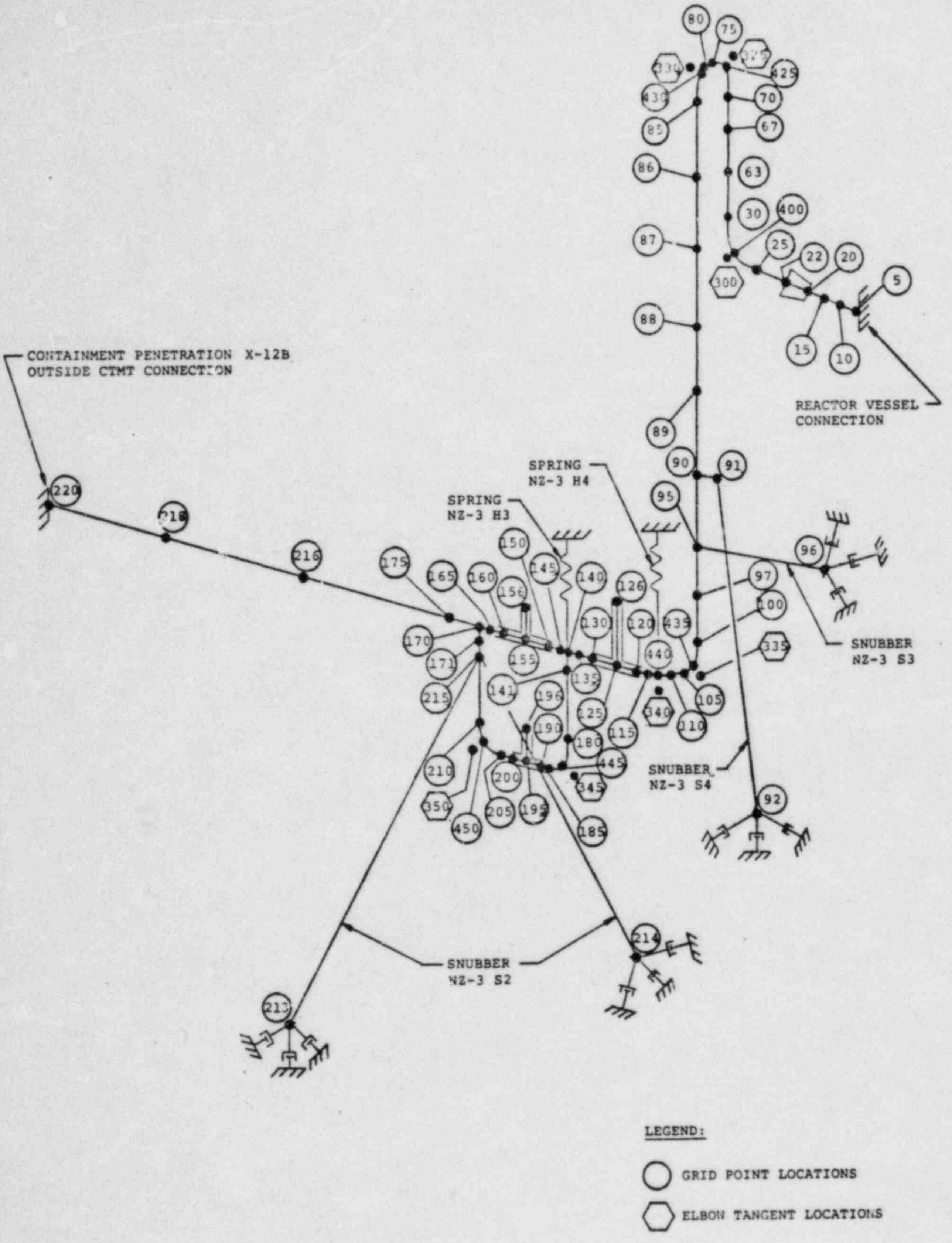
b) Stresses in the north loop core spray system piping are acceptable (i.e., within allowable values) for the lower spring hanger loads.

Computer output for the spring hanger relaxation analyses are given in Appendix F.

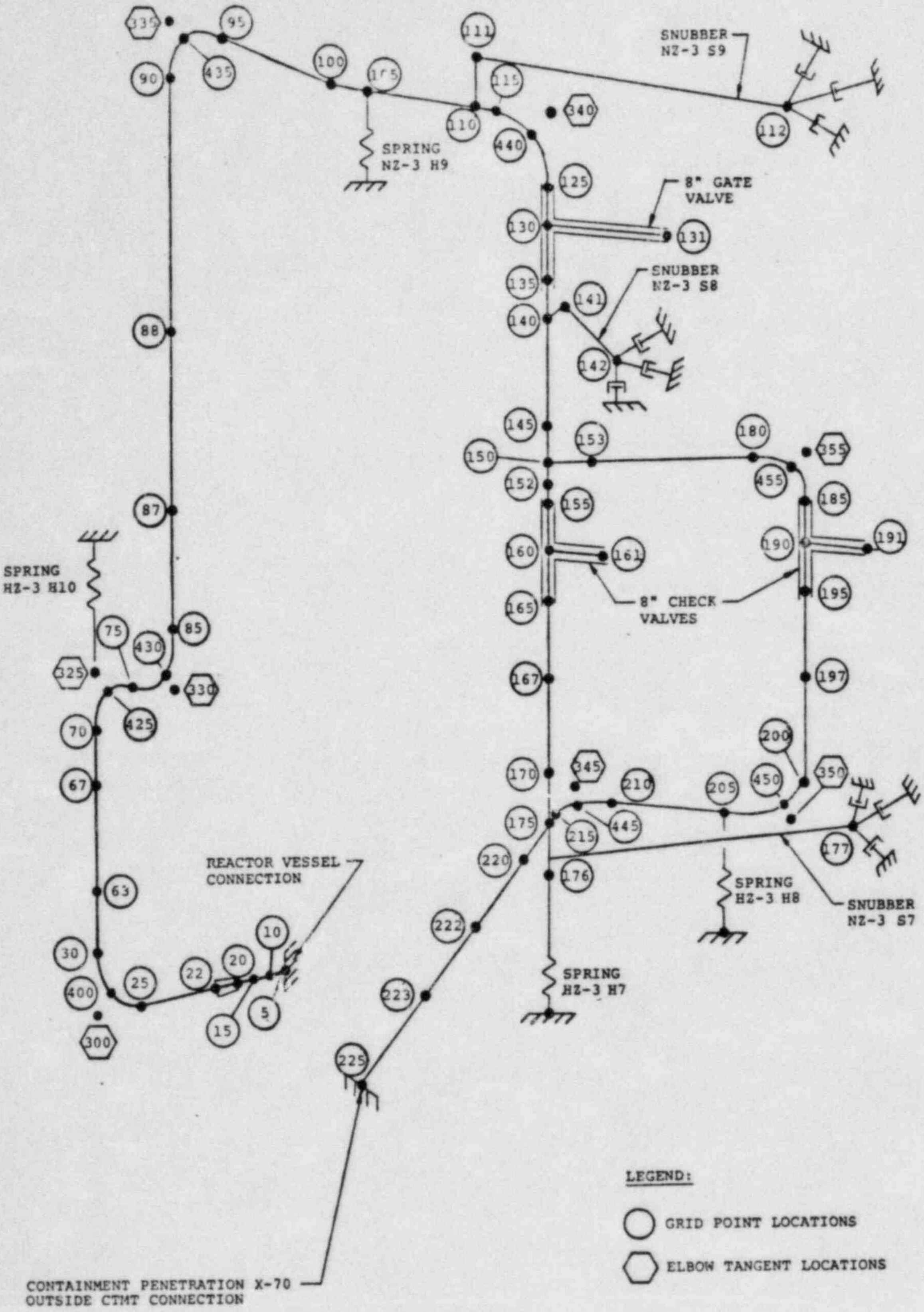
2. Seismic Stress Analyses

The seismic stress analyses determine the stresses in the core spray system piping due to the combination of internal pressure, deadweight, and seismic loads (OBE and SSE). Results of seismic stress analyses are given in Appendix E and summarized in Section II of this report. Deadweight stresses are evaluated at the reduced spring hanger loads determined from the spring hanger relaxation analyses. Stresses are calculated in accordance with Equation (9) of the ASME Code, Section III, Subsection NC. Load combinations including OBE are evaluated to Level B Service Limits. Load combinations including SSE are evaluated to Level C Service Limits.

Computer output for the seismic stress analyses are given in Appendix F.

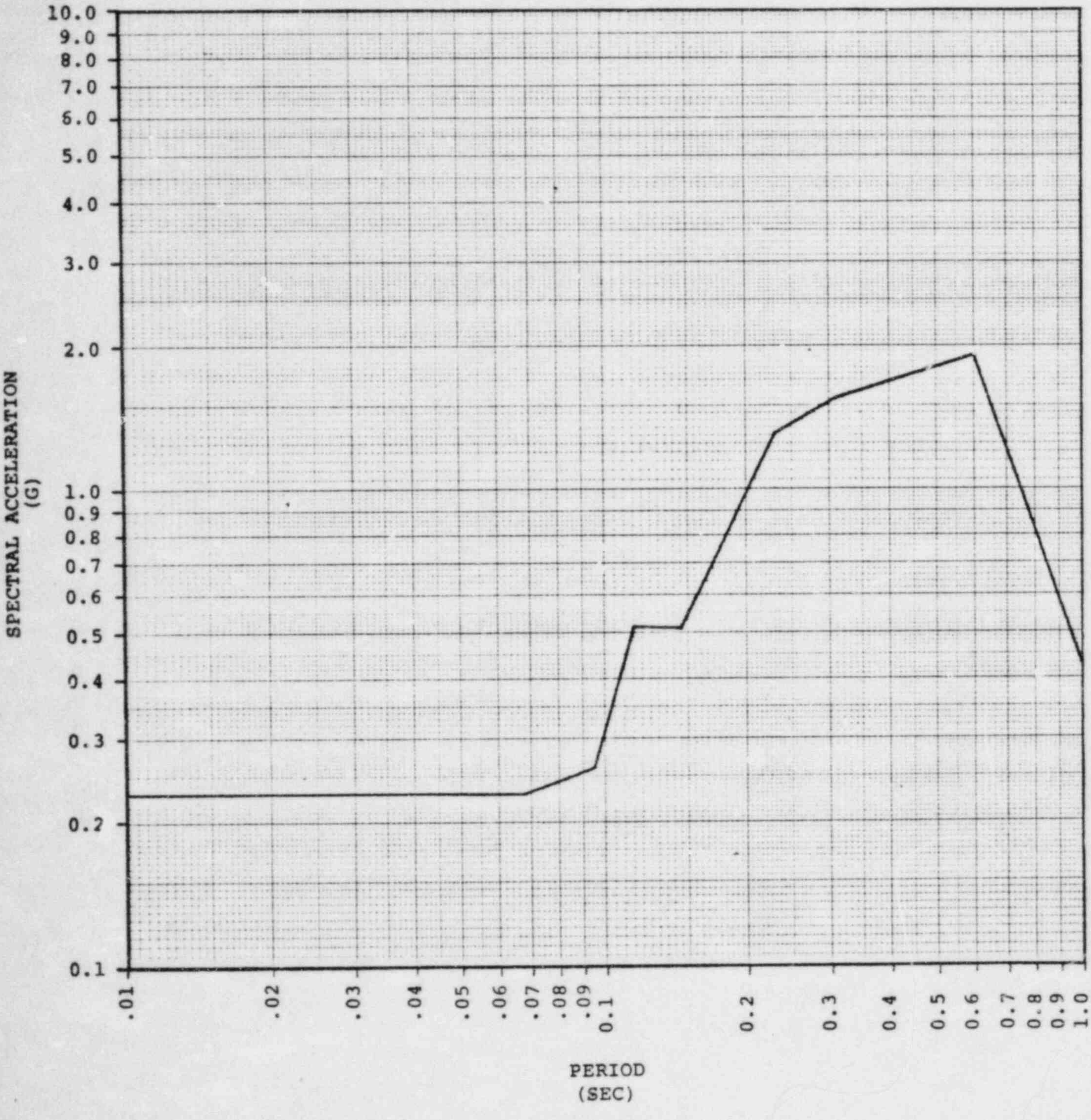


NORTH LOOP OF CORE SPRAY SYSTEM PIPING
ELEMENT AND GRID LOCATIONS
FIGURE IV-1



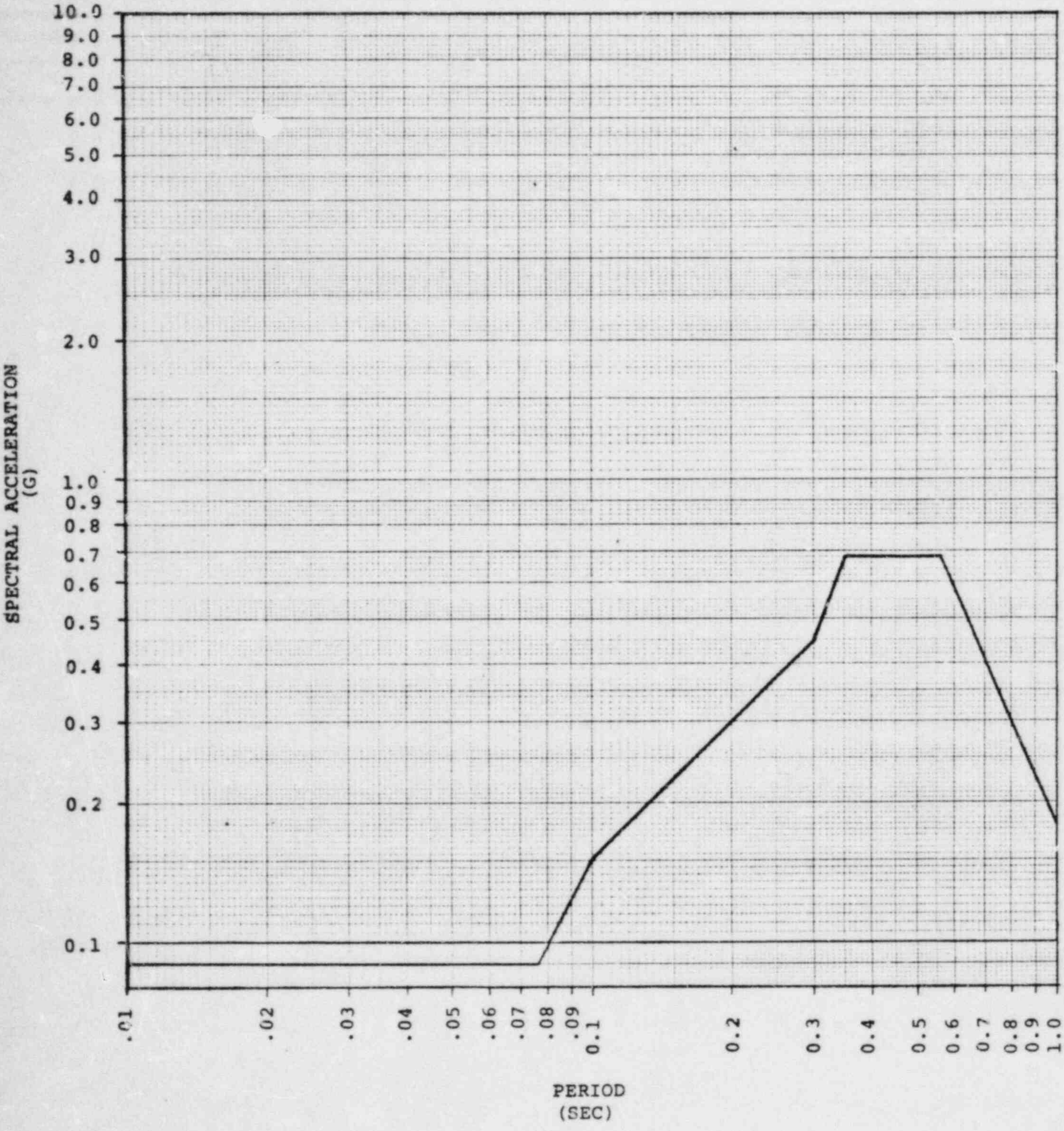
SOUTH LOOP OF CORE SPRAY SYSTEM PIPING
ELEMENT AND GRID LOCATIONS

FIGURE IV-2



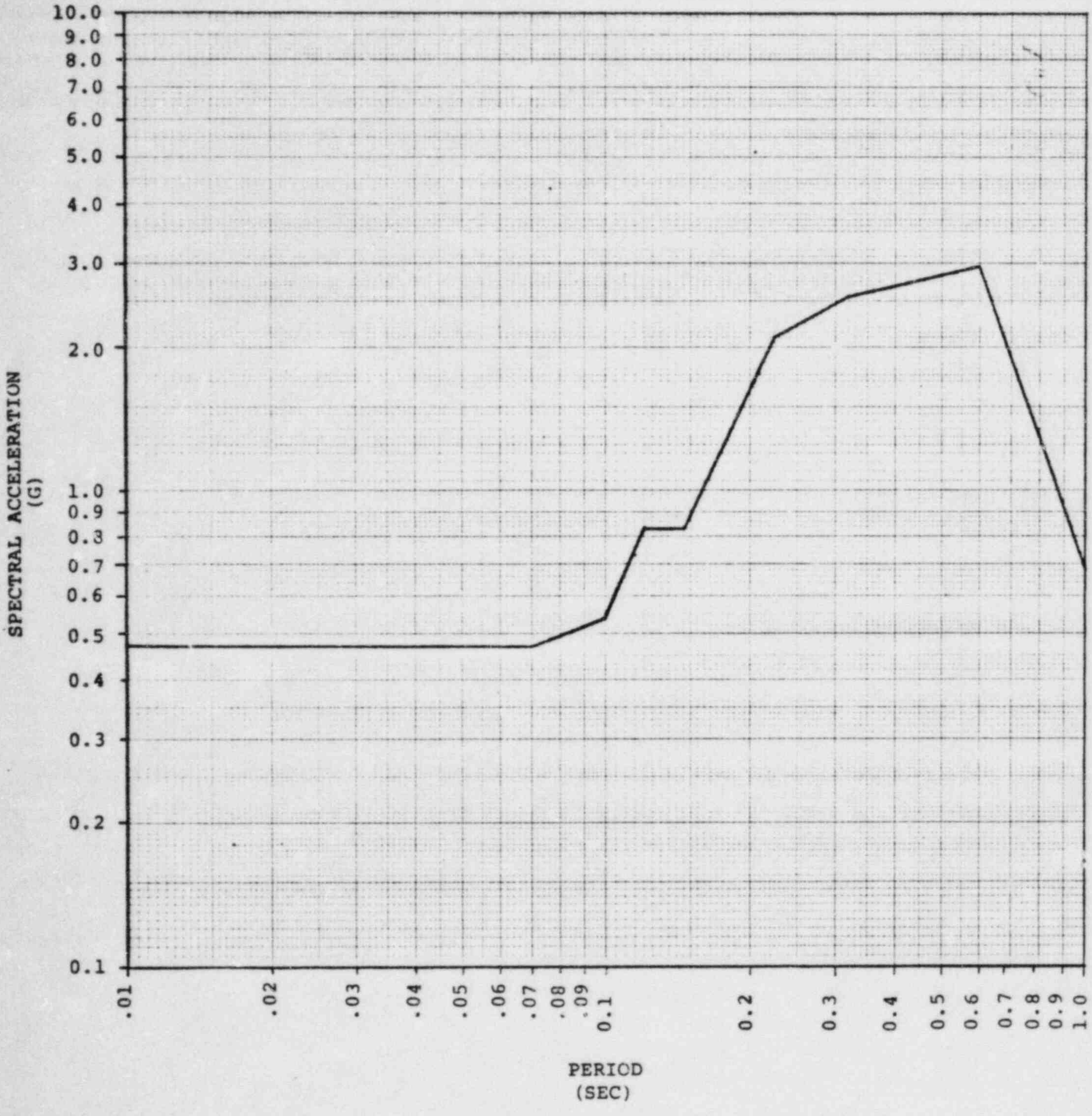
OPERATING BASIS EARTHQUAKE
CORE SPRAY PIPING HORIZONTAL RESPONSE
SPECTRA AT 1% DAMPING

FIGURE IV-3



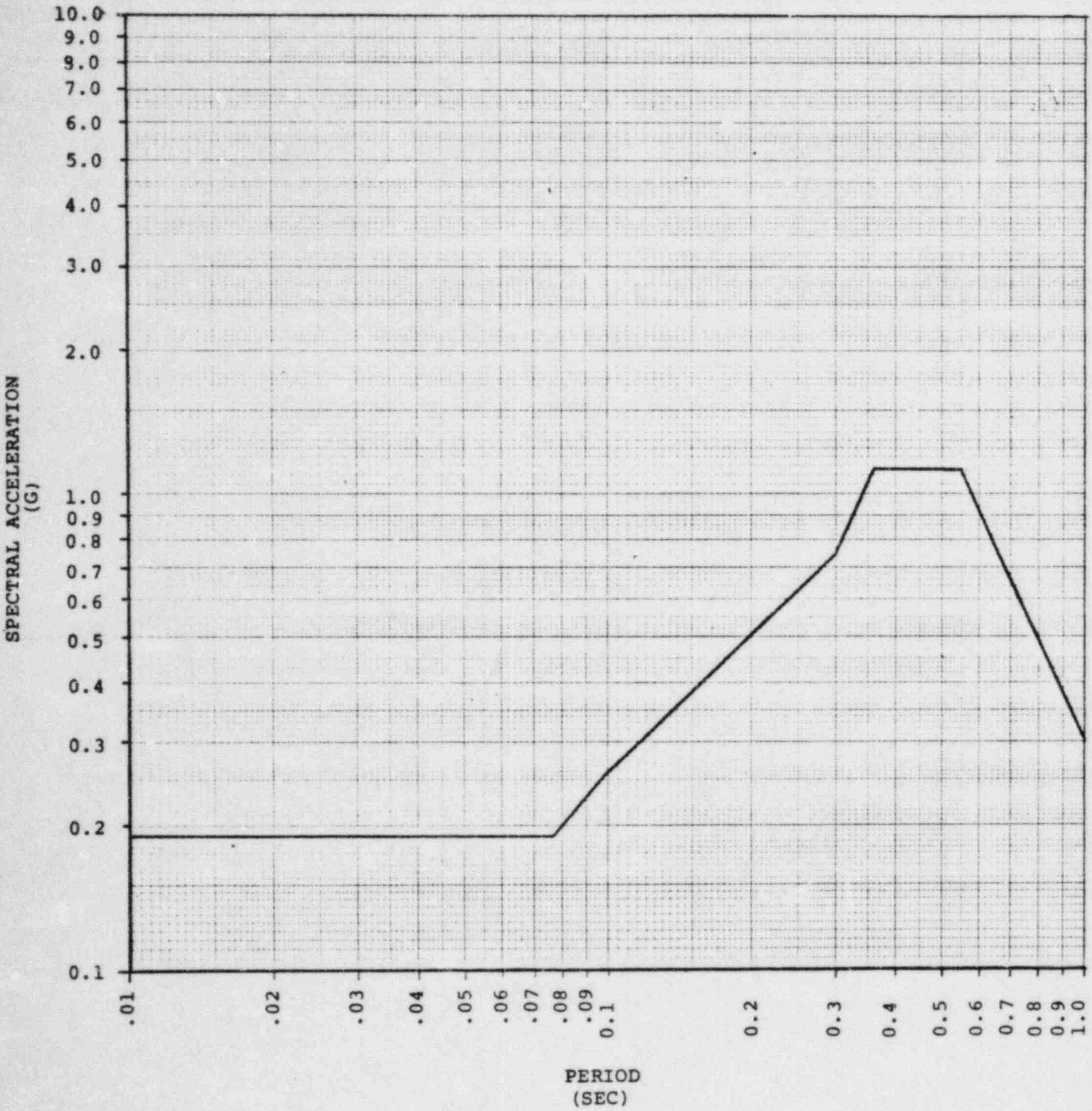
OPERATING BASIS EARTHQUAKE
CORE SPRAY PIPING VERTICAL RESPONSE
SPECTRA AT 1% DAMPING

FIGURE IV-4



SAFE SHUTDOWN EARTHQUAKE
CORE SPRAY PIPING HORIZONTAL RESPONSE
SPECTRA AT 2% DAMPING

FIGURE IV-5



SAFE SHUTDOWN EARTHQUAKE
CORE SPRAY PIPING VERTICAL RESPONSE
SPECTRA AT 2% DAMPING

FIGURE IV-6

V. APPENDICES

MPR ASSOCIATES, INC.
1050 Connecticut Ave., NW - Washington, DC 20036

Title: PIPING CONFIGURATION | Calculated by: M J Kennedy | Date: 5/19/83
Checked by: R Tifford | Date: 6-6-83
Reviewed by: TJ [illegible] | Date: 6-21-83

Project: SEP PIPING 83-03

PURPOSE

The following calculation documents the geometry used in the piping models of the south and North loops of the core spray system piping at oyster creek.

MPR ASSOCIATES, INC.
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Title: PIPING CONFIGURATION	Calculated by: MJK	Date: 5/19/83
	Checked by: SJ	Date: 6-6-83
	Reviewed by: JJ	Date: 6-7-83

Project: 83-03

Reference Drawings

Burns & Roe

2138-10 Rev. 11 Sheet 1
2139-10 Rev. 11 Sheet 1
4067-2 Rev. 2 Sheet 1
4204-1 Rev. 1 Sheet 1

GENERAL PHYSICS

JCP-19440 Rev. 3 Sheet 10
JCP-19440 Rev. 3 Sheet 11

Bergen Paterson Pipe Support Corp

103 Rev. 1 Sheet 1
104 Rev. 1 Sheet 1
198 Rev. 2 Sheet 1
199 Rev. 2 Sheet 1
200 Rev. 1 Sheet 1
201 Rev. 1 Sheet 1
456 Rev. 1 Sheet 1 & 2
457 Rev. 2 Sheet 1
458 Rev. 2 Sheet 1
459 Rev. 2 Sheet 1
460 Rev. 2 Sheet 1

Chicago Bridge & Iron

9-0971 Rev. 5 Sheet 7

Title:	Piping Configuration	Calculated by: MJK	Date: 5/19/83
		Checked by: BJ	Date: 6-6-83
		Reviewed by: JI	Date: 6.21.83
Project:	83-03		

Combustion Engineering

232-563 Rev. 8
232-567 Rev. 7

SOUTH LOOP

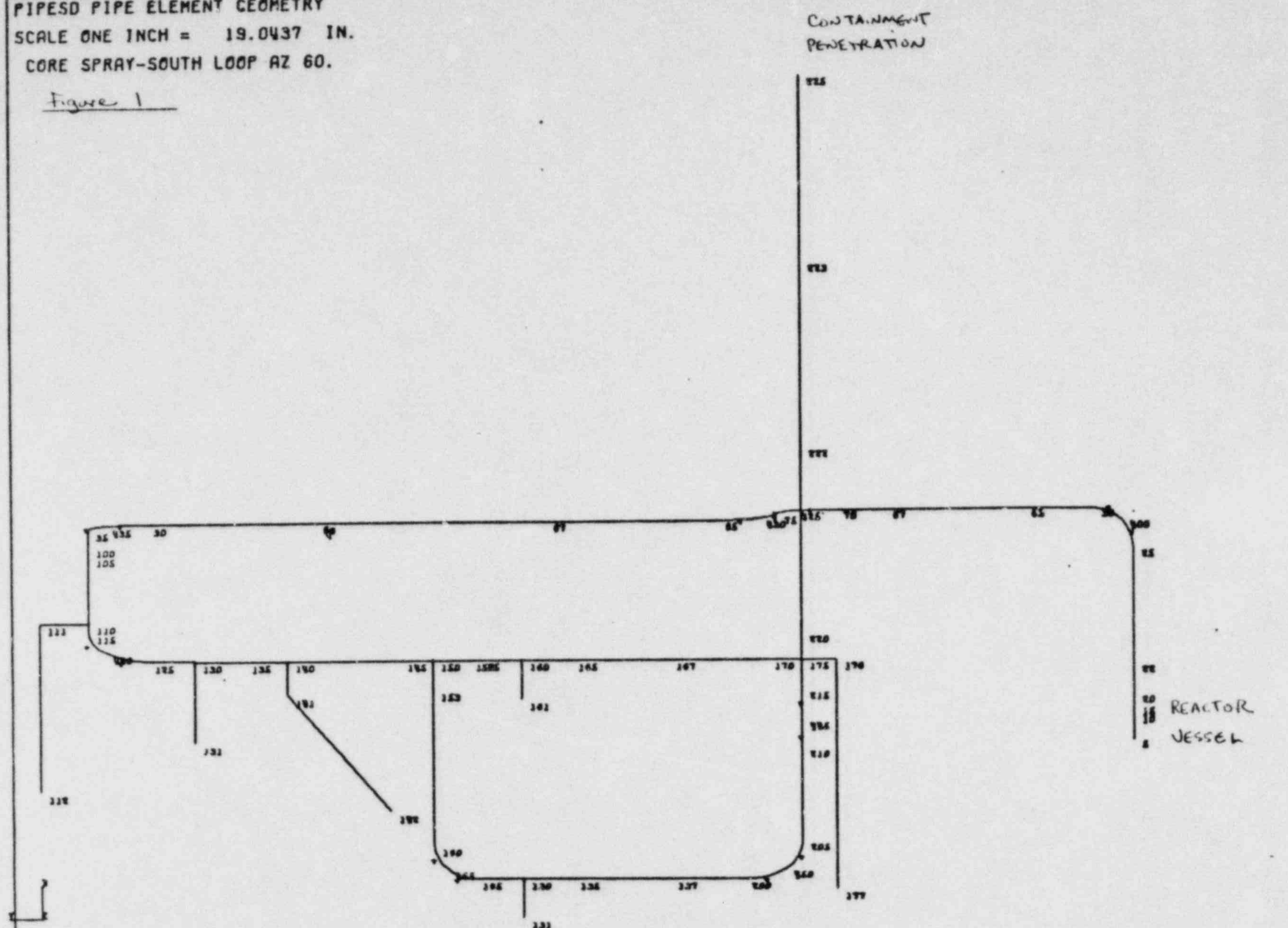
Figures 1 and 2 illustrate the geometry of the core spray south loop. Figure 3 illustrates the location of valves and supports. Table 1 contains the coordinates of the south loop piping nodes.

PIPESD PIPE ELEMENT GEOMETRY

SCALE ONE INCH = 19.0437 IN.

CORE SPRAY-SOUTH LOOP AZ 60.

Figure 1

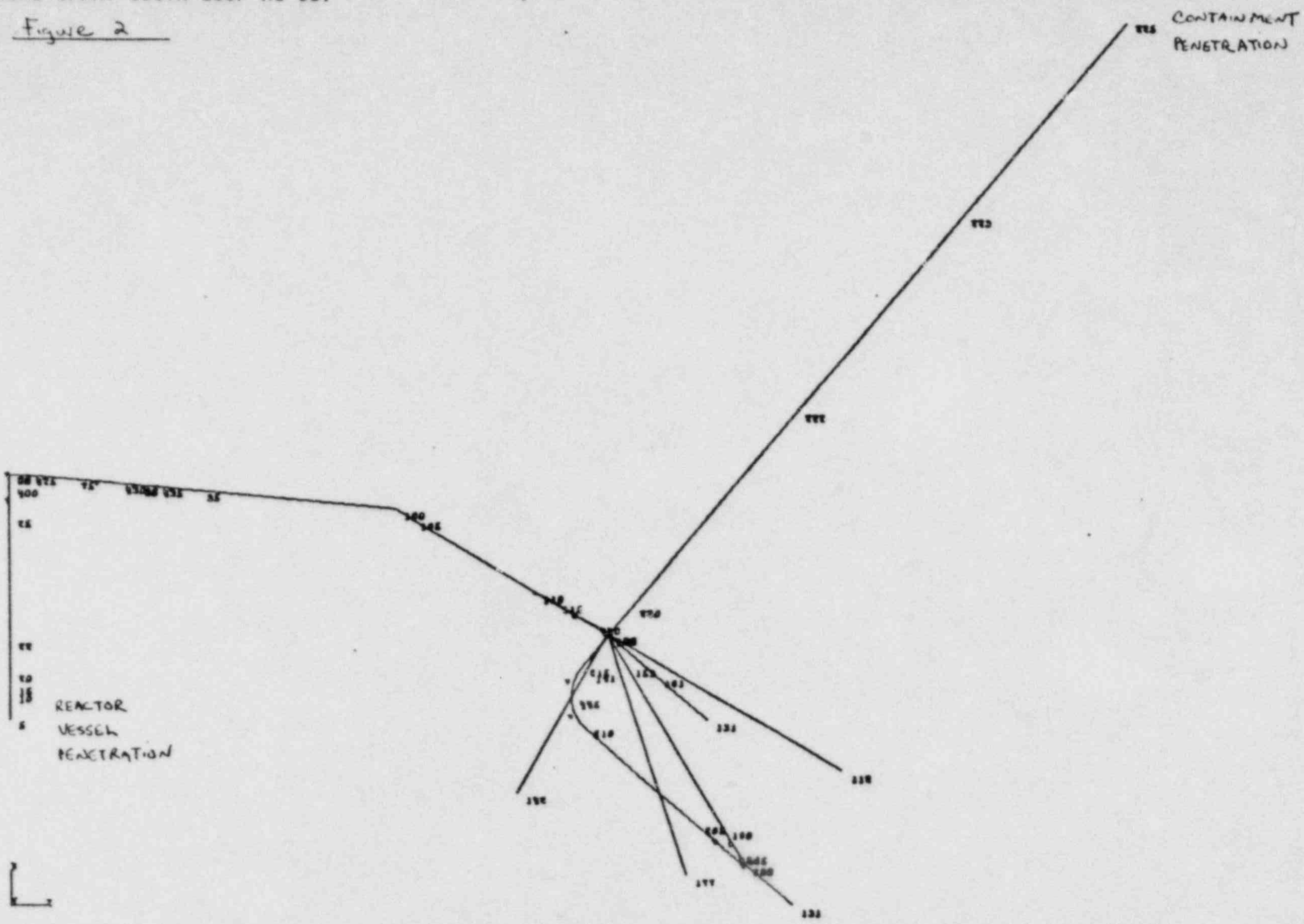


PIPESD PIPE ELEMENT GEOMETRY

SCALE ONE INCH = 19.0437 IN.

CORE SPRAY-SOUTH LOOP AZ 60.

Figure 2



MPR ASSOCIATES, INC.
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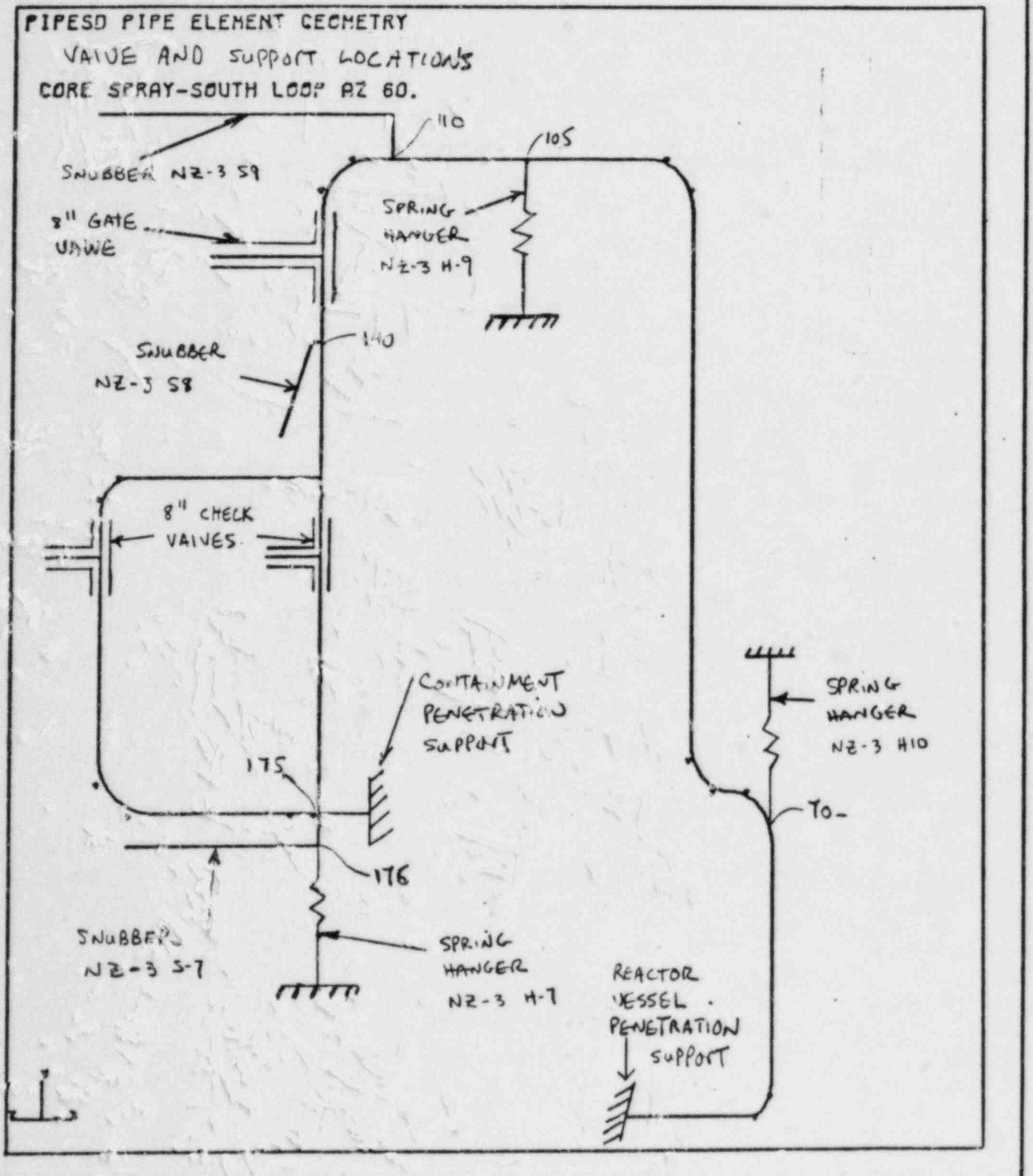
Title: PIPING CONFIGURATION | Calculated by: mjk | Date: 5/19/83
Checked by: BJ | Date: 6-6-83
Reviewed by: ZT | Date: 6-21-83

Project: 83-03

Figure 3.



Title: PIPING CONFIGURATION
Calculated by: [initials] Date: 5/19/83
Checked by: [initials] Date: 6-6-83
Reviewed by: [initials] Date: 6-21-83

Project: 83-03

TABLE 1
SOUTH LOOP PIPING GEOMETRY

RUN ID #	NODE NUMBER	X	Y	Z
1	5	122.844	0	0
1	10	127.719	0	0
1	15	129.219	0	0
1	20	131.500	0	0
1	22	137.500	0	0
1	25	156.497	0	0
1	400	164.982	3.515	0
1	30	168.497	12.0	0
1	63	168.497	22.0	0
1	67	168.497	50.0	0
1	70	168.497	60.0	0
1	425	168.191	68.485	3.501
1	75	167.451	72.0	11.955
1	430	166.711	75.515	20.408
1	85	166.405	84.0	23.909
1	87	166.405	119.0	23.909
1	88	166.405	166.0	23.909
1	90	166.405	201.0	23.909
1	435	166.099	209.485	27.410
1	95	165.359	213.0	35.863
1	100	162.088	213.0	73.254
1	105	160.326	213.0	76.306
1	110	146.826	213.0	99.689
1	115	144.826	213.0	103.153
1	440	140.583	209.485	110.501
1	125	138.826	201.0	113.545

MPR ASSOCIATES, INC.
1050 Connecticut Ave., NW – Washington, DC 20036

Title: PIPING CONFIGURATION
Calculated by: MJK Date: 5/19/83
Checked by: RY Date: 6-6-83
Reviewed by: JJ Date: 6-21-83

Project: 83-03

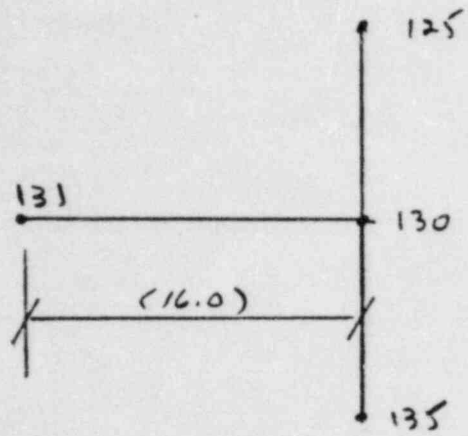
RUN ID #	NODE NUMBER	X	Y	Z
1	130	138.826	191.0	113.545
1	135	138.826	181.0	113.545
1	140	138.826	172.0	113.545
1	145	138.826	149.0	113.545
1	150	138.826	142.0	113.545
1	152	138.826	135.0	113.545
1	153	132.812	142.0	117.127
1	155	138.826	134.0	113.545
1	180	102.236	142.0	135.345
1	455	97.371	139.657	138.240
1	185	95.358	134.0	13[illegible].439
1&2	190	95.358	124.0	139.439
1&2	160	138.826	124.0	113.545
2	165	138.826	114.0	113.545
2	167	138.826	94.0	113.545
2	170	138.826	74.0	113.545
2	195	95.358	114.0	139.439
2	197	95.358	94.0	139.439
2	200	95.358	[illegible]	139.439
2	450	97.6[illegible]	[illegible].515	136.778
2	205	103.1[illegible]	[illegible]7.0	130.353
2	210	121.485	69.0	109.152
2	445	126.955	67.0	106.399
2	215	132.759	67.0	108.320
2	175	138.826	67.0	113.545
2	220	144.126	67.0	118.117
2	222	180.805	67.0	149.758
2	223	217.483	67.0	181.399
2	225	254.152	67.0	213.052

Title: PIPING CONFIGURATION
Calculated by: mjk Date: 5/19/83
Checked by: RJ Date: 6-6-83
Reviewed by: [illegible] Date: 6-21-83

Project: 83-03

VALVE Geometry – SOUTH LOOP

8" GAte VAlve



A pipe section from NODE 131 to 130 is used to model the gate valve. The mass of the valve is placed at NODE 131 (Assumed center of gravity).

RUN I.D. #	NODE NUMBER	X	Y	Z
1	131	122.496	191.0	132.475

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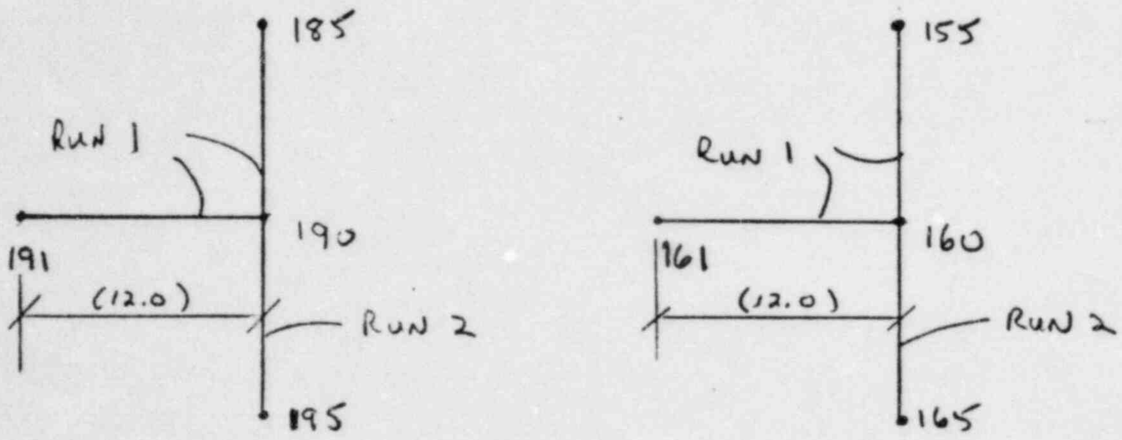
8" check valves



A pipe section from NODE 190 to 191 AND from NODE 160 to 161 is used to model the check valves. The mass of the valve is placed at NODES 191 AND 161 (assumed respective center of gravity)

RUN I.D.	NODE NUMBER	X	Y	Z
1	161	130.988	124.0	122.631
1	191	87.520	124.0	148.525

Title: Piping configuration
Calculated by: mjK Date: 5/19/83
Checked by: [illegible] Date: 6-6-83
Reviewed by: JT Date: 6-21-83

Project: 83-03

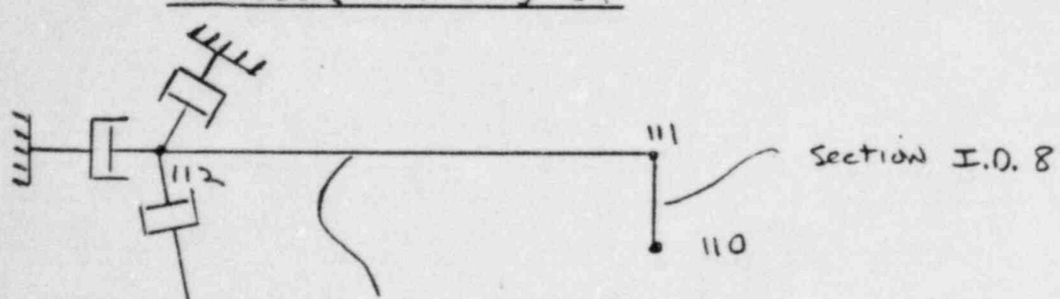
Support location AND Geometry - SOUTH LOOP

HANGER Supports

SPRING HANGER DESIGNATION	NODE
NZ-3 H10	70
NZ-3 H9	105
NZ-3 H7	176

SNUBBER Supports

SNUBBER NZ-3 S9



RUN I.D. #	NODE NUMBER	X	y	z
1	111	146.826	223.0	99.689
1	112	113.036	223.0	158.215

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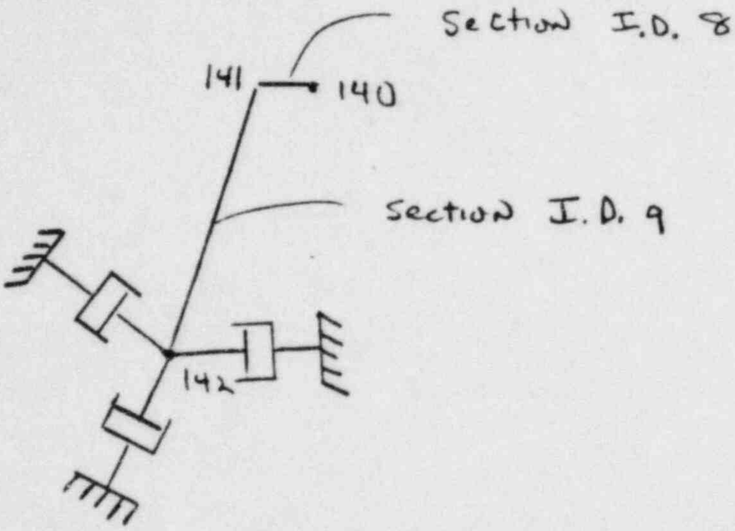
Reviewed by: [illegible] Date: 6-?-83

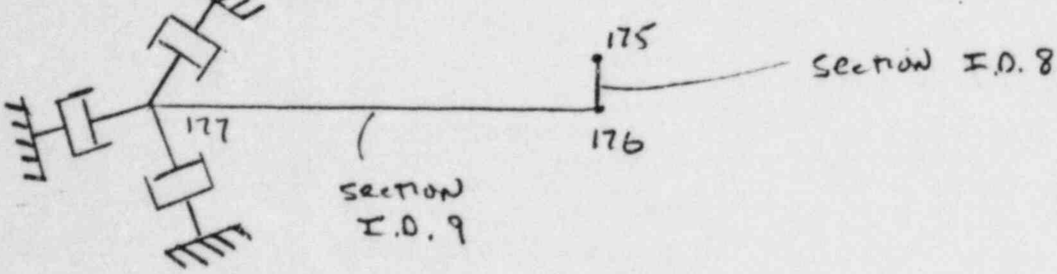
Project: 83-03

SNUBBER NZ-3 S8



RUN I.D.	NODE NUMBER	X	Y	Z
1	141	131.898	172.0	109.545
1	142	108.757	150.875	96.184

SNUBBER NZ-3 S7



RUN I.D.	NODE NUMBER	X	Y	Z
2	176	138.826	60.0	113.545
2	177	93.305	60.0	128.423

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Calculated by: MJK Date: 5/19/83
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Reviewed by: JJ Date: 6-21-83

Project: 83-03

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ELEMENT DEFINITION (SOUTH LOOP)

RUN #1

Straight members - PIPE

Member #	NODES	member #	NODES	Member #	NODES
1S	5-10	11S	88-90	21S	145-150
2S	10-15	12S	95-100	22S	150-152
3S	15-20	13S	100-105	23S	150-153
4S	20-22	14S	105-110	24S	152-155
5S	22-25	15S	110-115	25S	153-180
6S	30-63	16S	125-130	26S	155-160
7S	63-67	17S	130-131	27S	160-161
8S	67-70	18S	130-135	28S	185-190
9S	85-87	19S	135-140	29S	190-191
10S	87-88	20S	140-145		

CURVED members - PIPE

member #	NODES	member #	NODES
1C	25-400	7C	400-30
2C	70-425	8C	425-75
3C	75-430	9C	430-85
4C	90-435	10C	435-95
5C	115-440	11C	440-125
6C	180-455	12C	455-185

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Title: PIPING CONFIGURATION | Calculated by: [illegible] | Date: 5/19/83
Checked by: [illegible] | Date: 6-6-83
Reviewed by: [illegible] | Date: 6-?-83

Project: 83-03

RUN # 2

STRAIGHT MEMBERS - PIPE

Member #	NODES	member #	NODES
30 S	160-165	37 S	197-200
31 S	165-167	38 S	205-210
32 S	167-170	39 S	215-175
33 S	170-175	40 S	220-222
34 S	175-220	41 S	222-223
35 S	190-195	42 S	223-225
36 S	195-197		

CURVED MEMBERS - PIPE

MEMBER #	NODES	MEMBER #	NODES
13 C	200-450	15 C	445-215
14 C	210-445	16 C	450-205

NORTH LOOP

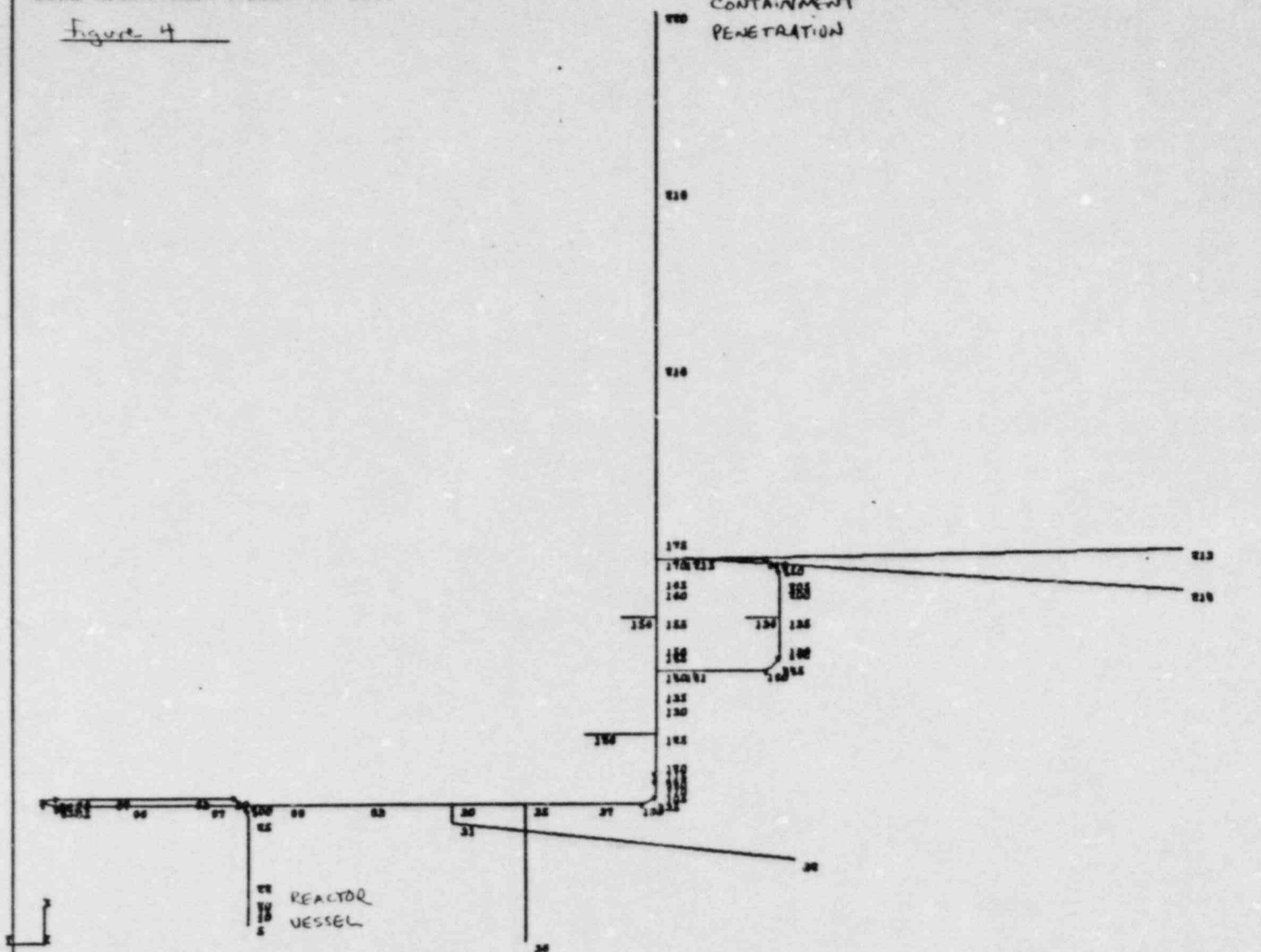
Figures 4 AND 5 illustrate the geometry of the core spray north loop. Figure 6 illustrates the location of values AND supports. Table 2 contains the coordinates of the south loop piping nodes.

PIPESD PIPE ELEMENT GEOMETRY

SCALE ONE INCH = 37.0107 IN.

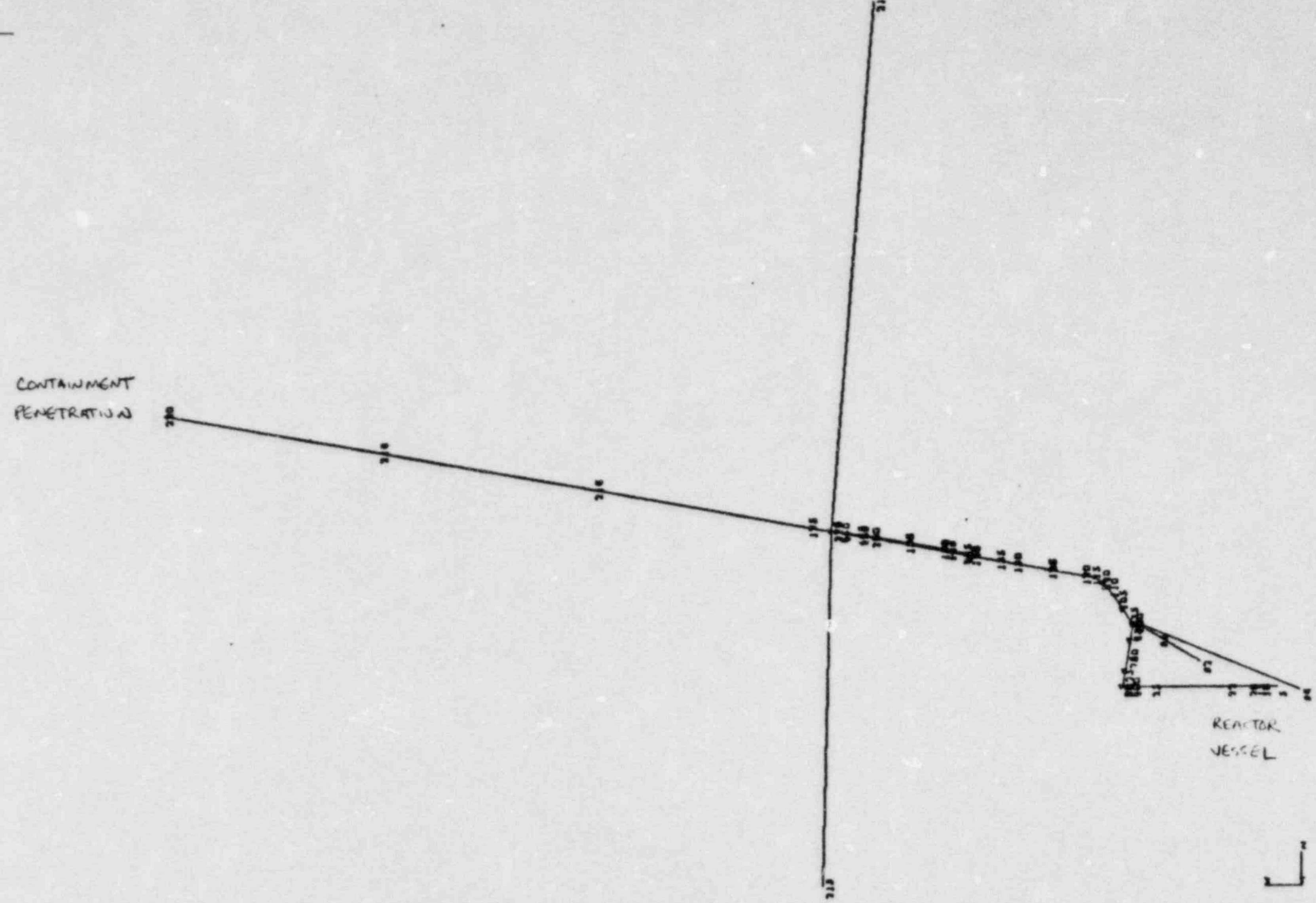
CORE SPRAY-NORTH LOOP AZ 240.

Figure 4



PIPESD PIPE ELEMENT GEOMETRY
SCALE ONE INCH = 28.4081 IN.
CORE SPRAY-NORTH LOOP AZ 240.

Figure 5



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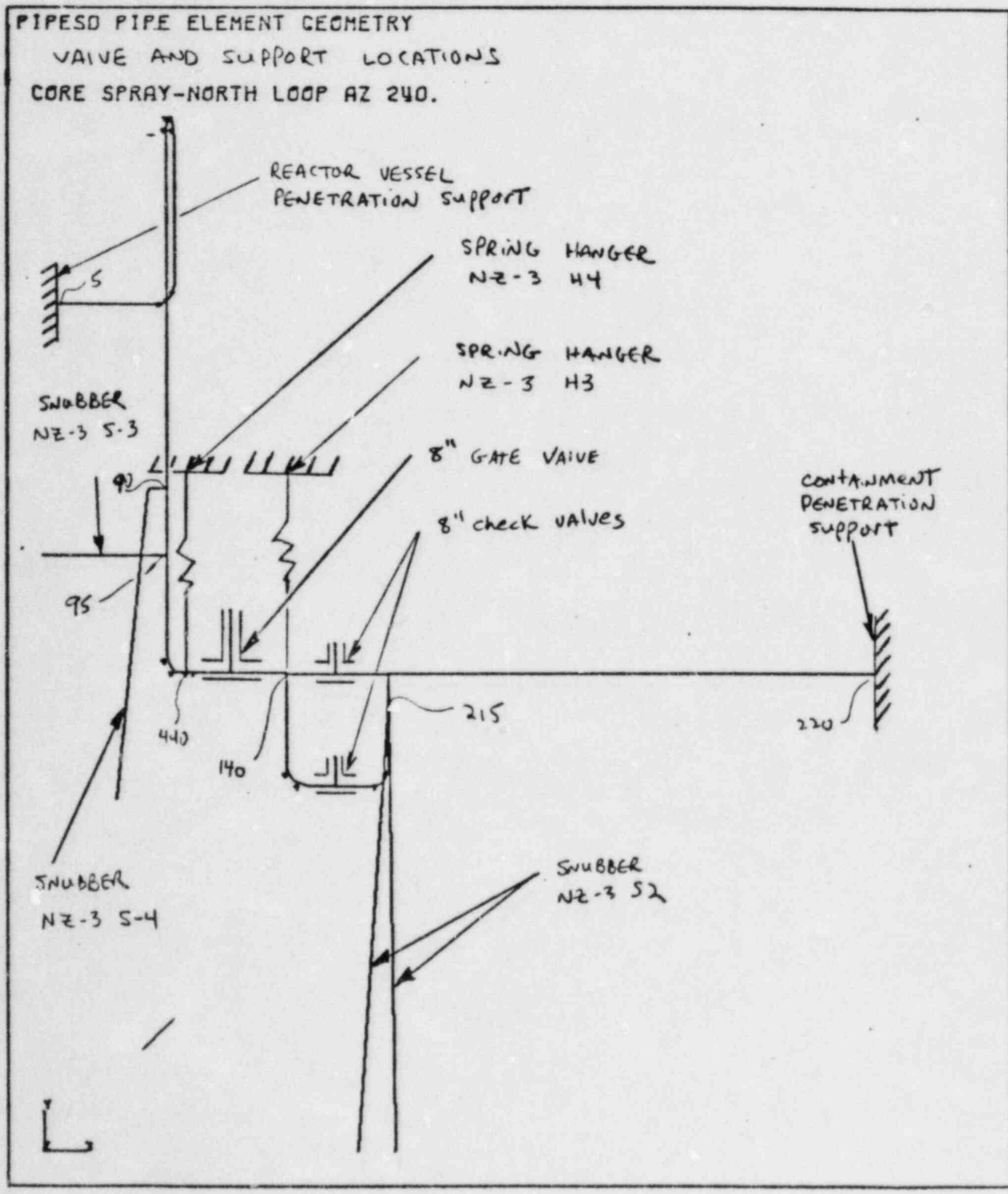
Title:	PIPING CONFIGURATION	Calculated by: MJK	Date: 5/19/83
		Checked by: [illegible]	Date: 6-6-83
		Reviewed by: [illegible]	Date: 6-21-83
Project:	83-03		Page 19 of 27

Figure 6.



Title: PIPING CONFIGURATION
Calculated by: MJK Date: 5/19/83
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Project: 83-03

Table 2.

NORTH LOOP PIPING GEOMETRY

RUN ID #	NODE NUMBER	X	Y	Z
1	5	122.844	0	0
1	10	127.719	0	0
1	15	129.219	0	0
1	20	131.500	0	0
1	22	137.500	0	0
1	25	154.997	0	0
1	400	163.482	3.515	0
1	30	166.997	12.0	0
1	63	166.997	22.0	0
1	67	166.997	50.0	0
1	70	166.997	64.313	0
1	425	166.590	69.970	2.308
1	75	165.608	72.313	7.878
1	80	165.260	72.313	9.849
1	430	164.278	69.970	15.419
1	85	163.871	64.313	17.727
1	86	163.871	44.313	17.727
1	87	163.871	16.313	17.727
1	88	163.871	-11.687	17.727
1	89	163.871	-39.687	17.727
1	90	163.871	-71.687	17.727
1	95	163.871	-97.687	17.727
1	97	163.871	-120.688	17.727
1	100	163.871	-135.687	17.727
1	435	165.222	-141.344	19.641
1	105	168.484	-143.687	24.263

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Project: 83-03

RUN ID #	NODE NUMBER	X	Y	Z
1	110	170.986	-143.687	27.806
1	440	173.249	-143.687	29.957
1	115	176.163	-143.687	31.077
1	120	178.810	-143.687	31.533
1	125	188.664	-143.687	33.232
1	130	198.519	-143.687	34.931
1	135	203.446	-143.687	35.781
1	140	210.345	-143.687	36.970
1	141	210.345	-150.687	36.970
1	145	217.243	-143.687	38.159
1	150	219.214	-143.687	38.499
1	180	210.345	-179.687	36.970
1	445	212.654	-185.344	43.368
1	185	218.229	-187.687	38.329
1	190	219.214	-187.687	38.499
1 & 2	195	22[illegible].068	-187.687	40.198
1 & 2	155	229.068	-143.687	40.198
2	160	238.923	-143.687	41.897
2	165	242.865	-143.687	42.577
2	170	249.763	-143.687	43.766
2	175	256.661	-143.687	44.955
2	171	249.763	-150.687	43.766
2	200	238.923	-187.687	41.897
2	205	241.879	-187.687	42.407
2	450	247.454	-185.344	43.368
2	210	249.763	-179.687	43.766
2	215	249.763	-153.687	43.766
2	216	317.760	-143.687	55.489
2	218	378.858	-143.687	66.023
2	220	439.958	-143.687	76.557

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Reviewed by: JJ | Date: 6-21-83

Project: 83-03

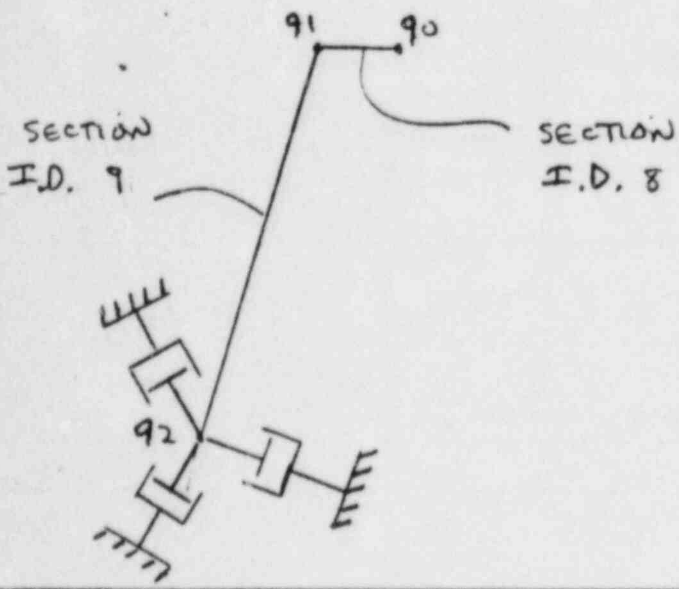
SUPPORT LOCATIONS AND Geometry – NORTH LOOP

HANGER SUPPORTS

SPRING HANGER DESIGNATION	NODE
NZ-3 H3	140
NZ-3 H4	440

SNUBBER SUPPORTS

SNUBBER NZ-3 S4



RUN I.D. #	NODE NUMBER	X	Y	Z
1	91	157.016	-71.687	13.769
1	92	144.385	-192.812	6.477

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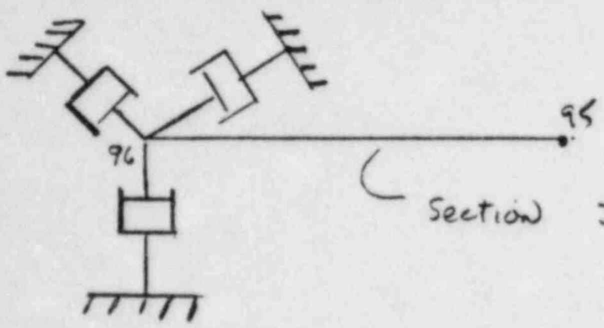
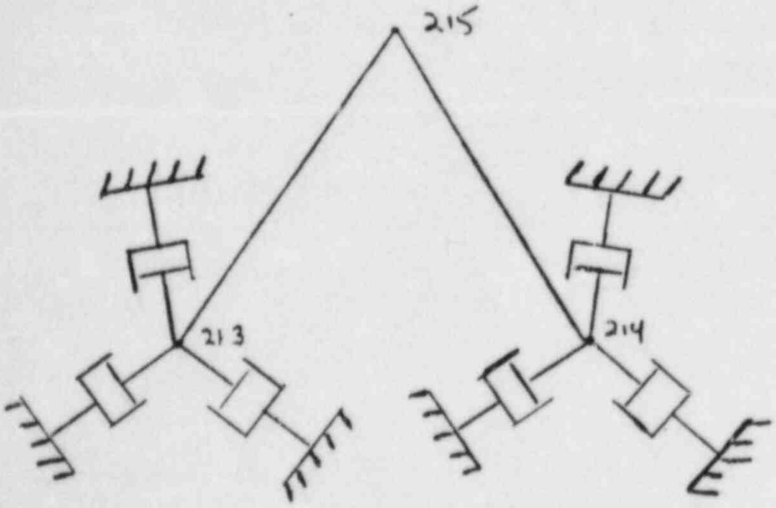
Project: 83-03

SNUBBER NZ-3 S3



RUN ID #	NODE NUMBER	X	Y	Z
1	96	116.114	-97.687	-1.549

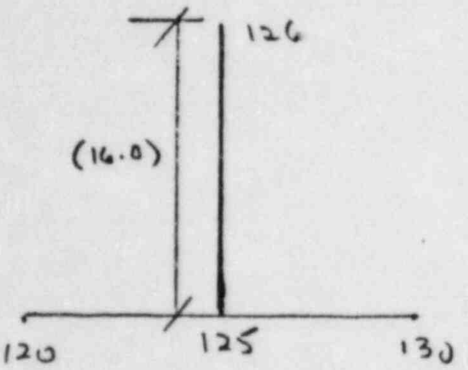
SNUBBER NZ-3 S2



RUN ID #	NODE NUMBER	X	Y	Z
2	213	252.289	-329.875	-56.315
2	214	237.[illegible]	-329.875	192.256

VALVE GEOMETRY - NORTH LOOP

8" GATE VALVE



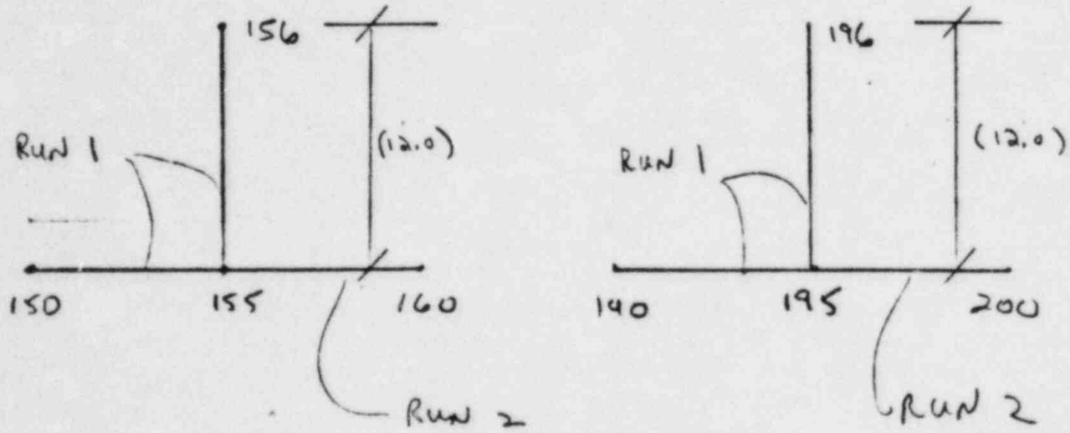
A PIPE SECTION from NODE 125 TO 126 is USED TO MODEL THE GATE VALVE. The MASS of the valve is placed at NODE 126 (ASSUMED CENTER of gravity).

RUN I.D. #	NODE NUMBER	X	Y	Z
1	126	188.664	-118.687	33.232

Title: PIPING CONFIGURATION
Calculated by: [illegible] Date: 5/19/83
Checked by: [illegible] Date: 6-6-83
Reviewed by: [illegible] Date: 6-21-83

Project: 83-03

8" CHECK VALVES



A PIPE SECTION from NODE 155 TO 156 AND from NODE 195 TO 196 IS USED TO MODEL THE CHECK VALVES. The MASS OF THE VALVE IS PLACED AT NODES 156 AND 196 (ASSUMED respective center of gravity)

RUN I.D.	NODE NUMBER	X	Y	Z
1	156	229.068	-131.687	40.198
1	196	229.068	-175.687	40.198

ELEMENT DEFINITION (NORTH LOOP)

RUN #1

STRAIGHT MEMBERS - PIPE

MEMBER #	NODES	MEMBER #	NODES	MEMBER #	NODES
1 S	5-10	12 S	87-88	23 S	130-135
2 S	10-15	13 S	88-89	24 S	135-140
3 S	15-20	14 S	89-90	25 S	140-141
4 S	20-22	15 S	90-95	26 S	140-145
5 S	22-25	16 S	95-97	27 S	141-180
6 S	30-63	17 S	97-100	28 S	145-150
7 S	63-67	18 S	105-110	29 S	150-155
8 S	67-70	19 S	115-120	30 S	155-156
9 S	75-80	20 S	120-125	31 S	185-190
10 S	85-86	21 S	125-126	32 S	190-195
11 S	86-87	22 S	125-130	33 S	195-196

CURVED MEMBERS - PIPE

MEMBER #	NODES	MEMBER #	NODES
1C	25-400	7C	400-30
2C	70-425	8C	425-75
3C	80-430	9C	430-85
4C	100-435	10C	435-105
5C	110-440	11C	440-115
6C	180-445	12C	445-185

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Calculated by: MJK Date: 5/19/83
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Project: 83-03

RUN # 2

STRAIGHT MEMBERS

MEMBER #	NODES	MEMBER #	NODES
34 S	155-160	40 S	195-200
35 S	160-165	41 S	200-205
36 S	165-170	42 S	210-215
37 S	170-175	43 S	215-171
38 S	171-170	44 S	216-218
39 S	175-216	45 S	218-220

CURVED MEMBERS

MEMBER #	NODES
13C	205-450
14C	450-210

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Title: MATERIAL AND PHYSICAL PROPERTIES
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Checked by: [signature] Date: 6-1-83
Reviewed by: [signature] Date: 5-31-83

Project: SEP PIPING 83-03

Purpose

The following calculation Documents the material and physical properties used in the piping models of the south and north loops of the core spray piping at oyster creek.

DESCRIPTION

The following figures of the south and North loop indicate the material and pipe property numbers used in the analysis. The material and pipe properties corresponding to these numbers follow the figures.

Title: MATERIAL AND PHYSICAL PROPERTIES
Calculated by: MJK Date: 5/2/83
Checked by: [illegible] Date: 6-1-83
Reviewed by: [illegible] Date: 5-31-83

Project: 83-03

NORTH & SOUTH LOOP IDENTIFICATION SUMMARY

PIPE I.D. No.	MATERIAL I.D. No.	O.D. (in.)	t (in)	Weight * (lb/in.)
1	1	7.375	0.554	4.475
2	1	6.688	0.612	4.154
3	1	6.625	0.432	3.322
4 **	1	7.625	0.466	4.236
5	1	8.625	0.500	5.264
6	1	8.625	0.500	5.264
7 ***	1	8.625	0.500	1.648

BEAM I.D. NO	MATERIAL I.D NO.	Area (in.^{2})	J_o (in.^{4})	I_{yy-zz} (in.^{4})	Weight (lb/in.)
8	1	127.6	2114.3	1057.2	0.1
9	1	1.0	1.0E-5	1.0E-5	0.1

MATERIAL I.D. NO.	MODULUS of ELASTICITY	POISSON'S RATIO	COEFFICIENT of THERMAL EXPANSION	Sh
1	27.95×10^6 PSI	0.3	8.61×10^{-6} in/in°F	18,800 PSI

* Includes weight of water.
** Average properties used for 8x6 Reducer.
*** Valve properties.

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Title: MATERIAL AND PHYSICAL PROPERTIES

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Reviewed by: [signature] Date: 5-3/-83

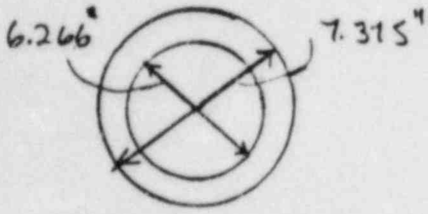
Project: 83-03

Pipe Identification #1 *

Run Identification #1

Location: Nodes 5 to 10 (North and South Loop)

Weight per unit length (Full of water)



$\frac{\text{Pipe weight}}{\text{length}}$ = Area * Density (ρ_{st})

$t = 0.554"$

Area $= \frac{\pi}{4}(7.375^2 - 6.266^2)$

$= 11.881 \text{ in}^2$

$\rho_{st} = .283 \text{ lb/in}^3$

$\frac{\text{Pipe weight}}{\text{length}} = 11.881 * .283 = 3.362 \text{ lb/in}$

weight of water = Area * Density (ρ_w)

Area $= \frac{\pi}{4}(6.266)^2 = 30.837 \text{ in}^2$

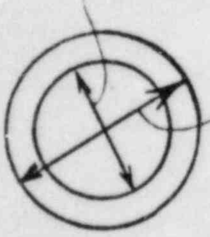
$\rho_w = 0.0361 \text{ lb/in}^3$

Weight of water $= 30.837 * .0361 = 1.113 \text{ lb/in}$

$\frac{\text{Total weight}}{\text{length}} = 3.362 + 1.113 = 4.475 \text{ lb/in}$

* See Attachment 1 to this calculation.

PIPE IDENTIFICATION # 2*
RUN IDENDIFICATION # 1
LOCATION : NODES 10 TO 15 (NORTH AND SOUTH LOOP)



$t = .612$

weight PER UNIT Length (full of water)

$$\frac{\text{PIPE weight}}{\text{length}} = \text{AREA} * \text{DENSITY } (\rho_{steel})$$

$$\text{Area} = \frac{\pi}{4}(6.688^2 - 5.463^2)$$

$$= 11.691 \text{ in}^2$$

$$\rho_{steel} = .283 \text{ lb/in}^3$$

$$\frac{\text{PIPE weight}}{\text{length}} = 11.691 * .283 = 3.308 \text{ lb/in}$$

weight of water = Area * DENSITY (ρ_w)

$$\text{Area} = \frac{\pi}{4}(5.463)^2 = 23.440 \text{ in}^2$$

$$\rho_w = 0.0361 \text{ lb/in}^3$$

weight of water = 23.440 * .0361 = 0.846 lb/in

$$\frac{\text{TOTAL weight}}{\text{length}} = 3.308 + 0.846 = 4.154 \text{ lb/in}$$

* See Attachment 1 to this calculation

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Title: MATERIAL AND PHYSICAL PROPERTIES
Calculated by: [signature] Date: 5/2/83
Checked by: [signature] Date: 6-1-83
Reviewed by: [signature] Date: 5-31-83

Project: 83-03

PIPE IDENTIFICATION #3*
RUN IDENTIFICATION #1
LOCATION: NODES 15 TO 20 (NORTH AND SOUTH LOOP)

OUTSIDE DIAMETER AND THICKNESS:

USE 6" Sch 80 PIPE **

O.D. = 6.625"
t = .432"

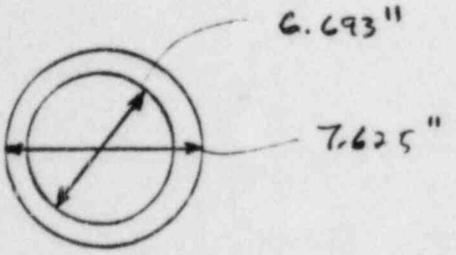
weight of PIPE = 28.57 lb/ft. = 2.381 lb/in
weight of water = 11.29 lb/ft. = .941 lb/in

TOTAL weight per unit Length 3.322 lb/in

* See Attachment 1 to this calculation.
** CRANE TECHNICAL PAPER No. 410.

PIPE IDENTIFICATION #4
RUN IDENTIFICATION #1
LOCATION: 20 to 22 (TRANSITION REGION of Reducer *)
NORTH AND SOUTH LOOP

outside diameter and thickness **



$t = .466"$

Weight per unit length (full of water):

PIPE weight $= \pi/4\ (7.625^2 - 6.693^2) \cdot .283 = 2.966$ lb/in

Water weight $= \frac{\pi}{4} (6.693^2) \cdot 0.0361 = 1.270$ lb/in

TOTAL WEIGHT PER UNIT LENGTH = 4.236 lb/in

* Stress indices for a butt welded reducer are put on at each end of the reducer element.

** Average properties for 6" Sch 80 and 8" Sch 80 are used. CRANE TECHNICAL PAPER NO. 410.

PIPE IDENTIFICATION #5
RUN IDENTIFICATION #1
LOCATION: NODES 22 TO CHECK VALVES

Outside Diameter and Thickness:

8" SCH 80 PIPE *

O.D. = 8.625"

t = 0.50"

weight of PIPE = 43.39 lb/ft = 3.616 lb/in

weight of water = 19.78 lb/ft = 1.648 lb/in

Total weight per unit length = 5.264 lb/in

* CRANE TECHNICAL PAPER NO. 410.

Title: MATERIAL AND PHYSICAL PROPERTIES

Calculated by: [illegible] Date: 5/2/83
Checked by: [illegible] Date: 6-1-83
Reviewed by: [illegible] Date: 5-31-83

Project: 83-03

PIPE IDENTIFICATION #6
RUN IDENTIFICATION #2
LOCATIONS: CHECK VALVES TO DRYWELL PENETRATION

Outside Diameter AND Thickness: } SAME AS PIPE IDENTIFICATION #4
Weight per unit length: }

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Title: MATERIAL AND PHYSICAL PROPERTIES

Calculated by: MJK Date: 5/2/83
Checked by: GJ Date: 6-1-83
Reviewed by: JJ Date: 5-31-83

Project: 83-03

PIPE IDENTIFICATION #7

MATERIAL AND PHYSICAL Properties of VALVES

There are six valves in the north and south loops, designated on Gen. Physics Dwgs. JCP-19440 sheets 10 & 11. Valve designation and type are listed below:

VALVE DESIGNATION	TYPE
V-20-17 (NORTH LOOP)	8" GATE VALVE (Butt welded)
V-20-23 (South LOOP)	8" GATE VALVE (Butt Welded)
NZ 02 A (NORTH LOOP)	8" Check VAlve (Butt Welded)
NZ 02 B (SOUTH LOOP)	8" Check VAlve (Butt Welded)
NZ 02 C (NORTH LOOP)	8" Check VAlve (Butt Welded)
NZ 02 D (SOUTH LOOP)	8" Check VAlve (Butt Welded)

Ref. BURNS AND ROE Dwg. 2075

Material and Physical properties for All 6 valves (2 - 8" Gates & 4 - 8" checks) of both North and South Loops are assumed to be identical and of the same material as the connecting pipe.

MATERIAL IDENTIFICATION # 1.

Outside Diameter and Thickness of Valves are Assumed to be 8.625" and 0.50", Respectively

Valve Weights

Two weights considered:

1) valve weight per unit length
2) valve concentrated weight at the C.G. of the valve.

Weight per Unit Length

Weight of water in valve = $A_{pw} = \frac{\pi}{4}(7.625^2) \times .0361$

$= 1.648$ lb/in

Weight of steel placed at C.G.

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Title: MATERIAL AND PHYSICAL PROPERTIES	Calculated by: RJK	Date: 5/2/83
	Checked by: BJ	Date: 6-1-83
	Reviewed by: JJ	Date: 5-31-83

Project: 83-03

Weight Concentrated at Valve C.G.:

Valve weights for the specific manufacturers (i.e. 8" Gate - ANCHOR, 8" CHECK - ATWOOD MORRILL) could not be found. Valve weights are estimated From CRANE VALVE MANUFACTURER DATA.

	8" GATE VALVE 600# CLASS - Butt WELDED	8" CHECK VALVE 600# CLASS - Butt Welded
weights	~1100 lbs	~750 lbs

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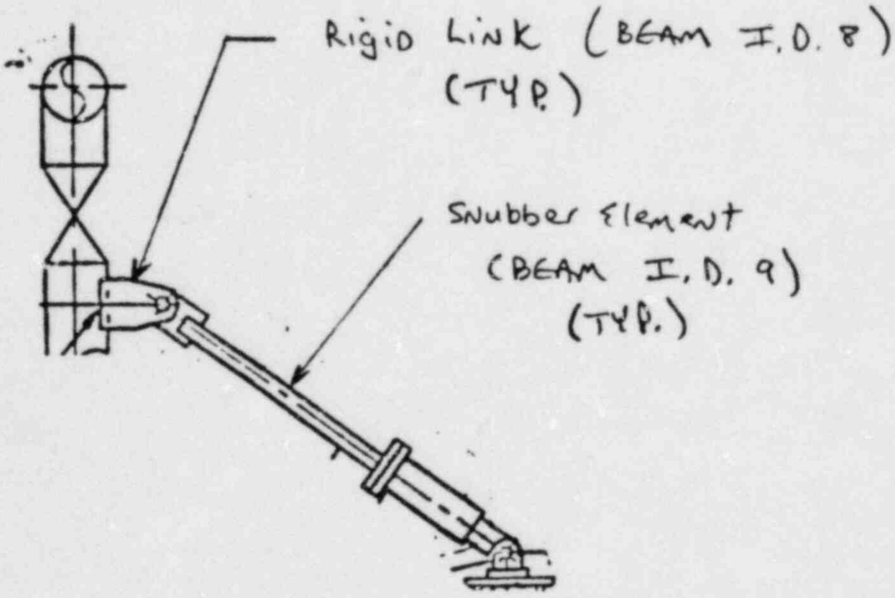
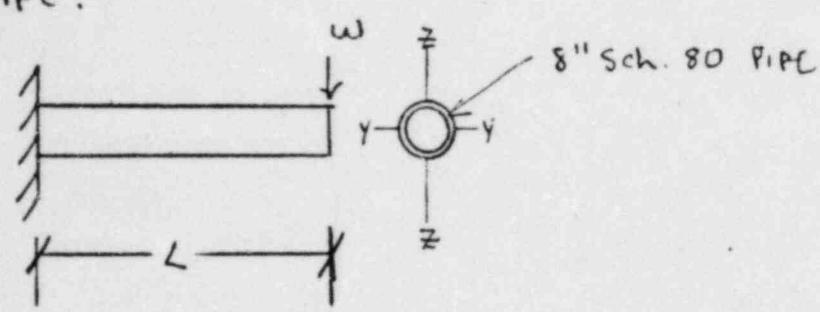
Title:	MATERIAL AND PHYSICAL PROPERTIES	Calculated by: 2/1/K	Date: 5/2/83
		Checked by: BJ	Date: 6-1-83
		Reviewed by: JJ	Date: 5-31-83
Project:	83-03		

SNUBBER BEAM PROPERTIES FOR BOTH LOOPS



BEAM PROPERTIES OF RIGID LINKS BEAM I.D. 8

AS SHOWN ON THE NORTH AND SOUTH support SUMMARY figures, MOST snubbers are attached to the system piping with a link. The PROPERTIES of THESE LINKS ARE determined SUCH THAT The stiffness of EACH LINK is TEN TIMES THAT of AN EQUIVALENT piece of 8" PIPE:



$$\text{AREA PIPE} = \frac{\pi}{4}\left(8.625^2 - 7.625^2\right)$$

$$= 12.76 \text{ in}^2$$

$$I_{yy\text{-}zz} = \frac{\pi}{64}\left(8.625^4 - 7.625^4\right)$$

$$= 105.72 \text{ in}^4$$

$$I_{xy} = 2 I_{yy} = 211.43 \text{ in}^4$$

$$\text{AXIAL STIFF.} = \frac{P}{\Delta L} = \frac{AE}{L} \times 10 \quad \left\{ \text{AREA of LINK} = 10\,(12.76) = 127.6 \text{ in}^2 \right\}$$

BENDING STIFF. = $\frac{W}{y_{MAX}} = \frac{3EI}{L^3} \times 10$ $\{ I_{yy\text{-}zz} = 10(105.72) = 1057.2 \text{ in}^4 \}$

$I_{xx} = 2114.3 \text{ in}^4$

weight / length of LINK = 0.1 lb/in (ASSUMED VALUE)

BEAM PROPERTIES OF SNUBBER ELEMENTS BEAM I.D. 9

The AREA INPUT TO DEFINE SNUBBER AXIAL STIFFNESS is BASED ON 10,000 psi stress in the snubbers AT RATED LOAD:

$$A = F/\sigma = \frac{\text{RATED LOAD (Note 1)}}{10000 \text{ PSI}}$$

$$= \frac{10,000}{10,000} = 1.0 \text{ in}^2$$

BENDING AND TORSIONAL MOMENTS OF INERTIA ARE CHOSEN ARBITRARILY AS: $I_{yy} = I_{zz} = I_{xx} = 1.0E-5 \text{ in}^4$

weight / Length of snubber = 0.1 lb/in (ASSUMED VALUE)

Notes:

1.) RATED LOAD based on AVAILABLE snubber catalog DATA for A 6" stroke, PACIFIC Scientific Snubber. RATED LOAD = 10,000 lbf

MATERIAL PROPERTIES

MATERIAL PROPERTIES FOR THE NORTH AND SOUTH LOOPS ARE IDENTICAL. MATERIAL PROPERTIES ARE EVALUATED AT THE OPERATING TEMPERATURE OF 135°F

MATERIAL IDENTIFICATION # 1

MATERIAL OF PIPING : 316 SST (16Cr-12Ni-2Mo)
NOTE (1)

LOCATION - all points

MODULUS OF ELASTICITY : 27.95×10^6 PSI
NOTE (2)

POISSON'S RATIO = 0.30

COEFFICIENT OF THERMAL EXPANSION = 8.61×10^{-6} in/in-°F
NOTE (3)

NOTES :

(1) Reference Burns & Roe Spec S-2299-60-C-REACTOR

(2) ASME Code Append. Table I-6.0

(3) ASME Code APPEND Table I-5.0 (MEAN VALUE)

Title: MATERIAL AND PHYSICAL PROPERTIES | Calculated by: mjK | Date: 5/2/83
Checked by: RZ | Date: 6-1-83
Reviewed by: JJ | Date: 5-31-83

Project: 83-03

Allowable Stress

The allowable stress value required for use in Equation (9) of Section III, Subsection NC, Article NC-3653.1 is S_h. S_h is taken from Table I-7.2 of Section III Appendices:

S_h = basic material allowable stress at normal service temperature = 18,800 psi

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Title: MATERIAL AND PHYSICAL PROPERTIES	Calculated by: MJK	Date: 5/2/83
	Checked by: [illegible]	Date: 6-1-83
	Reviewed by: [illegible]	Date: 6-3-83

Project: SEP PIPING. 83-03

Attachment 1

The following figure documents dimensions taken from Combustion Engineering Dwg E-232567. These dimensions are used to determine properties for Pipe ID # 1 & 2.

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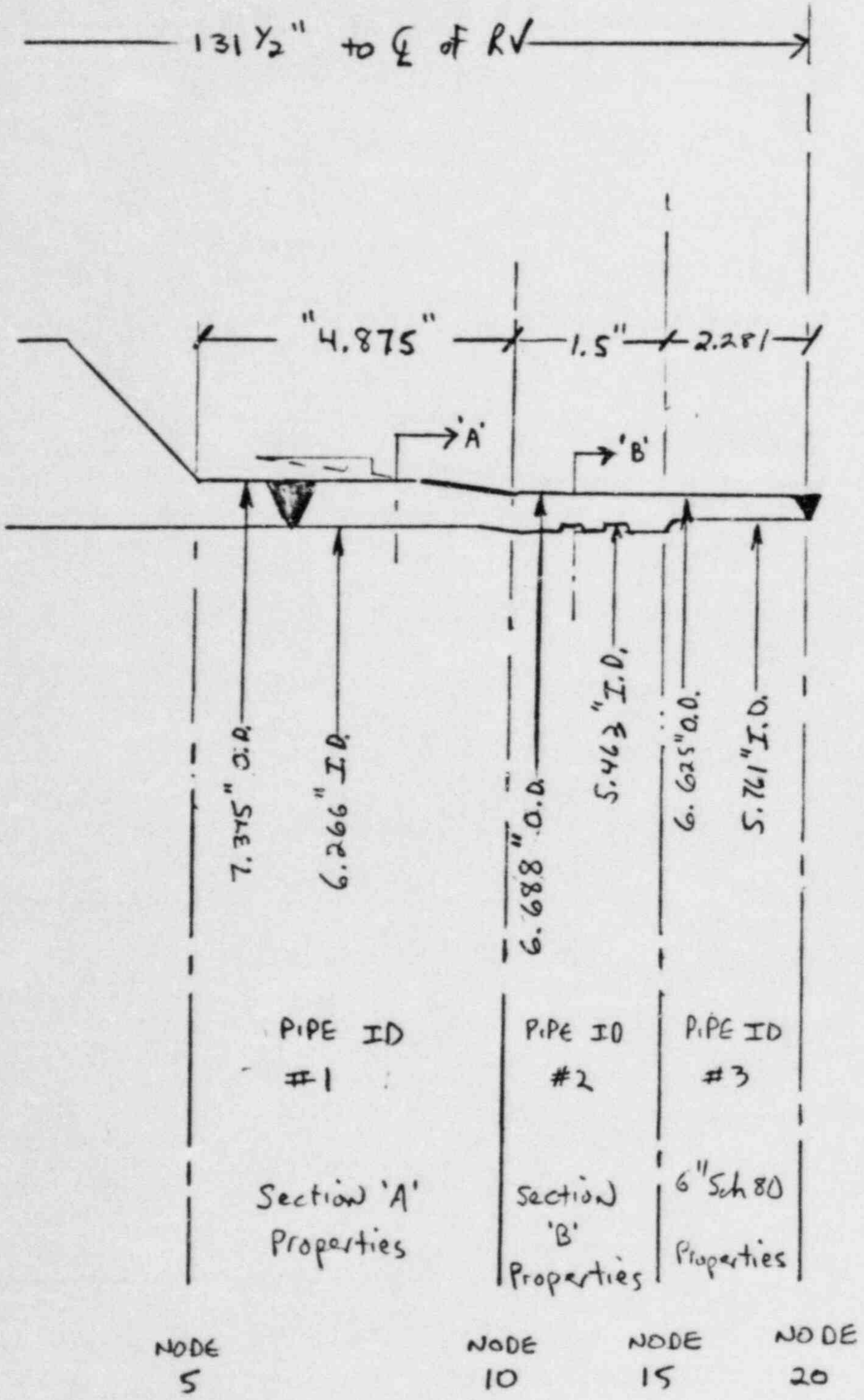
Title: MATERIAL & PHYSICAL PROPERTIES	Calculated by: [illegible]	Date: 5/2/83
	Checked by: [illegible]	Date: 6-1-83
	Reviewed by: [illegible]	Date: 5-31-83
Project: 83-03		Page 2 of 2

DETAIL OF REACTOR VESSEL NOZZLE ANCHOR



Purpose

The following calculation determines anchor movements and piping temperature changes for the north and south loops of the core spray piping at Oyster Creek.

Description

The piping systems connect to the reactor vessel and drywell as shown on the following figure:

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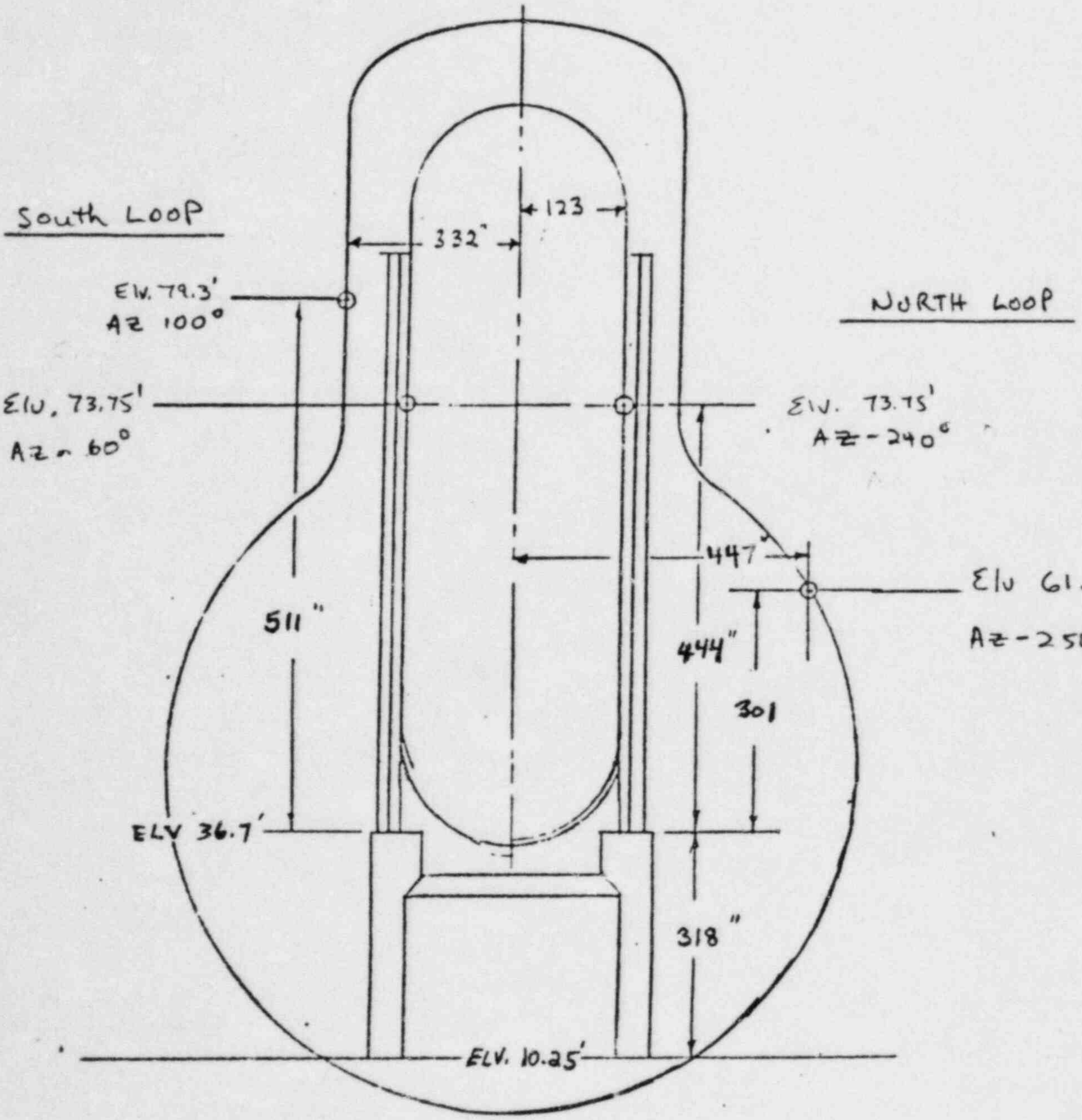
Title:	Thermal Displacements Core Spray System	Calculated by:	[illegible]	Date:	5/1/83
		Checked by:	[illegible]	Date:	6-1-83
		Reviewed by:	[illegible]	Date:	5-24-83

Project: SEP Piping 83-03



Reference Dwgs:

B & R Dwgs – 2138-10, 2139-10

B & R Dwgs – 4204-1, 4067-2

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Title: Thermal Displacements Core Spray System
Calculated by: [illegible] Date: 5/1/83
Checked by: [illegible] Date: 6-1-83
Reviewed by: [illegible] Date: 5-20-83

Project: SEP Piping 83-03

SUMMARY of THERMAL ANALYSIS

CASE	LOCATION	Pressure (Psig)	ANCHOR MOVEMENTS (INCHES)				PIPE ΔT (°F)
			LOCATION	x	y	z	
OPERATING CONDITIONS	NORTH	1250 Psig to check valves	5	0.459	1.585	0.0	65.0
			220	0.168	0.0	0.29	
	SOUTH	285 Psig past check valves	5	0.459	1.505	0.0	
			225	0.095	0.0	0.082	

Pressure - 1250 Psig to check valves
- 285 psig past check valves

Reactor Vessel temperature - 550°F
Containment temperature - 135°F
Temperature of concrete base - 135°F
Temperature of piping - 135°F
Reference temperature - 70°F

Title: Thermal Displacements, Core Spray System	Calculated by: mjK	Date: 5/1/83
	Checked by: BJ	Date: 6-1-83
	Reviewed by: JP	Date: 5-24-83

Project: SEP Piping 83-03

Coefficients of thermal expansion

CONCRETE - 8.0×10^{-6} in/in °F (note 1)

Containment - 5.86×10^{-6} in/in °F @ 135°F (note 2)

Reactor vessel - 7.77×10^{-6} in/in °F @ 550°F (note 3)

Notes:

1.) Concrete BASE coefficient taken from MARK'S HANDBOOK, 8th Ed, 4-7 (mean value between 32 and 212 °F)

2) Containment material - A212 B, Ref CB & I DWG. # 90971, SH. NO. 7 Rev. 5.

Equivalent material - SA-516 GR. 70 (C-Mn-Si) mat Group B (mean value - B)

3) Reactor vessel material - SA-302 Gr B, Ref Combustion Eng. DWG # 232-563, Rev 8.

material designation found in Div. 1 of ASME B&PV CODE, 1968, Sect. VIII pg 104 (Mn-½Mo) mat. Group D. (mean value - B)

Title: Thermal Displacements CORE SPRAY SYSTEM	Calculated by: mJK	Date: 5/1/83
	Checked by: BJ	Date: 6-1-83
	Reviewed by: JJ	Date: 5-24-83
Project: SEP PIPING 83-03		Page 5 of 6

OPERATING CONDITIONS EXPANSION DISPLACEMENT CALCULATION

$d = \alpha L \Delta T$

LOCATION	α (in/in °F)	L (in.)	ΔT (°F)	d (in)
CONCRETE BASE	8.0×10^{-6}	318.0	65.0	0.165
R.V. Vertical N & S	7.77×10^{-6}	444.0	480.0	1.656
D.W. Vertical south	5.86×10^{-6}	829.0	65.0	0.316
D.W. Vertical North	5.86×10^{-6}	619.0	65.0	0.236
R.V Radial N & S	7.77×10^{-6}	123.0	480.0	0.459
D.W. RADIAL south	5.86×10^{-6}	332.0	65.0	0.126
D.W. Radial North	5.86×10^{-6}	447.0	65.0	0.170

ANCHOR MOVEMENT SUMMARY (inches)

South SIDE

ΔL At Reactor = 1.821
ΔL At D.W. = 0.316
ΔR At Reactor = 0.459
ΔR AT D.W. = 0.126

NORTH SIDE

ΔL At REACTOR = 1.821
ΔL At D.W. = 0.236
ΔR At REACTOR = 0.459
ΔR AT D.W. = 0.170

only the relative movement of the reactor to the containment in the vertical (Y - direction) is input

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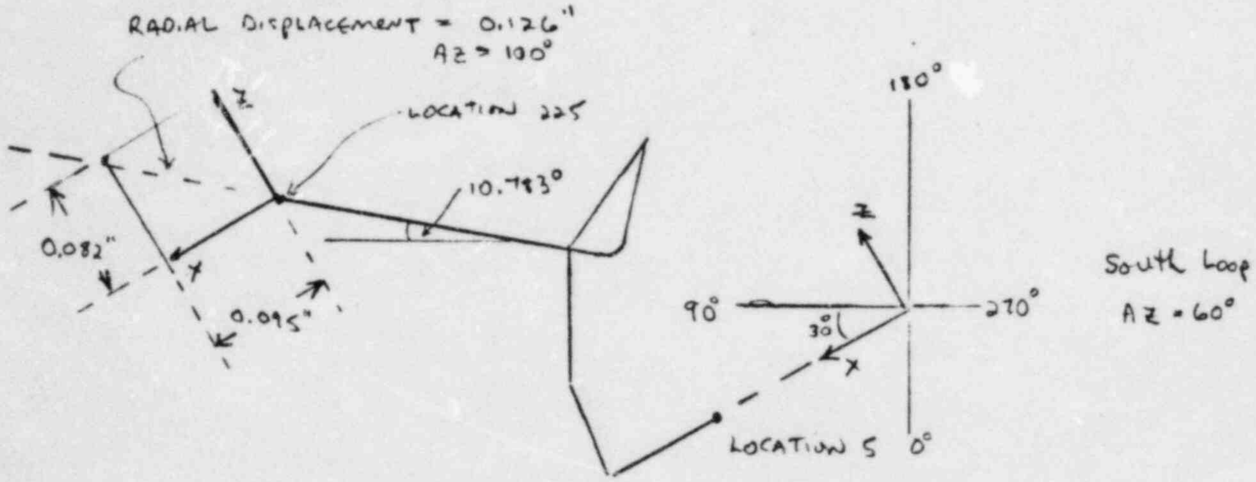
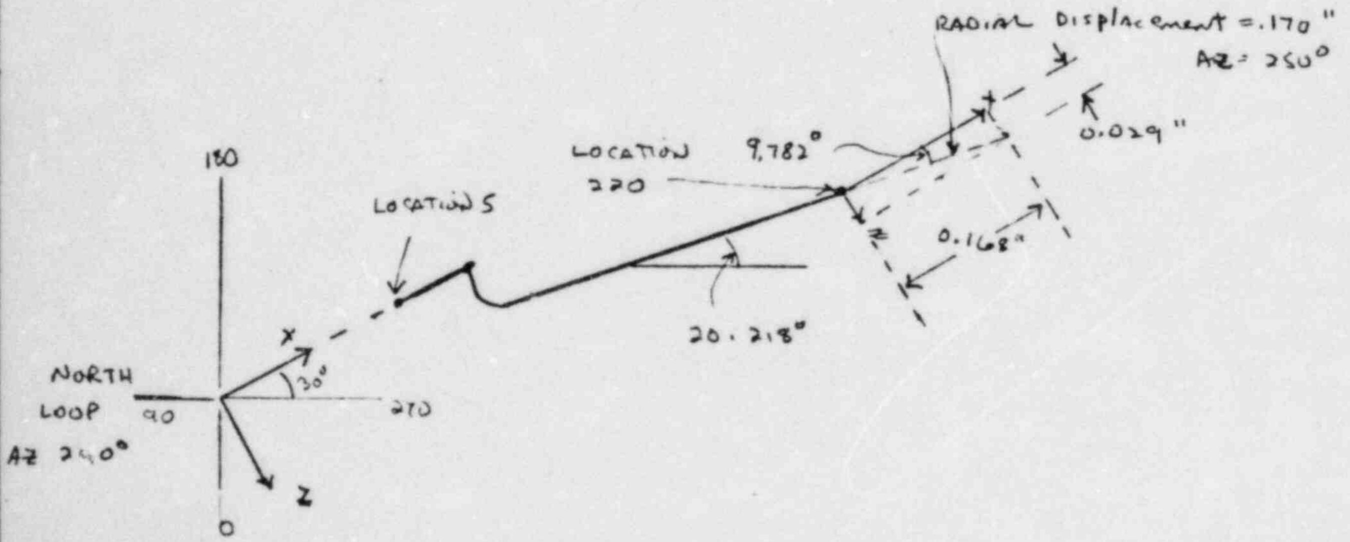
Title: Thermal Displacements Core Spray System	Calculated by: MJK	Date: 5/1/83
	Checked by: RJ	Date: 6-1-83
	Reviewed by: JJ	Date: 5-24-83
Project: SEP Piping 83-03		Page 6 of 6

ANCHOR MOVEMENT INPUT SUMMARY





ANCHOR DISPLACEMENTS USED IN COMPUTER ANALYSES

SOUTH LOOP

LOCATION	X	Y	Z
5	0.459	1.505	0.0
225	0.095	0.0	0.082

NORTH LOOP

LOCATION	X	Y	Z
5	0.459	1.585	0.0
220	0.168	0.0	0.029

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Title: RESPONSE SPECTRA	Calculated by: B. Tipford	Date: 2-25-83
	Checked by: M. J. Kennedy	Date: 2/25/83
	Reviewed by: J. Johnson	Date: 2-25-83

Project: SEP PIPING
83-03

PURPOSE

THE FOLLOWING CALCULATION DETERMINES THE RESPONSE SPECTRA INPUT FOR THE DESIGN BASIS EARTHQUAKE AND THE SAFE SHUTDOWN EARTHQUAKE (TWICE THE DESIGN BASIS EARTHQUAKE) FOR THE NORTH AND SOUTH LOOPS OF THE CORE SPRAY PIPING AT OYSTER CREEK.

Title: Response Spectra
Calculated by: BJ Date: 2-25-83
Checked by: MK Date: 2/25/83
Reviewed by: JJ Date: 2-25-83

Project: 83-03

METHOD OF ANALYSIS

RESPONSE SPECTRA WILL BE USED AS INPUT TO THE FINITE ELEMENT PROGRAM "PIPESD" TO ANALYZE EARTHQUAKE EFFECTS.

RESPONSE SPECTRA COME FROM REVISED APPENDIX B OF NUREG/CR-1981*. OYSTER CREEK SITE SPECIFIC SPECTRA ARE GENERATED USING THE NUREG/CR SPECTRA SCALED TO 0.165/0.22 (0.165 g's IS ZPA AT O.C. VS. 0.22 g's USED IN NUREG/CR, PER USNRC LETTER LS05-81-06-068 DATED 6/17/81)

RESPONSE SPECTRA IN REVISED APPENDIX B ARE FOR 2 TIMES THE DESIGN BASIS EARTHQUAKE.

* REVISED APPENDIX B RECEIVED 6/25/81, FROM LLL LETTER TO MPR (E. SCHMIDT) DATED 6/23/81, LETTER # SM-81-159.

METHODS OF ANALYSIS AND ASSUMPTIONS ARE LISTED BELOW:

- MODAL RESPONSES ARE SUMMED BY THE SQUARE ROOT OF THE SUM OF THE SQUARES METHOD EXCEPT THAT CLOSELY SPACE MODES ARE SUMMED ABSOLUTELY BY THE 10% RULE SPECIFIED IN REG. GUIDE 1.92

- THREE SPATIAL COMPONENTS OF SEISMIC INPUT WILL BE USED (2 HORIZONTAL AND A VERTICAL). THE MAXIMUM CODIRECTIONAL RESPONSES WILL BE COMBINED BY THE SQUARE ROOT OF THE SUM OF THE SQUARES METHOD AS DESCRIBED IN REG-GUIDE 1.92.

- DESIGN BASIS EARTHQUAKE DAMPING = 1.0%
  SAFE SHUTDOWN EARTHQUAKE DAMPING = 2.0% (2 X's DESIGN BASIS). BASED ON REG GUIDE 1.61

- AN UPPER BOUND ENVELOPE OF ALL INDIVIDUAL RESPONSE SPECTRA WILL BE USED BASED ON STANDARD REVIEW PLAN, SECTION 3.7.3. (NUREG-0800) ELEVATIONS VARY FROM ~92'-5" (SOUTH LOOP - SNUBBER NZ-3 S9) TO 46'-1" (NORTH LOOP - SNUBBER NZ-3 S2). ENVELOPED HORIZONTAL SPECTRA WILL BE FROM 38'-5" TO 95'-3".

- RESPONSE SPECTRA TAKEN FROM NUREG/CR-1981, USED TO ANALYZE THE SYSTEM PIPING, WILL COME FROM SPECTRA GENERATED FOR THE REACTOR BUILDING. THIS ASSUMPTION IS BASED ON THE FACT THAT STRUCTRUAL SUPPORT AND LATERAL BRACING BETWEEN THE REACTOR BUILDING AND THE PRIMARY SUPPORTS (DRYWELL, BIO-SHIELD, REACTOR VESSEL) WILL FORCE THE PRIMARY SUPPORT SYSTEMS TO MOVE WITH THE REACTOR BUILDING.

- RESPONSE SPECTRA FOR 1% AND 2% DAMPING WILL BE EXTRAPOLATED FROM THE SPECTRA PROVIDED IN NUREG/CR-1981.

- ANCHOR MOVEMENTS DURING EARTHQUAKE ANALYSIS ARE CONSIDERED NEGLIGIBLE. THIS ASSUMPTION IS BASED ON THE ANCHOR DISPLACEMENT EQUATION:

$$S_d = S_a \, g/\omega^2 \; *$$

S_d = DISPLACEMENTS
S_a = ZPA (g's)
g = ACCELERATION CONSTANT (386.4 in/sec²)
ω = NATURAL FREQUENCY OF PRIMARY SUPPORT STRUCTURE

* REFERENCE STANDARD REVIEW PLAN 3.7.3

Title: Response Spectra | Calculated by: BJ | Date: 2-25-83
Checked by: [illegible] | Date: 2/25/83
Reviewed by: [illegible] | Date: 2-25-83

Project: 83-03

FOR THE REACTOR VESSEL.

$T_n = 0.13$ sec

REF. - REPORT ON SEISMIC ANALYSIS OF THE R.V. FOR JCP&L "JOHN A. BLUME & ASSOCIATE ENG'S" 3/16/66.

$f_n = 1/T_n = 7.692$ cycles/sec

$\omega_n = 7.692 \text{ cycles/sec} \times 2\pi = 48.332$ rad/sec

$$S_a = \sqrt{S_{a_H}^2 + S_{a_H}^2 + S_{a_V}^2}$$

S_{aH} = HORIZONTAL ZPA 0.23 g's
S_{aV} = VERTICAL ZPA = 0.09 g's

S_a = .337 g's

$$S_d = \frac{0.337\,(386.4)}{(48.332)^2} = .06 \text{ in}$$

MPR ASSOCIATES, INC.

1050 Connecticut Ave., NW – Washington, DC 20036

Title: Response Spectra

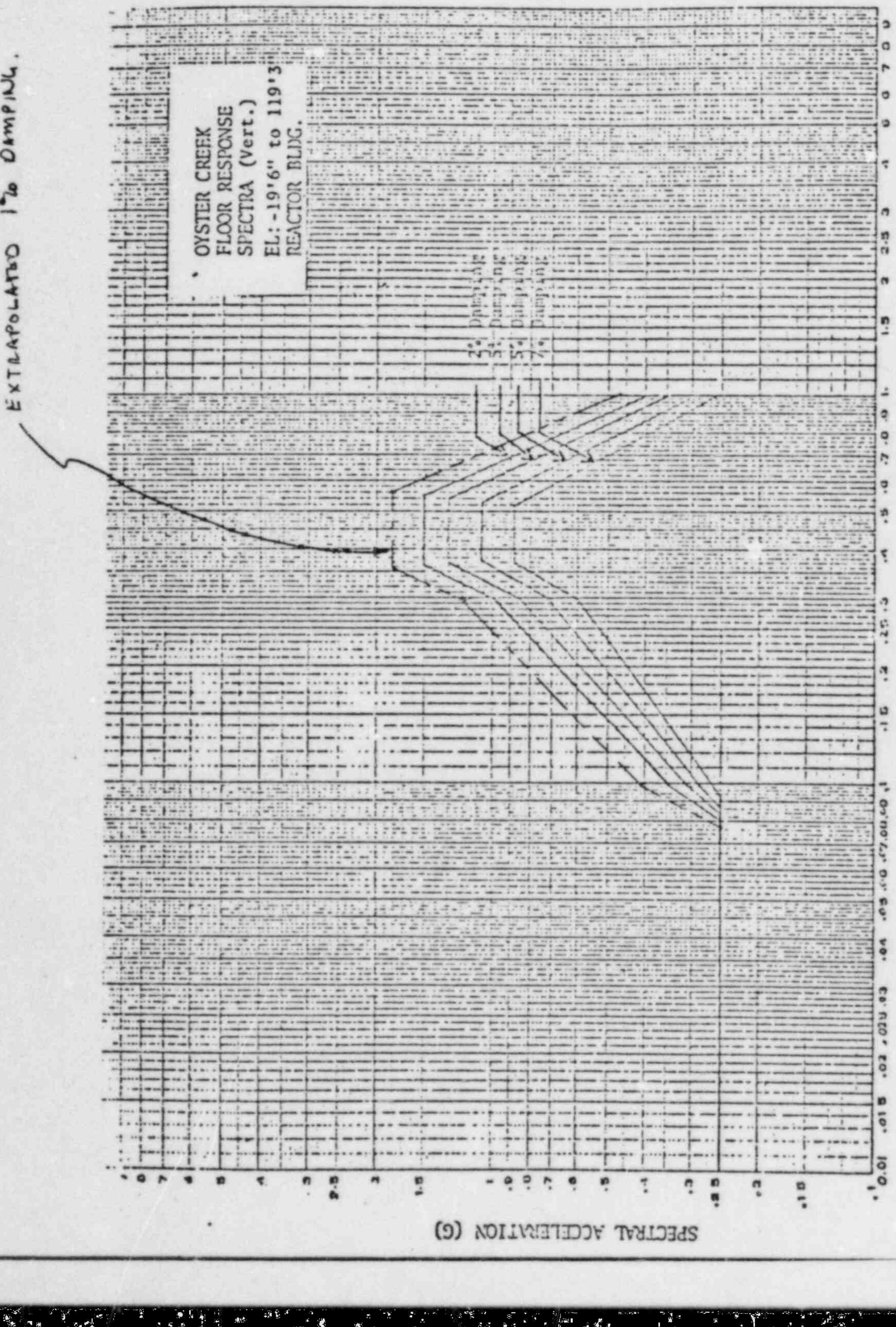
Calculated by: BJ Date: 2-25-83

Checked by: mjk Date: 2/25/83

Reviewed by: JJ Date: 2-25-83

Project: 83-03

VERTICAL RESPONSE – ELV. 19'-6" TO 119'-3"



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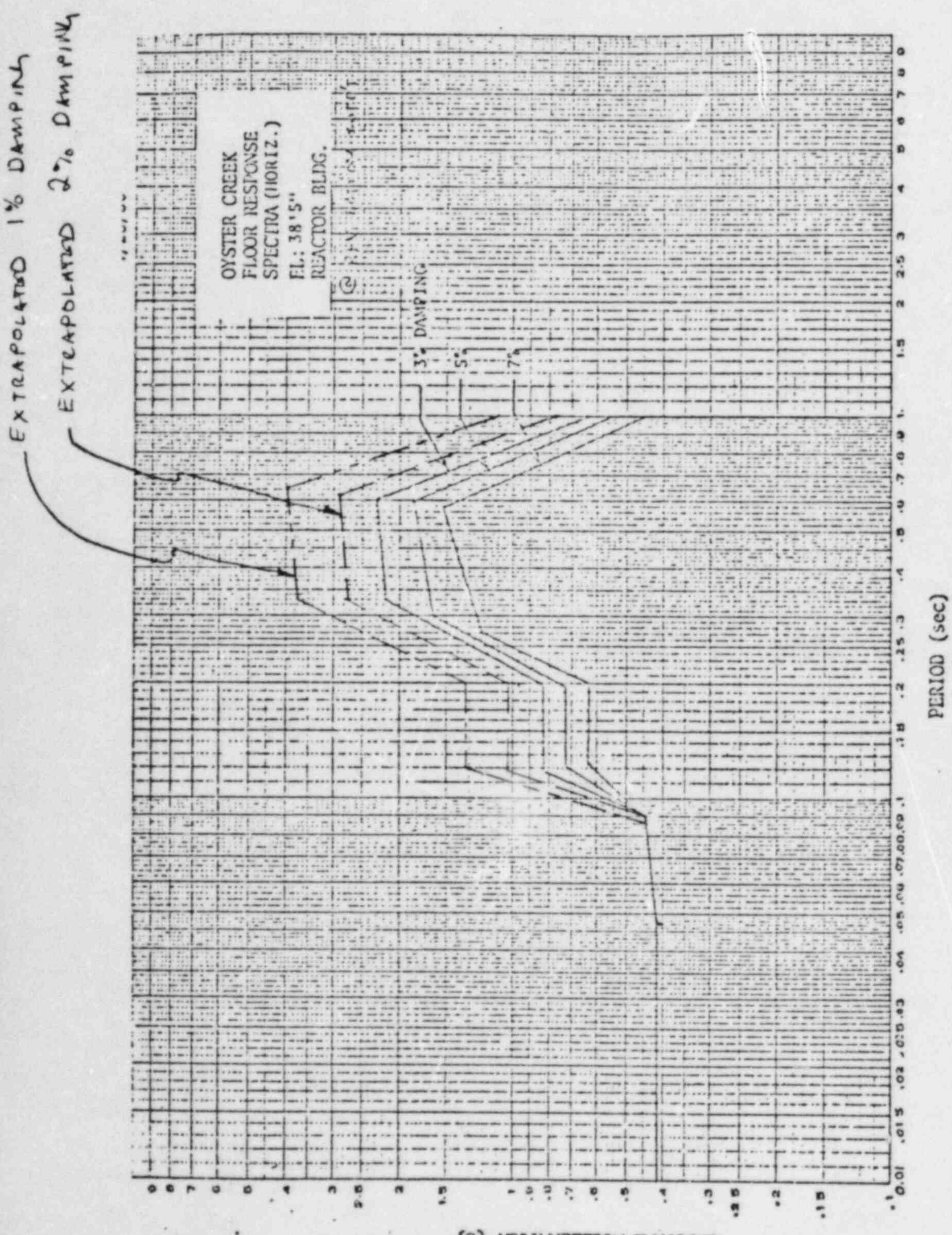
Title: Response Spectra	Calculated by: BY	Date: 2-25-83
	Checked by: WJK	Date: 2/25/83
	Reviewed by: JJ	Date: 2-25-83
Project: 83-03		Page 7 of 15

HORIZONTAL RESPONSE - ELV. 38'-5"



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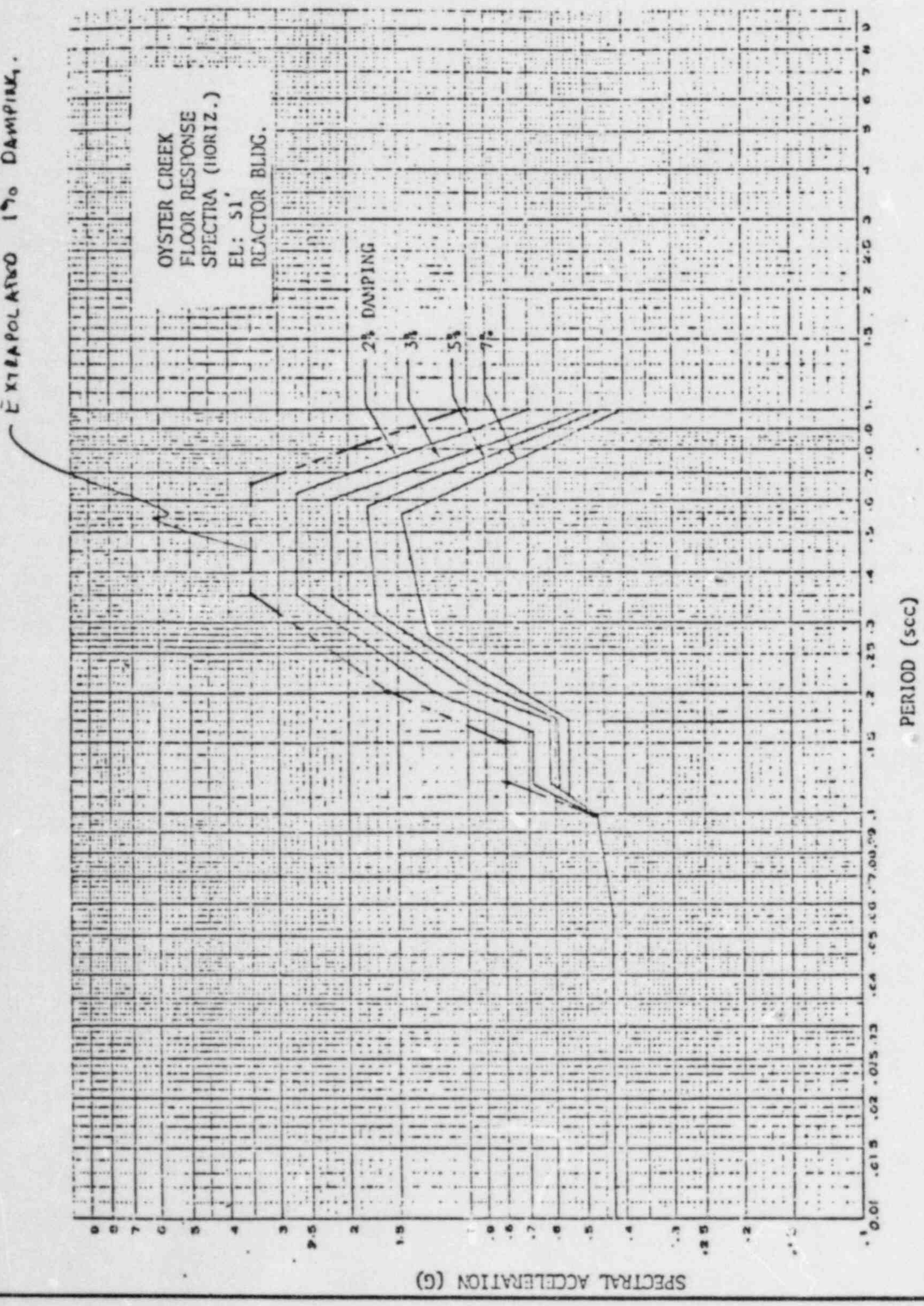
1050 Connecticut Ave., NW – Washington, DC 20036

Title: Response Spectra	Calculated by: BJ	Date: 2-25-83
	Checked by: MJK	Date: 2/25/83
	Reviewed by: TJ	Date: 2-25-83

Project: 83-03

HORIZONTAL RESPONSES – ELV. 51'



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Title: Response Spectra	Calculated by: BJ	Date: 2-25-83
	Checked by: MJK	Date: 2/25/83
	Reviewed by: JJ	Date: 2-25-83

Project: 83-03

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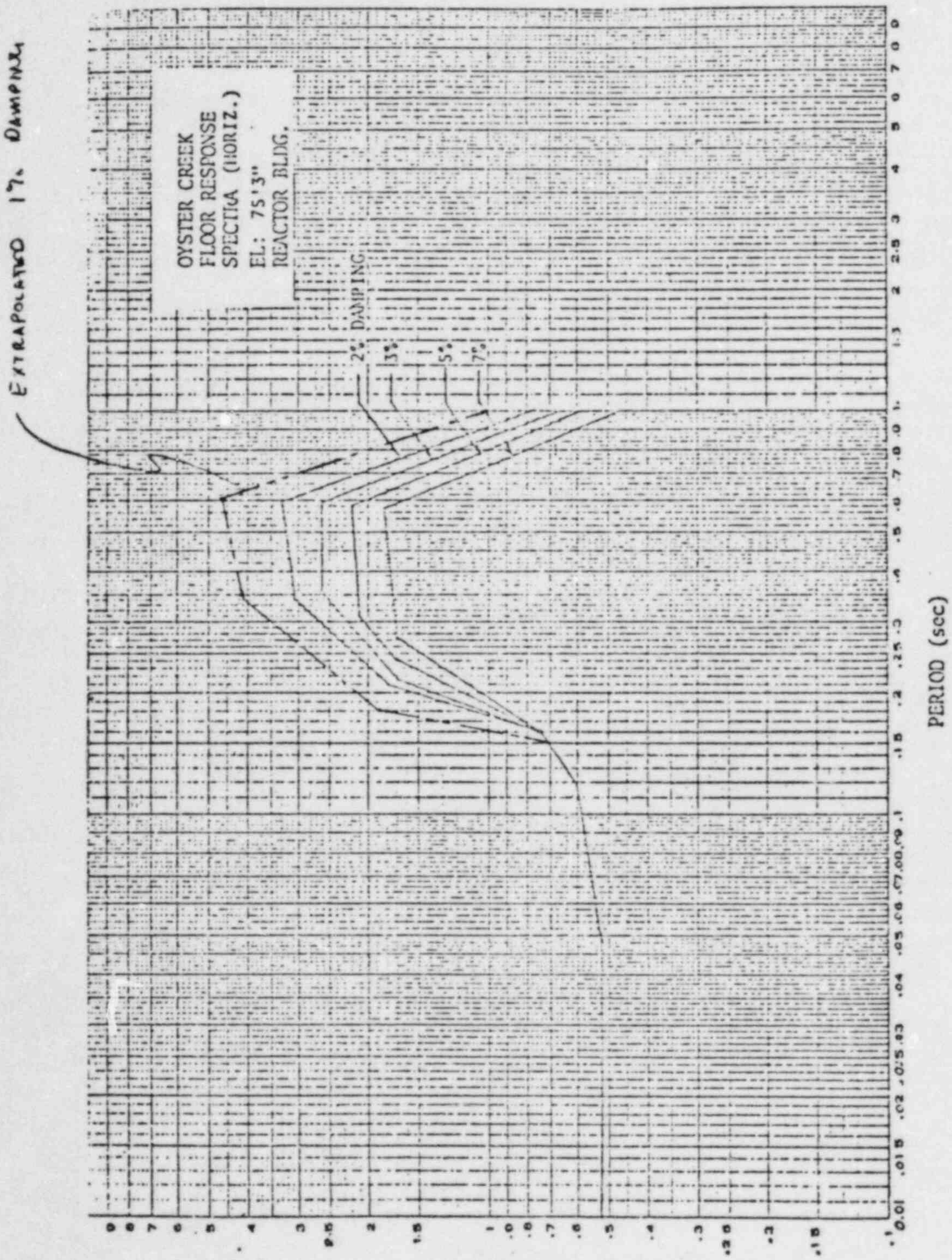
HORIZONTAL RESPONSE - ELV. 75'-3"



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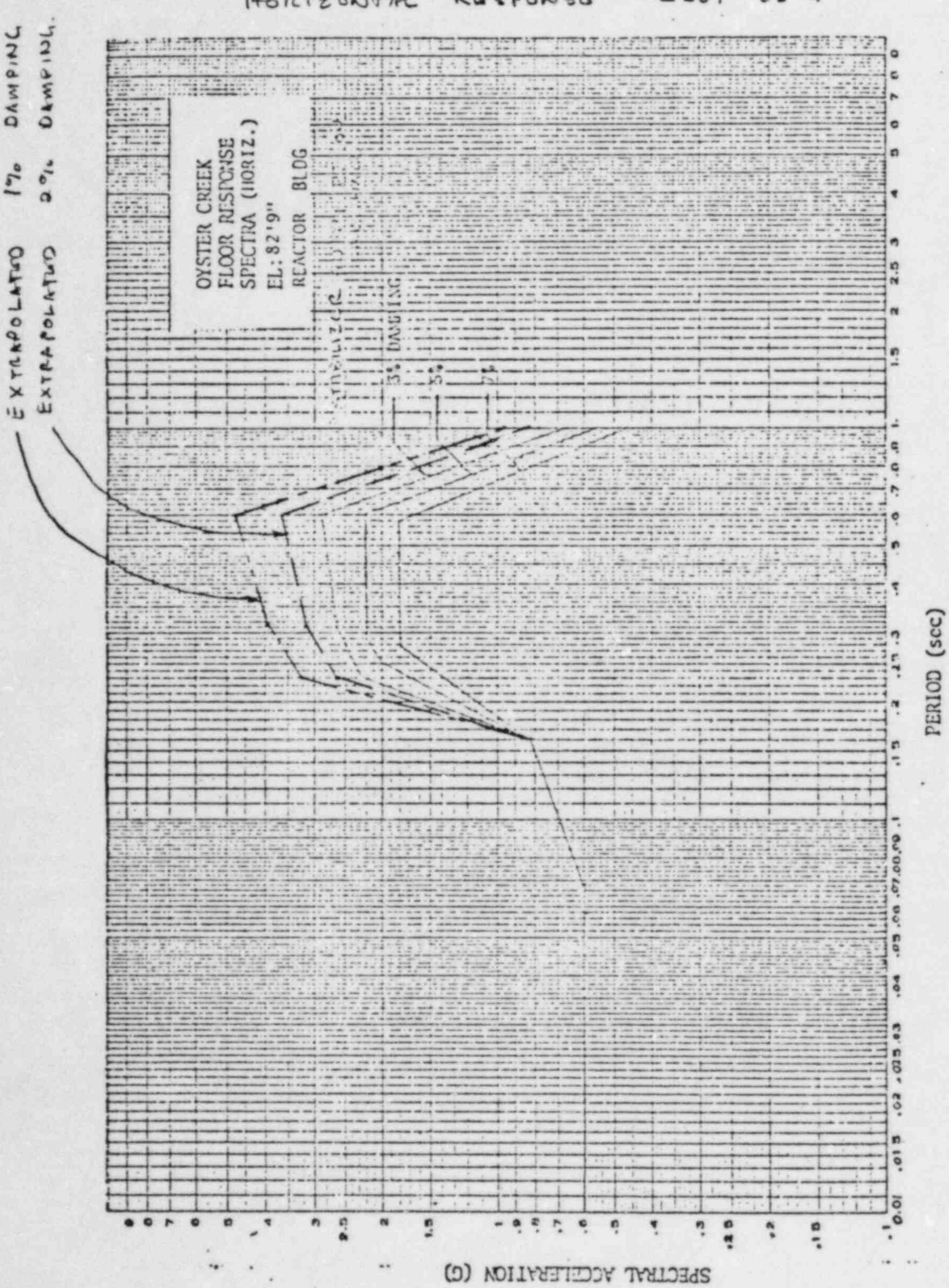
Title: Response Spectra	Calculated by: BY	Date: 2-25-83
	Checked by: [illegible]	Date: 2/25/83
	Reviewed by: JJ	Date: 2-25-83

Project: 83-03

HORIZONTAL RESPONSE - ELV. 82'9"



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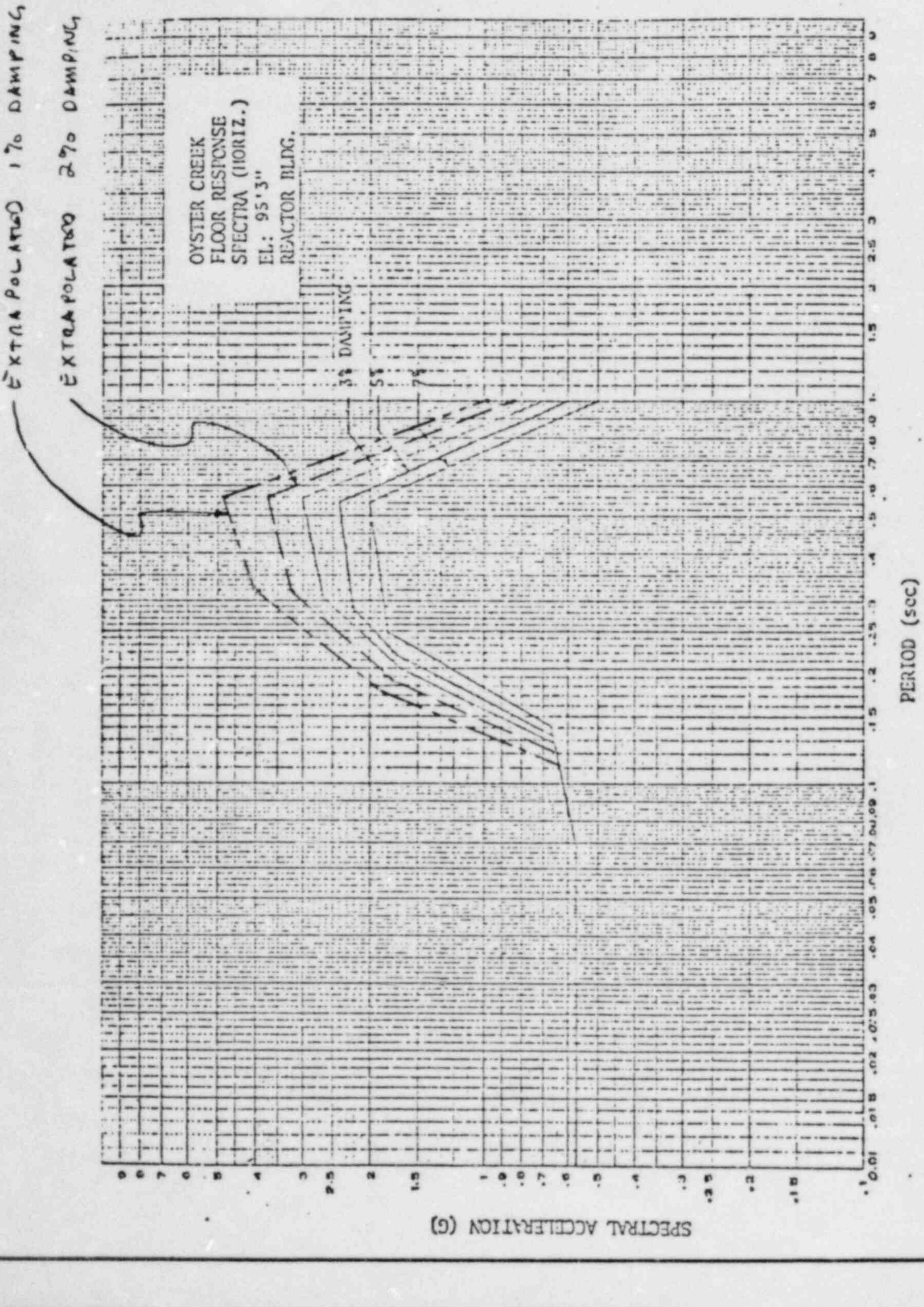
Title: Response Spectra	Calculated by: BJ	Date: 2-25-83
	Checked by: MJK	Date: 2/25/83
	Reviewed by: JJ	Date: 2-25-83
Project: 83-03		

HORIZONTAL RESPONSE - ELEV. 95'-3"

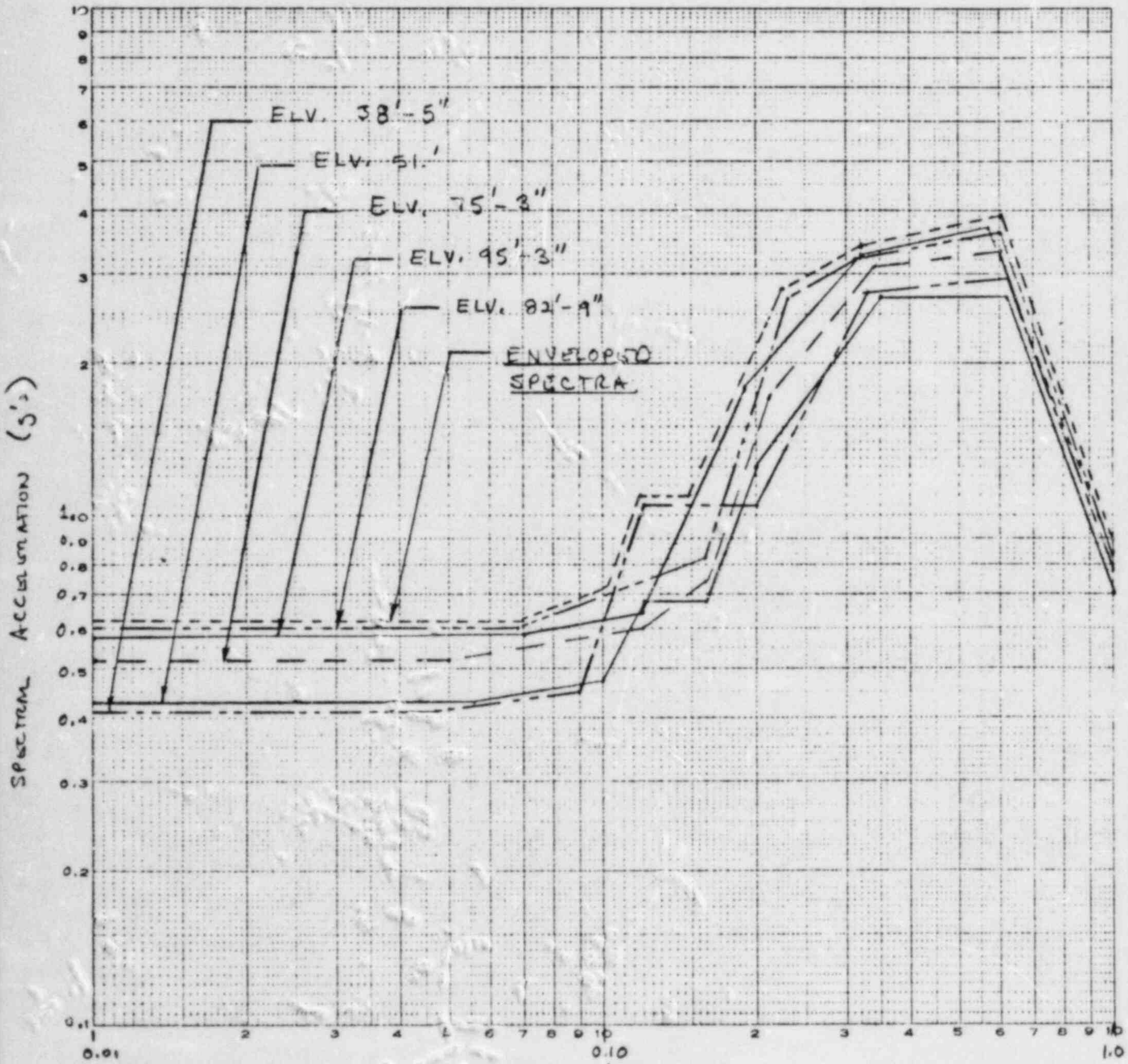


MPR ASSOCIATES, INC.
1050 Connecticut Ave., NW – Washington, DC 20036

Title: Response Spectra | Calculated by: BY | Date: 2-25-83
Checked by: MK | Date: 2/25/83
Reviewed by: JJ | Date: 2-25-83

Project: 83-03

ENVELOPE OF 2% DAMPING – ZPA = 0.22g's



MPR ASSOCIATES, INC.
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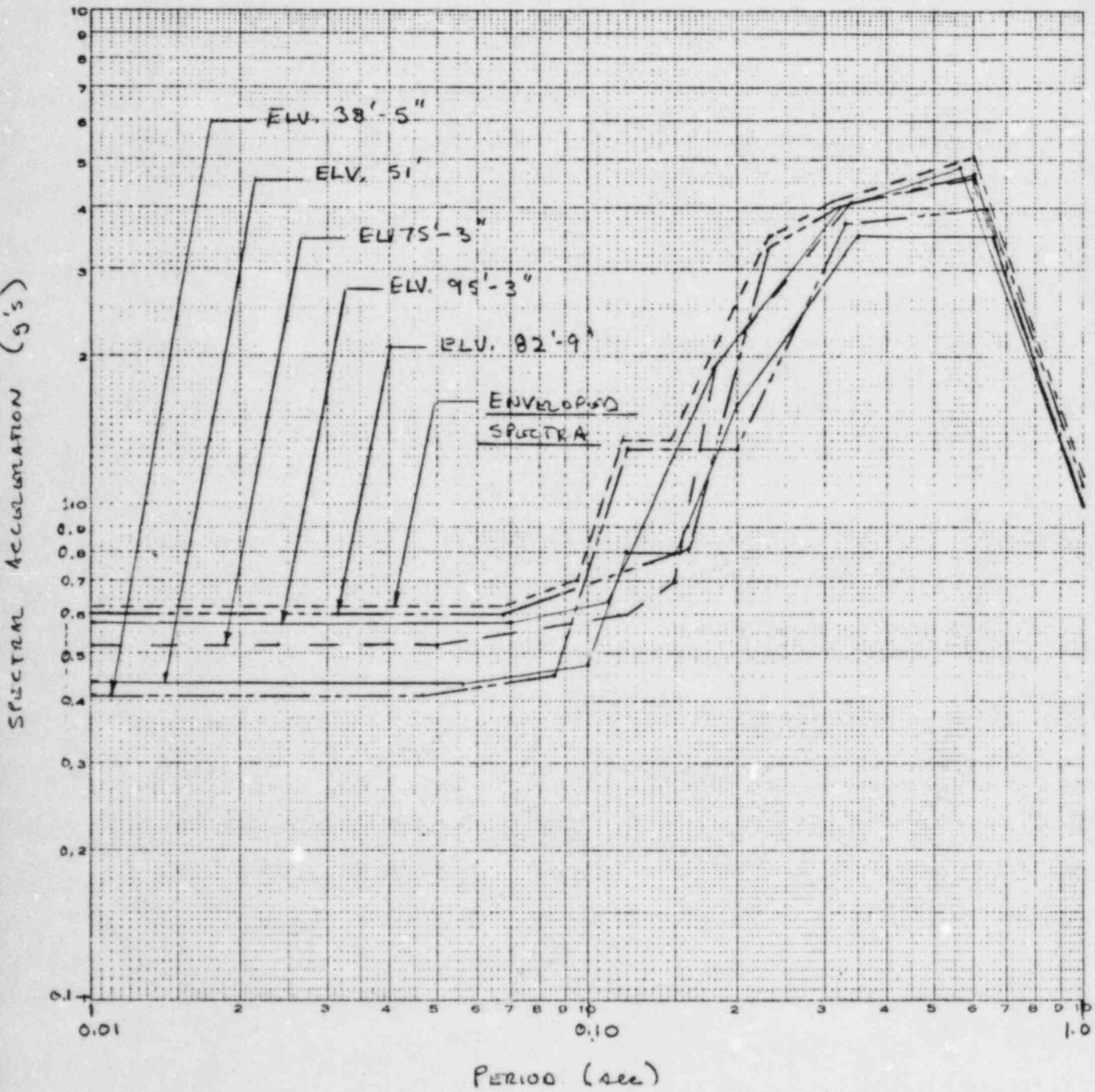
Title: Response Spectra
Calculated by: BG Date: 2-25-83
Checked by: MJK Date: 2/25/83
Reviewed by: JJ Date: 2-25-83

Project: 83-03

ENVELOPE OF 1% DAMPING – ZPA = 0.22g's



Title: Response Spectra | Calculated by: BY | Date: 2-25-83
Checked by: MJK | Date: 2/25/83
Reviewed by: JJ | Date: 2-25-83

Project: 83-03

HORIZONTAL SPECTRA

1% DAMPING - ZPA = 0.22 g's — SSE

PERIOD (sec)	g's
0.001	0.62
0.068	0.62
0.095	0.70
0.115	1.35
0.145	1.35
0.230	3.50
0.310	4.10
0.600	5.10
1.0	1.15

2% DAMPING - ZPA = 0.22 g's — SSE

PERIOD (sec)	g's
0.001	0.62
0.070	0.62
0.100	0.72
0.120	1.10
0.145	1.10
0.225	2.80
0.320	3.40
0.600	3.90
1.0	0.90

VERTICAL SPECTRA

1% DAMPING - ZPA = 0.22 g's — SSE

PERIOD (sec)	g's
0.001	0.25
0.076	0.25
0.100	0.41
0.300	1.20
0.350	1.80
0.560	1.80
1.0	0.47

2% DAMPING - ZPA = 0.22 g's — SSE

PERIOD (sec)	g's
0.001	0.25
0.076	0.25
0.100	0.35
0.300	1.00
0.360	1.50
0.550	1.50
1.0	0.40

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Title: Response Spectra
Calculated by: AJ Date: 2-25-83
Checked by: MJK Date: 2/25/83
Reviewed by: JJ Date: 2-25-83

Project: 83-03

OBE RESPONSE SPECTRA
1% DAMPING - FLOOR ZPA = 0.165 g's

HORIZONTAL SPECTRA

PERIOD (sec)	g's
0.001	0.23
0.068	0.23
0.095	0.26
0.115	0.51
0.145	0.51
0.230	1.31
0.310	1.54
0.600	1.91
1.0	0.43

VERTICAL SPECTRA

PERIOD (sec)	g's
0.001	0.09
0.076	0.09
0.100	0.15
0.300	0.45
0.350	0.68
0.560	0.68
1.0	0.18

SSE RESPONSE SPECTRA
2% DAMPING - FLOOR ZPA = 0.165 g's

HORIZONTAL SPECTRA

PERIOD (sec)	g's
0.001	0.47
0.070	0.47
0.100	0.54
0.120	0.83
0.145	0.83
0.225	2.10
0.320	2.55
0.600	2.93
1.0	0.68

VERTICAL SPECTRA

PERIOD (sec)	g's
0.001	0.19
0.076	0.19
0.100	0.26
0.300	0.75
0.360	1.13
0.550	1.13
1.0	0.30

PURPOSE

The following calculation documents the load cases analyzed to determine the seismic adequacy of the core spray system piping inside containment.

METHOD

Two computer analyses are required for each piping run. The first analysis determines the spring preload at operating thermal conditions. The second analysis evaluates the piping system to the 1980 Edition (up to and including Summer 1981 Addenda) of the ASME Code.

SPRING RELAXATION ANALYSES

SPRING PRELOAD AT OPERATING THERMAL CONDITIONS

The following tables document the spring preload at "cold" (70°F) conditions:

South Loop

SPRING LOCATION	SPRING TYPE	SPRING RATE (lb/in)	SPRING PRELOAD (lb.)	SPRING WORKING-RANGE (lb)
70	VS4O-7	43.8	538.0	332.0 - 539.0
105	VS4F-7	43.8	502.0	332.0 - 539.0
176	VS1F-14	1282.0	3261.0	2437.0 - 3960.0
205	VS1F-10	410.0	1251.0	780.0 - 1267.0

NORTH LOOP

SPRING LOCATION	SPRING TYPE	SPRING RATE (lb/in)	SPRING PRE-LOAD (lb)	SPRING WORKING-RANGE (lb)
140	VS1A-13	964.0	2602.0	1833.0 - 2978.0
440	VS1A-12	726.0	2102.0	1379.0 - 2240.0

Ref: B&R support dwgs.

Due to thermal expansion of the pipe and anchor displacements at operating conditions, the preload decreases as the pipe displaces. This relaxation is analyzed in computer runs CS1 and CS2. Microfiche of these runs are contained in Appendix F. The following tables document the relaxation of the spring preload due to the anchor displacements calculated in Appendix C and due to pipe thermal expansion from a reference temperature of 70°F to an operating temperature of 135°F.

Note: The cold load on spring hanger NZ-3 H8 (node 205) is above the working range of the spring by 4%. The hot load on spring hangers NZ-3 H3 (node 140) and NZ-3 H4 (node 440) is below the working range of the spring by 13% and 11%, respectively. These overload/underload conditions are considered acceptable because:

(a) There is no loss of function of the spring (i.e., maximum displacement out of the working range of the spring is 0.24 inches; permissible displacement out of the working range of the spring is 0.50 inches.)

(b) Stresses in the pipe are acceptable (i.e., within allowable values) for the lower spring hanger load.

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Title: Seismic Stress Analysis
Calculated by: [signature] Date: 6/1/83
Checked by: [signature] Date: 6-22-83
Reviewed by: [signature] Date: 6-?-83

Project: 83-03

South Loop

SPRING LOCATION	Cold Spring Preload (lb)	Cold Deadweight Spring Load (lb)	Hot Deadweight Spring Load (lb)	Operating Condition Relaxation (lb)	Operating Condition Preload (lb)	Working Range (lb)
70	538.0	537.9	470.8	-67.1	470.9	332-539
105	502.0	503.4	462.5	-41.0	461.0	332-539
176	3261.0	3360.3	2824.0	-536.3	2724.7	2437-3960
205	1251.0	1317.0	1201.7	-115.3	1135.7	780-1267

North Loop

SPRING LOCATION	Cold Spring Preload (lb)	Cold Deadweight Spring Load (lb)	Hot Deadweight Spring Load (lb)	Operating Condition Relaxation (lb)	Operating Condition Preload (lb)	Working Range (lb)
140	2602.0	2626.4	1598.3	-1028.0	1574.0	1833-2978
440	2102.0	2105.0	1140.1	-964.9	1137.1	1379-2240

The operating condition preload is the preload used in the deadweight run in the stress analyses.

Stress Analyses

Applicable Code Sections

ASME Boiler and Pressure Vessel Code, Section III

- Subsection NB (Class 1 Piping) for piping from the reactor vessel to the second isolation valve.

- Subsection NC (Class 2 piping) for piping from the second isolation valve.

In accordance with NB-3630, Class 1 piping may be analyzed in accordance with the Class 2 analysis of piping systems in Subsection NC, provided the following criteria are met:

NB-3630 (d) (2) (a) Atmospheric to Service Pressure Cycle

S_m @ 135° = 20.0 KSI

$S_a = 3 * S_m$ = 60.0 KSI

allowable number of cycles = 9000 {Ref: Tab I-9.1 ASME Code Appendices}

startup/shutdown cycles in 40 yrs ≈ 130 + 390 = 520] Assumed
130 startup/shutdown ; 390 scram to LP Hot Standby

NB-3630 (d) (2) (b) Normal Service Pressure Fluctuation

No specified pressure fluctuations

NB-3630 (d) (2) (c) Temperature Difference - Startup and Shutdown

$135^\circ - 70^\circ = 65^\circ$

S_a for 520 cycles = 121 KSI

$E = 28.125 \times 10^6$ PSI

$\alpha = 8.61 \times 10^{-6}$ in/in °F

$$\frac{S_a}{2E\alpha} = \frac{121\,000}{2(28.125\times10^6)(8.61\times10^{-6})} = 250 > 65$$

NB-3630 (d) (2) (d) Temperature Difference - Normal Service

No temperature change during normal service

NB-3630 (d) (2) (e) Temperature Difference - Dissimilar Materials

No dissimilar materials

Therefore, the entire piping system may be analyzed using Subsection NC rules.

Seismic analysis under Class NC rules is embodied in Article NC-3652.2

OCCASIONAL LOADS, Equation (9):

$$S_{OL} = \frac{P_{MAX} D_o}{4 t_N} + 0.75 i \left(\frac{M_A + M_B}{Z} \right)$$

where

P_{MAX} = peak pressure (psi)

D_o = outside diameter of pipe (in.)

t_N = nominal wall thickness (in.)

Z = section modulus of pipe (in^3)

i = stress intensification factor [NC-3672.2(b)]
The product of 0.75 i shall never be less than 1.0

M_A = resultant moment loading on cross section due to weight and other sustained loads (in. lb.)

M_B = resultant moment loading on cross section due to occasional loads including earthquake (in. lb.)

Allowable Limits for S_{OL} are given in Article

NC - 3611.2 Stress Limits :

(c) (2) Level B Service Limits (OBE)

$S_{OL} \leq 1.2\ S_h$

(c) (3) Level C Service Limits (SSE)

$S_{OL} \leq 1.8\ S_h$

where S_h = basic material allowable stress at maximum (hot) temperature (PSI)

The peak pressure load is 1250 psi from the reactor vessel to the check valves and 285 psi from the check valves to containment. Sustained load moments are the result of deadweight. Occasional load moments are determined by the response spectra method using the response spectra contained in Appendix D. The stress analysis results for the north and south loops are in computer runs CS3 and CS4. Microfiche of these runs are contained in Appendix F. The following tables summarize the stress analysis results at controlling locations. Table 1 gives the calculated stress by load component. Table 2 gives the calculated stress ratio for the two service limits. Table 3 gives the snubber loads during OBE and SSE.

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Title: SEISMIC STRESS ANALYSIS

Calculated by: [illegible] Date: 6/5/83
Checked by: CH Date: 6-20-83
Reviewed by: JT Date: 6-21-83

Project: 83-03

TABLE 1 STRESS ANALYSIS RESULTS

South Loop

LOCATION	PIPING COMPONENT	Pressure Stress (PSI)	DEADweight Stress (PSI)	OCCASIONAL LOAD STRESS (PSI)	
				OBE	SSE
15	SAFE END	[illegible]792	1050	4565	7680
25	Elbow	5391	1134	2102	3531
125	GAte VAlve	5391	1063	2006	3386
150	welded Tee	5391	307	2524	4305
155	check valve	5391	137	1946	3268

North Loop

LOCATION	PIPING COMPONENT	Pressure Stress (PSI)	Deadweight Stress (PSI)	OCCASIONAL LOAD Stress (PSI)	
				OBE	SSE
15	SAFE END	4792	6334	1501	2545
430	Elbow	5391	1152	2078	3416
125	GAte VAlve	5391	689	1074	1789
145	welded tee	5391	370	877	1448
155	check VAlve	5391	920	1282	2105

Title: Seismic Stress Analysis Calculated by: WJK Date: 6/5/83
Checked by: [illegible] Date: 6-20-83
Reviewed by: JJ Date: 6-?-83

Project: 83-03

TABLE 2 ASME Code Class 2 Analyses

South Loop

LOCATION	PIPING COMPONENT	EQUATION (9) STRESS RATIO[1]	
		OBE	SSE
15	SAFE END	0.46	0.40
25	ELBOW	0.38	0.30
125	GATE VALVE	0.38	0.29
150	WELDED TEE	0.36	0.30
155	CHECK VALVE	0.33	0.26

NORTH LOOP

LOCATION	PIPING COMPONENT	EQUATION (9) STRESS RATIO[1]	
		OBE	SSE
15	SAFE END	0.56	0.40
430	ELBOW	0.38	0.29
125	GATE VALVE	0.32	0.23
145	WELDED TEE	0.29	0.21
155	CHECK VALVE	0.34	0.25

1. Allowable Stress Ratio is 1.0.

TABLE 3 SUMMARY OF SNUBBER REACTION LOADS

South LOOP

SNUBBER DESIGNATION (NOTE 1)	OBE LOAD (KIPS)	SSE LOAD (KIPS)	RATED LOAD (KIPS)
NZ-3 S7	1.0	1.8	10.0
NZ-3 S8	0.7	1.3	10.0
NZ-3 S9	0.5	1.1	10.0

North LOOP

SNUBBER DESIGNATION (NOTE 1)	OBE LOAD (KIPS)	SSE LOAD (KIPS)	RATED LOAD (KIPS)
NZ-3 S2	1.7	2.8	10.0
NZ-3 S2	1.8	3.0	10.0
NZ-3 S3	0.9	1.4	10.0
NZ-3 S4	0.5	0.9	10.0

1. SNUBBER designations refer to GENERAL Physics Drawing JCP-19440, Sheets 10 AND 11, Rev. 3.

APPENDIX F

MICROFICHE COMPUTER OUTPUT

COMPUTER RUN	DESCRIPTION
CS1	Oyster Creek SEP Core Spray Piping - South Loop AZ-60, Operating Thermal Spring Relaxation MJK 6-1-83
CS2	Oyster Creek SEP Core Spray Piping - North Loop AZ-240, Operating Thermal Spring Relaxation MJK 6-1-83
CS3	Oyster Creek SEP Core Spray Piping - South Loop AZ-60, ASME Code, Class 2 Seismic Stress Analysis MJK 6-1-83
CS4	Oyster Creek SEP Core Spray Piping - North Loop AZ-240, ASME Code, Class 2 Seismic Stress Analysis MJK 6-1-83

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Title: COMPUTER PROGRAM DOCUMENTATION SHEET
Calculated by: ______ Date: ______
Checked by: ______ Date: ______
Reviewed by: ______ Date: ______

Project: ______

Page ______ of ______

PROGRAM: PIPE SD
REVISION: 6.2
RUN BANNER: O.C. SEP - CORE SPRAY PIPING South Loop AZ-60 OPERATING THERMAL SPRING RELAXATION
DATE: 6/10/83
INPUT PREPARED BY: MJ Kennedy
DATE: 6/10/83
INPUT CHECKED BY: B Tepford
DATE: 6/10/83
OUTPUT REVIEWED BY: J Johnson
DATE: 6-21-83

PROGRAM: PIPE SD
REVISION: 6.2
RUN BANNER: O.C. SEP - CORE SPRAY PIPING North Loop AZ-240 OPERATING THERMAL SPRING RELAXATION
DATE: 6/10/83
INPUT PREPARED BY: MJ Kennedy
DATE: 6/10/83
INPUT CHECKED BY: B Tepford
DATE: 6/10/83
OUTPUT REVIEWED BY: J Johnson
DATE: 6-21-83

PROGRAM: PIPESD
REVISION: 6.2
RUN BANNER: O.C. SEP - CORE SPRAY PIPING SOUTH LOOP AZ-60 ASME CODE, CLASS 2 SEISMIC STRESS ANALYSIS
DATE: 6/1/83
INPUT PREPARED BY: MJ Kennedy
DATE: 6/1/83
INPUT CHECKED BY: B Tepford
DATE: 6/1/83
OUTPUT REVIEWED BY: J Johnson
DATE: 6-21-83

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Title: COMPUTER PROGRAM DOCUMENTATION SHEET

Calculated by: ______ Date: ______
Checked by: ______ Date: ______
Reviewed by: ______ Date: ______

Project: ______

Page ______ of ______

PROGRAM: PIPESD REVISION: 6.2

RUN BANNER: O.C. SEP-CORE SPRAY PIPING NORTH LOOP AZ-240 ASME CODE, CLASS 2 SEISMIC STRESS ANALYSIS DATE: 6/1/83

INPUT PREPARED BY: M J Kennedy DATE: 6/1/83

INPUT CHECKED BY: B Tyford DATE: 6/1/83

OUTPUT REVIEWED BY: J Johnson DATE: 6-21-83

PROGRAM: ______ REVISION: ______

RUN BANNER: ______ DATE: ______

INPUT PREPARED BY: ______ DATE: ______

INPUT CHECKED BY: ______ DATE: ______

OUTPUT REVIEWED BY: ______ DATE: ______

PROGRAM: ______ REVISION: ______

RUN BANNER: ______ DATE: ______

INPUT PREPARED BY: ______ DATE: ______

INPUT CHECKED BY: ______ DATE: ______

OUTPUT REVIEWED BY: ______ DATE: ______