The Light company Houston Lighting & Power P.O. Box 1700 Houston, Texas 77001 (713) 228-9211

October 14, 1985
ST-HL-AE-1389
File No.: G9.17

Mr. George W. Knighton, Chief
Licensing Branch No. 3
Division of Licensing
U. S. Nuclear Regulatory Commission
Washington, DC 20555

South Texas Project
Units 1 and 2
Docket Nos. STN 50-498, STN 50-499
Responses to DSER/FSAR Items Regarding Section 3.6

Dear Mr. Knighton:

The attachments enclosed provide STP's response to Draft Safety Evaluation Report (DSER) or Final Safety Analysis Report (FSAR) items.

The item numbers listed below correspond to those assigned on STP's internal list of items for completion which includes open and confirmatory DSER items, STP FSAR open items and open NRC questions. This list was given to your Mr. N. Prasad Kadambi on October 8, 1985 by our Mr. M. E. Powell. Note that the item numbers ending with (P) are partial closure only.

The attachments include mark-ups of FSAR pages which will be incorporated in a future FSAR amendment unless otherwise noted below.

The items which are attached to this letter are:

Attachment	Item No.*	Subject
1	F 3.6-1, F 3.6-2 F 3.6-5 (P) F 3.6-7, F 3.6-8 F 3.6-10, F 3.6-22 (P), Q010.018-1	Section 3.6 Pipe Break Analysis Items

* Legend
D - DSER Open Item C - DSER Confirmatory Item
F - FSAR Open Item Q - FSAR Question Response Item

L1/DSER/L

B001 1/1

Attachment	Item No.*	Subject
1 (Cont'd)	Q210.020-1(P)	
	Q210.020-2(P)	
	Q231.004-1	
	Q410.005-1(P)	

If you should have any questions concerning this matter, please contact Mr. Powell at (713) 993-1328.

Very truly yours,

M. R. Wisenburg
Manager, Nuclear Licensing

CAA/bl

Attachments: See above

* Legend
D - DSER Open Item
F - FSAR Open Item
C - DSER Confirmatory Item
Q - FSAR Question Response Item

L1/DSER/L

cc:

Hugh L. Thompson, Jr., Director
Division of Licensing
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Robert D. Martin
Regional Administrator, Region IV
Nuclear Regulatory Commission
611 Ryan Plaza Drive, Suite 1000
Arlington, TX 76011

*N. Prasad Kadambi, Project Manager
U.S. Nuclear Regulatory Commission
7920 Norfolk Avenue
Bethesda, MD 20814

Claude E. Johnson
Senior Resident Inspector/STP
c/o U.S. Nuclear Regulatory
Commission
P.O. Box 910
Bay City, TX 77414

M.D. Schwarz, Jr., Esquire
Baker & Botts
One Shell Plaza
Houston, TX 77002

J.R. Newman, Esquire
Newman & Holtzinger, P.C.
1615 L Street, N.W.
Washington, DC 20036

Director, Office of Inspection
and Enforcement
U.S. Nuclear Regulatory Commission
Washington, DC 20555

E.R. Brooks/R.L. Range
Central Power & Light Company
P.O. Box 2121
Corpus Christi, TX 78403

H.L. Peterson/G. Pokorny
City of Austin
P.O. Box 1088
Austin, TX 78767

J.B. Poston/A. vonRosenberg
City Public Service Board
P.O. Box 1771
San Antonio, TX 78296

Brian E. Berwick, Esquire
Assistant Attorney General for
the State of Texas
P.O. Box 12548, Capitol Station
Austin, TX 78711

Lanny A. Sinkin
3022 Porter Street, N.W. #304
Washington, DC 20008

Oreste R. Pirfo, Esquire
Hearing Attorney
Office of the Executive Legal Director
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Charles Bechhoefer, Esquire
Chairman, Atomic Safety &
Licensing Board
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Dr. James C. Lamb, III
313 Woodhaven Road
Chapel Hill, NC 27514

Judge Frederick J. Shon
Atomic Safety and Licensing Board
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Mr. Ray Goldstein, Esquire
1001 Vaughn Building
807 Brazos
Austin, TX 78701

Citizens for Equitable Utilities, Inc.
c/o Ms. Peggy Buchorn
Route 1, Box 1684
Brazoria, TX 77422

*Docketing & Service Section
Office of the Secretary
U.S. Nuclear Regulatory Commission
Washington, DC 20555
(3 Copies)

Advisory Committee on Reactor Safeguards
U.S. Nuclear Regulatory Commission
1717 H Street
Washington, DC 20555

Revised 9/25/85

Note: All copies without drawings except as noted (*).
L1/DSER/L

Attachment I

3.6 PROTECTION AGAINST THE DYNAMIC EFFECTS ASSOCIATED WITH THE POSTULATED RUPTURE OF PIPING

Pipe failure protection is provided in accordance with the requirements of 10 CFR 50, Appendix A, General Design Criterion (GDC) 4.

In the event of a high- or moderate-energy pipe failure within the plant, adequate protection is provided to ensure that the essential structures, systems, or components are not adversely impacted by the effects of postulated piping failure. Essential systems and components are those required to shut down the reactor and mitigate the consequences of the postulated piping failure. ~~Appendix (LATER)~~ Table 3.6.2-2 provides several examples of the evaluations made of the effects of postulated high energy pipe failures within the plant. The following sections provide the basis for selection of the pipe failures, the determination of the resultant effects, and details of the protection requirements.

3.6.1 Postulated Piping Failures in Fluid Systems Inside and Outside Containment

Table 3.6.1-1 provides a matrix of plant systems that indicates their classification: high-energy, moderate-energy, essential, or nonessential. Selection of pipe failure locations and evaluation of the consequences on nearby essential systems, components, and structures are presented in Section 3.6.2 and are in accordance with the requirements of 10CFR50, Appendix A, GDC 4. Except for the reactor coolant loop (RCL), selections and evaluations are in accordance with the guidance of Nuclear Regulatory Commission (NRC) Branch Technical Positions (BTP) ASB3-1 and MEB 3-1 (including RG 1.46). For the RCL, Reference 1 provides the basis for the selection and evaluation of pipe breaks. 40

3.6.1.1 Design Bases. The following design bases relate to the evaluation of the effects of the pipe failures determined in Section 3.6.2.

1. The selection of the failure type is based on whether the system is high- or moderate-energy during normal operating conditions of the system.

   High-energy piping includes those systems or portions of systems in which the maximum normal operating temperature exceeds 200°F or the maximum normal operating pressure exceeds 275 psig.

   Piping systems or portions of systems pressurized above atmospheric pressure during normal plant conditions and not identified as high-energy are considered moderate-energy.

   Piping systems that exceed 200°F or 275 psig for about 2 percent or less of the time the system is in operation or that experience high-energy pressures or temperatures for less than 1 percent of the plant operation time are considered moderate-energy.

In general, whipping ends from a pipe break are restrained so that plastic hinge formation is not allowed to occur. Where a plastic hinge could be formed, the effects are evaluated. Pipe whip restraints are provided wherever postulated pipe breaks could impair the ability of any essential system or component to perform its intended safety functions listed in Section 3.6.1.1.

11. The calculation of thrust and jet impingement forces considers any line restrictions (e.g., flow limiter) between the pressure source and break location and the absence of energy reservoirs, as applicable.

12. Initial pipe break events were not assumed to occur in pump and valve bodies because of their greater wall thickness and their usual location in the low stress portions of the piping systems.

13. Where a system consisting of piping, restraints, and supporting structures is so complex that the assumption of planar motion is neither conservative nor realistic, the zone of whip influence is conservatively enlarged to a region approaching a sphere with a radius equal to the distance between the breakpoint and the first restraint. In lieu of this assumption a more detailed elastoplastic analysis is performed. 40

14. No loss of pressure boundary integrity is assumed from jet impingement, regardless of pressure, when the ruptured pipe has a diameter and wall thickness less than those of the impinged piping. For essential piping, jet impingement loads are evaluated regardless of the ratio of impinged and postulated broken pipe sizes. 50 Q210 23N

3.6.1.2 Description. Systems, components, and equipment required to perform the essential functions are reviewed to ensure conformance with the design bases and to determine their susceptibility to the failure effects. The break and crack locations are determined in accordance with Section 3.6.2. Figure 3.6.1-1 shows the high-energy pipe break locations, break types, and preliminary restraint locations.

A design comparison to NRC BTP ASB 3-1 and MEB 3-1 is provided in Tables 3.6.1-2 and 3.6.1-3. → 3.6A

Pressure response analyses are performed for subcompartments containing high-energy piping. For a detailed discussion of the pipe breaks selected and pressure results, refer to Section 6.2.1 for selected subcompartments inside the Containment and to Appendix ~~(LATER)~~ for selected subcompartments outside the Containment. Effects of both internal reactor pressure vessel asymmetric pressurization loads and asymmetric compartment pressurization loads inside Containment are addressed in Section 6.2.1. The analytical methods used for pressure response analysis are in accordance with Reference 3.6-2.

~~Appendix (LATER) provides a typical hazards analysis for the effects of postulated pipe breaks on essential systems, components, and structures.~~

There are no high-energy lines in the proximity of the control room; therefore, there are no effects upon the habitability of the control room resulting from postulated pipe breaks. Further discussion of the control room habitability systems is provided in Section 6.4.

4. Individual cracks are not required to be postulated at specific locations determined by stress analyses when a review of the piping layout and plant arrangement drawings shows that the effects of through-wall leakage cracks are isolated or physically remote from structures, systems, and components required for safe shutdown.

5. Through-wall leakage cracks are postulated in non-seismic Category I piping at welded points where the effects might compromise essential equipment or structures. 40 Q110.09

To simplify analysis, cracks may be postulated to occur everywhere in moderate-energy piping, regardless of the stress analysis results to determine the maximum damage from fluid spraying and flooding, with the consequent hazards or environmental conditions. Flooding effects are determined on the basis of 30-min operator time required to effect corrective actions. Further discussion of internal flooding effects is ~~provided in Appendix (LATER)~~ discussed in FSAR Section 3.4.3 and 3.4.4.

Cracks in moderate energy ASME Code Class 1 piping are not postulated since there are no ASME Class 1 moderate energy systems. All the ASME Class 1 piping systems are inside the Containment Building and are high energy. 50 Q210.36N Q110.10

3.6.2.1.3 Types of Breaks/Cracks Postulated:

3.6.2.1.3.1 ASME Section III, Class 1 RCL Piping - High-Energy - The types of breaks postulated in the ASME Section III, Class 1 primary RCL are discussed in Ref. 3.6-1.

3.6.2.1.3.2 Piping Other than RCL Piping - High-Energy - The following types of breaks are postulated to occur at the locations determined in accordance with Section 3.6.2.1.1.

1. In piping whose nominal diameter is greater than or equal to 4 in., both circumferential and longitudinal breaks are postulated at each selected break location unless eliminated by comparison of longitudinal and axial stresses with the maximum stress as follows: 40

   a. If the maximum stress range exceeds the limits specified in Sections 3.6.2.1.1.1.b.2 and 3.6.2.1.1.2.b but the circumferential stress range is at least 1.5 times the axial stress range, only a longitudinal break is postulated. 49

   b. If the maximum stress range exceeds the limits specified in Sections 3.6.2.1.1.1.b.2 and 3.6.2.1.1.2.b but the axial stress is at least 1.5 times the circumferential stress range, only a circumferential break is postulated. 49

   Longitudinal breaks however, are not postulated at the following locations:

   a. Terminal ends.

   b. Intermediate points of Class 1 piping systems where the stress range as calculated by equations (10) and either (12) or (13) does not exceed 2.4 S_m as described in paragraph NB-3653 of the ASME B&PV

are given in Table 3.6.2-1. The final summary stress analysis results (as-built condition) will be provided upon their completion. Associated stress nodes are shown in Figure 3.6.1-1. High-energy pipe break effects analysis for a selected portion of the plant are discussed ~~room-by-room~~ in Table 3.6.2-2. Table 3.6.2-2 also references the appropriate sheet of applicable high-energy lines shown in Figure 3.6.1-1.

Moderate-energy piping crack locations are defined in Section 3.6.2.1.2.4. Evaluation of the effects of moderate-energy cracks is discussed in ~~appendix (LATER)~~ FSAR Section 3.4.3 and 3.4.4.

The augmented inservice inspection plan is discussed in Section 6.6.

Pipe whip restraints are designed in accordance with Section 3.6.2.3. Pipe whip restraint location and orientation for each high-energy break are shown in Figure 3.6.1-1. Barriers and shields are designed in accordance with the criteria of Section 3.6.2.4. Jet thrust and impingement forces were determined in accordance with Ref. 3.6-5. Reaction forces for each pipe whip restraint are presented in Figure 3.6.1-1.

3.6.2.5.2 Reactor Coolant Loop:

1. Table 3.6.2-3 and Figure 3.6.2-2 identify the design basis break locations and orientations for the RCLs.

   The primary and secondary stress intensity ranges and the fatigue cumulative usage factors at the design break locations specified in Ref. 3.6-1 are given in Table 3.6.2-4 for a reference fatigue analysis. The reference analysis has been prepared to be applicable for many plants. It uses seismic umbrella moments higher than those used in Ref. 3.6-1: in Ref. 3.6-1, one location was at the limit, but in the Reference analysis the primary stress is equal to the limits of equation (9) in NB-3650 (Section III of the ASME B&PV Code) at many locations in the system. Therefore, the results of the reference analysis may differ slightly from Ref. 3.6-1, but the philosophy and conclusions of Ref. 3.6-6 are valid. Consistent with Ref. 3.6-1, there are no other locations in the model used in reference fatigue analysis where the stress intensity ranges and/or usage factors exceed the criteria of 2.4 S_m and 0.2, respectively. 40Q 10. 04

   Actual plant moments for STP are also given in Table 3.6.2-4 at the design basis break locations so that the reference fatigue analysis can be shown to be applicable for this plant. Since actual plant moments are shown to be no greater than those used in the reference analysis, it follows that the stress intensity ranges and usage factors for STP are less than those for comparable locations in the reference model. Thus, it is shown that there are no locations other than those identified in Ref. 3.6-1 where the stress intensity ranges and/or usage factors for STP exceed the criteria of 2.4 S_m and 0.2, respectively. Thus, the applicability of Ref. 3.6-1 to STP is verified.

2. Pipe whip restraints associated with the main RCL are described in Section 5.4.14. Loading combinations and stress limits are discussed in Section 3.9.1.

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3. The results of evaluating jet impingement loads associated with the rupture of the main RCL piping are provided in Appendix (later). As described in item 4 below, these loads are used to determine the adequacy of the primary equipment and supports. 40 Q10.04

4. Design loading combinations and applicable criteria for ASME Class 1 components and supports are provided in Section 3.9. Pipe rupture loads include not only the jet thrust forces acting on the piping but also jet impingement loads on the primary equipment supports.

As discussed in response to Question 210.20N, STP has submitted a request to the NRC for exemption to General Design Criterion 4 in order to delete postulation of RCL pipe breaks based on the "Leak Before Break" analyses. Therefore, jet impingement loads associated with the ~~rupt~~ rupture of the main RCL piping are no longer considered in the plant design. However, primary component supports have been designed to withstand the structural loads associated with non-mechanistic Reactor coolant pipe breaks at the locations described in Reference 3.6-1.

TABLE 3.6.1-1

ESSENTIAL, HIGH ENERGY, AND MODERATE - ENERGY SYSTEMS

SYSTEM	ESSENTIAL SYSTEMS[(a)]	HIGH ENERGY[(b)]	MODERATE ENERGY[(c)]
Reactor Coolant System	X	X	
Main Steam System	X	X	
Main Feedwater System	X	X	
Auxiliary Feedwater System	X	X	X
Steam Generator Blowdown System	X	X	X
Auxiliary Steam System		X	
Chemical and Volume Control System	X	X	X
Residual Heat Removal System	X		X
Safety Injection System	X	X	X
Extraction Steam System		X	
Heater Drips System		X	
Turbine Bypass System		X	
Turbine Gland Sealing System		X	
Compressed Air System for Diesel			X
Generator Starting System			X
Containment Systems including:			
Containment Vessel	X		
Containment Penetrations	X		
Containment Isolation Valves	X		
Containment Sump	X		
Reactor Containment Fan Coolers	X		X
Containment Hydrogen Removal System	X		X
Containment Purge System	X		X

40

a. Not all essential systems are required for all postulated piping failures; e.g., the containment spray system is essential for loss-of-coolant accident and main steam line break inside containment but is nonessential for piping failure outside containment. Not all portions of essential systems are required for postulated piping failure; e.g., the main steam system is only essential from the steam generator to the main steam isolation valves, including the safety and atmospheric steam relief valves.

b. Not all portions of high-energy systems contain high-energy fluid.

c. During the initial phase of cooldown, the residual heat removal system is a high-energy system. For interaction with the redundant train, the residual heat removal system is considered a dual-purpose, moderate-energy system. (See Section 3.6.1.1(7))

TABLE 3.6.2-1 (Continued)

HIGH-ENERGY PIPE BREAK INITIAL STRESS SUMMARY RESULTS

System: Auxiliary Feedwater (Inside Containment)

Problem No.: AF-01
Revision: 0

FSAR Figure: Figure 3.6.1-1 (Sheet 3A)

NODE	TOTAL STRESS (psi)	RATIO(1)	LOCATION	TYPE OF POSTULATED BREAKS(2)
5	13616	0.420	S/G Nozzle	TE/C
125	15469	0.477	Containment Penetration (M94)	TE/C
61	22355	0.690	Elbow	(3)

(1) Ratio = Total stress/stress limit = $\frac{\text{Total Stress}}{.8\ (1.2\ S_h + S_A)} = \frac{\text{Total Stress}}{32{,}400\ \text{psi}}$

(2) TE = Terminal End   C = Circumferential

IM = Intermediate   L = Longitudinal

(3) Highest Relative Stress Point: No break postulated

TABLE 3.6.2-1 (Continued)

HIGH-ENERGY PIPE BREAK INITIAL STRESS SUMMARY RESULTS

System: Auxiliary Feedwater (Inside Containment)

Problem No.: AF-02
Revision: 0

FSAR Figure: Figure 3.6.1-1 (Sheet 3B)

NODE	TOTAL STRESS (psi)	RATIO(1)	LOCATION	TYPE OF POSTULATED BREAKS(2)
61	17078	0.527	S/G Nozzle	TE/C
3	14387	0.444	Containment Penetration (M-95)	TE/C
59	20014	0.618	Elbow	(3)

(1) Ratio = Total stress/stress limit = $\frac{\text{Total Stress}}{.8\ (1.2\ S_h + S_A)} = \frac{\text{Total Stress}}{32{,}400\ \text{psi}}$

(2) TE = Terminal End C = Circumferential

IM = Intermediate L = Longitudinal

(3) Highest Relative Stress Point: No break postulated

TABLE 3.6.2-1 (Continued)

HIGH-ENERGY PIPE BREAK INITIAL STRESS SUMMARY RESULTS

System: Auxiliary Feedwater (Inside Containment)

Problem No.: AF-03
Revision: 0

FSAR Figure: Figure 3.6.1-1 (Sheet 3C)

NODE	TOTAL STRESS (psi)	RATIO(1)	LOCATION	TYPE OF POSTULATED BREAKS(2)
40	20261	0.625	S/G Nozzle	TE/C
M84	20790	0.642	Containment Penetration (M-84)	TE/C
C58	23384	0.722	Elbow	(3)

(1) Ratio = Total stress/stress limit = $\frac{\text{Total Stress}}{.8\ (1.2\ S_h + S_A)} = \frac{\text{Total Stress}}{32{,}400\ \text{psi}}$

(2) TE = Terminal End   C = Circumferential

IM = Intermediate   L = Longitudinal

(3) Highest Relative Stress Point: No break postulated

TABLE 3.6.2-1 (Continued)

HIGH-ENERGY PIPE BREAK INITIAL STRESS SUMMARY RESULTS

System: Auxiliary Feedwater (Inside Containment)

Problem No.: AF-04
Revision: 0

FSAR Figure: Figure 3.6.1-1 (Sheet 3D)

NODE	TOTAL STRESS (psi)	RATIO(1)	LOCATION	TYPE OF POSTULATED BREAKS(2)
5	26989	0.833	S/G Nozzle	TE/C
150	10193	0.314	Containment Penetration (M-83)	TE/C
10	26435	0.816	Elbow	(3)

(1) Ratio = Total stress/stress limit = $\frac{\text{Total Stress}}{.8\ (1.2\ S_h + S_A)} = \frac{\text{Total Stress}}{32{,}400\ \text{psi}}$

(2) TE = Terminal End C = Circumferential
IM = Intermediate L = Longitudinal

(3) Highest Relative Stress Point: No break postulated

TABLE 3.6.2-1 (Continued)

HIGH-ENERGY PIPE BREAK INITIAL STRESS SUMMARY RESULTS

System: Auxiliary Feedwater (Outside Containment)

Problem No.: AF-11
Revision: 0

FSAR Figure: Figure 3.6.1-1 (Sheet 4A)

NODE	TOTAL STRESS (psi)	RATIO (1)	LOCATION	TYPE OF POSTULATED BREAKS (2)
10	8716	0.269	Containment Penetration (M-94)	TE/C
115	10762	0.332	Normally closed valve	TE/C
315	14334	0.442	Normally closed valve	TE/C
773	19856	0.613	18" FW Header Nozzle	TE/C
755	13406	0.414	Normally closed valve	TE/C
55	23075	0.712	Elbow	(3)

(1) Ratio = Total stress/stress limit = $\frac{\text{Total Stress}}{.8\ (1.2\ S_h + S_A)} = \frac{\text{Total Stress}}{32{,}400\ \text{psi}}$

(2) TE = Terminal End   C = Circumferential

IM = Intermediate   L = Longitudinal

(3) Highest Relative Stress Point: No break postulated

TABLE 3.6.2-1 (Continued)

HIGH-ENERGY PIPE BREAK INITIAL STRESS SUMMARY RESULTS

System: Auxiliary Feedwater (Outside Containment)

Problem No.: AF-12
Revision: 0

FSAR Figure: Figure 3.6.1-1 (Sheet 4B)

NODE	TOTAL STRESS (psi)	RATIO(1)	LOCATION	TYPE OF POSTULATED BREAKS(2)
10	7093	0.219	Containment Penetration	TE/C
75	16264	0.502	Normally closed valve	TE/C
315	21219	0.655	Normally closed valve	TE/C
822	18616	0.575	18" FW Header Nozzle	TE/C
795	11462	0.354	Normally closed valve	TE/C
298	24079	0.743	Reducer	(3)

(1) Ratio = Total stress/stress limit = $\frac{\text{Total Stress}}{.8\ (1.2\ S_h + S_A)} = \frac{\text{Total Stress}}{32{,}400\ \text{psi}}$

(2) TE = Terminal End — C = Circumferential

IM = Intermediate — L = Longitudinal

(3) Highest Relative Stress Point: No break postulated

TABLE 3.6.2-1 (Continued)

HIGH-ENERGY PIPE BREAK INITIAL STRESS SUMMARY RESULTS

System: Auxiliary Feedwater (Outside Containment)

Problem No.: AF-13
Revision: 0

FSAR Figure: Figure 3.6.1-1 (Sheet 4C)

NODE	TOTAL STRESS (psi)	RATIO(1)	LOCATION	TYPE OF POSTULATED BREAKS(2)
10	16960	0.523	Containment Penetration (M-84)	TE/C
75	17499	0.5401	Normally closed valve	TE/C
425	28876	0.891	Normally closed valve	TE/C
380	27988	0.864	18" FW Header Nozzle	TE/C
355	14110	0.436	Normally closed valve	TE/C
410	27741	0.856	Elbow	(3)

(1) Ratio = Total stress/stress limit = $\frac{\text{Total Stress}}{.8\ (1.2\ S_h + S_A)} = \frac{\text{Total Stress}}{32{,}400\ \text{psi}}$

(2) TE = Terminal End C = Circumferential

IM = Intermediate L = Longitudinal

(3) Highest Relative Stress Point: No break postulated

TABLE 3.6.2-1 (Continued)

HIGH-ENERGY PIPE BREAK INITIAL STRESS SUMMARY RESULTS

System: Auxiliary Feedwater

Problem No.: AF-14
Revision: 0

FSAR Figure: Figure 3.6.1-1 (Sheet 4D)

NODE	TOTAL STRESS (psi)	RATIO (1)	LOCATION	TYPE OF POSTULATED BREAKS (2)
10	6295	0.194	Containment Penetration (M-83)	TE/C
79	26353	0.813	Normally closed valve	TE/C
315	18993	0.586	Normally closed valve	TE/C
795	13447	0.415	Normally closed valve	TE/C
826	30698	0.948	18" FW Header Nozzle	TE/C
78	28004	0.864	Drain Connection	(3)

(1) Ratio = Total stress/stress limit = $\frac{\text{Total Stress}}{.8\ (1.2\ S_h + S_A)} = \frac{\text{Total Stress}}{32{,}400\ \text{psi}}$

(2) TE = Terminal End C = Circumferential

IM = Intermediate L = Longitudinal

(3) Highest Relative Stress Point: No break postulated

TABLE 3.6.2-1 (Continued)

HIGH-ENERGY PIPE BREAK INITIAL STRESS SUMMARY RESULTS

System: Steam Generator Blowdown (Inside Containment)

Problem No.: SB-01
Revision: 0

FSAR Figure: Figure 3.6.1-1(Sheet 5A)

NODE	TOTAL (4) STRESS (psi)	RATIO (1)	LOCATION	TYPE OF POSTULATED BREAKS (2)
4	6691	0.210	Containment Penetration (M-63)	TE/C
N81	13147	0.413	Steam Generator Nozzle	TE/C
N83	14458	0.454	Steam Generator Nozzle	TE/C
97	25339	0.796	~~Elbow~~ Tee	(3)

(1) Ratio = Total stress/stress limit = $\frac{\text{Total Stress}}{.8\ (1.2\ S_h + S_A)} = \frac{\text{Total Stress}}{31{,}820\ \text{psi}}$

(2) TE = Terminal End C = Circumferential

IM = Intermediate L = Longitudinal

(3) Highest Relative Stress Point: No break postulated

(4) Stresses due to steam hammer are not included in the total stresses shown. Adding the peak stream hammer stress of 4618 psi to the above, the total stresses are still within the break threshold stress limit, i.e. 4618 + 25339 = 29947 psi < 31820 psi.

TABLE 3.6.2-1 (Continued)

HIGH-ENERGY PIPE BREAK INITIAL STRESS SUMMARY RESULTS

System: Steam Generator Blowdown (Inside Containment)

Problem No.: SB-02
Revision: 0

FSAR Figure: Figure 3.6.1-1 (Sheet 5B)

NODE	TOTAL(4) STRESS (psi)	RATIO (1)	LOCATION	TYPE OF POSTULATED BREAKS (2)
2	6043	0.190	Containment Penetration (M-64)	TE/C
110	8485	0.267	Steam Generator Nozzle	TE/C
142	10711	0.337	Steam Generator Nozzle	TE/C
34	18918	0.595	Elbow	(3)

(1) Ratio = Total stress/stress limit = $\frac{\text{Total Stress}}{.8\ (1.2\ S_h + S_A)} = \frac{\text{Total Stress}}{31{,}820\ \text{psi}}$

(2) TE = Terminal End C = Circumferential

IM = Intermediate L = Longitudinal

(3) Highest Relative Stress Point: No break postulated

(4) Stresses due to steam hammer are not included in the total stresses shown. Adding the peak steam hammer stress of 4618 psi to the above, the total stresses are still within the break threshold stress limit, i.e. 4618 + 18918 = 23536 psi < 31820 psi.

TABLE 3.6.2-1 (Continued)

HIGH-ENERGY PIPE BREAK INITIAL STRESS SUMMARY RESULTS

System: Steam Generator Blowdown (Inside Containment)

Problem No.: SB-03
Revision: 0

FSAR Figure: Figure 3.6.1-1 (Sheet 5C)

NODE	TOTAL (4) STRESS (psi)	RATIO (1)	LOCATION	TYPE OF POSTULATED BREAKS (2)
3	4784	0.150	Containment Penetration (M-65)	TE/C
99	10869	0.342	Steam Generator Nozzle	TE/C
162	5430	0.171	Steam Generator Nozzle	TE/C
83	18031	0.567	~~Elbow~~ Tee	(3)

(1) Ratio = Total stress/stress limit = $\frac{\text{Total Stress}}{.8\ (1.2\ S_h + S_A)} = \frac{\text{Total Stress}}{31{,}820\ \text{psi}}$

(2) TE = Terminal End C = Circumferential

IM = Intermediate L = Longitudinal

(3) Highest Relative Stress Point: No break postulated

(4) Stresses due to steam hammer are not included in the total stresses shown. Adding the peak steam hammer stress of 4618 psi to the above, the total stresses are still within the break threshold stress limit, i.e. 18031 + 4618 = 22649 psi < 31820 psi.

TABLE 3.6.2-1 (Continued)

HIGH-ENERGY PIPE BREAK INITIAL STRESS SUMMARY RESULTS

System: Steam Generator Blowdown (Inside Containment)

Problem No.: SB-04
Revision: 0

FSAR Figure: Figure 3.6.1-1 (Sheet 5D)

NODE	TOTAL STRESS (psi) (4)	RATIO (1)	LOCATION	TYPE OF POSTULATED BREAKS (2)
2	5321	0.167	Containment Penetration (M-62)	TE/C
86	11921	0.375	Steam Generator	TE/C
150	7576	0.238	Steam Generator Nozzle	TE/C
126	23236	0.730	~~Elbow~~ Tee	(3)

(1) Ratio = Total stress/stress limit = $\frac{\text{Total Stress}}{.8\ (1.2\ S_h + S_A)} = \frac{\text{Total Stress}}{31{,}820\ \text{psi}}$

(2) TE = Terminal End C = Circumferential

IM = Intermediate L = Longitudinal

(3) Highest Relative Stress Point: No break postulated

(4) Stresses due to steam hammers are not included in the total stresses shown. Adding the peak stream hammer stress of 4618 psi to the above, the total stresses are still within the break threshold stress limit, i.e. 4618 + 23236 = 27854 psi < 31820 psi.

TABLE 3.6.2-1 (Continued)

HIGH-ENERGY PIPE BREAK INITIAL STRESS SUMMARY RESULTS

System: Steam Generator Blowdown (Outside Containment)

Problem No.: SB-11
Revision: 0

FSAR Figure: Figure 3.6.1-1 (Sheet 6A)

NODE	TOTAL STRESS (psi)	RATIO(1)	LOCATION	TYPE OF POSTULATED BREAKS(2)
E45	12428	0.384	Containment Penetration (M-63)	TE/C
D84	8889	0.274	Normally Closed Valve	TE/C
F31	4195	0.130	Normally Closed Anchor	TE/C
E68	26516	0.818	Valve	~~Note 3~~ (3)

(1) Ratio = Total stress/stress limit = $\frac{\text{Total Stress}}{.8\,(1.2\,S_h + S_A)} = \frac{\text{Total Stress}}{32{,}400\text{ psi}}$

(2) TE = Terminal End C = Circumferential

IM = Intermediate L = Longitudinal

(3) Highest Relative Stress Point: No break postulated

6122N:0252N/12

TABLE 3.6.2-1 (Continued)

HIGH-ENERGY PIPE BREAK INITIAL STRESS SUMMARY RESULTS

System: Steam Generator Blowdown (Outside Containment)

Problem No.: SB-12
Revision: 0

FSAR Figure: Figure 3.6.1-1 (Sheet 6B)

NODE	TOTAL STRESS (psi)	RATIO(1)	LOCATION	TYPE OF POSTULATED BREAKS(2)
E45	23862	0.736	Containment Penetration (M-64)	TE/C
F31	3519	0.109	Anchor	TE/C
D84	1382	0.043	Normally Closed Valve	TE/C
E36	22328	0.689	Normally Closed Valve	~~Note 3~~ (3)

(1) Ratio = Total stress/stress limit = $\frac{\text{Total Stress}}{.8\ (1.2\ S_h + S_A)} = \frac{\text{Total Stress}}{32{,}400\ \text{psi}}$

(2) TE = Terminal End C = Circumferential

IM = Intermediate L = Longitudinal

(3) Highest Relative Stress Point: No break postulated

TABLE 3.6.2-1 (Continued)

HIGH-ENERGY PIPE BREAK INITIAL STRESS SUMMARY RESULTS

System: Steam Generator Blowdown (Outside Containment)
Problem No.: SB-13
Revision: 0

FSAR Figure: Figure 3.6.1-1 (Sheet 6C)

NODE	TOTAL STRESS (psi)	RATIO(1)	LOCATION	TYPE OF POSTULATED BREAKS(2)
M51	10487	0.324	Containment Penetration (M-65)	TE/C
N58	4250	0.131	Anchor	TE/C
L94	8115	0.251	Normally Closed Valve	TE/C
M88	22015	0.679	Reducer	~~Note 3~~ (3)

(1) Ratio = Total stress/stress limit = $\frac{\text{Total Stress}}{.8\,(1.2\,S_h + S_A)} = \frac{\text{Total Stress}}{32{,}400\text{ psi}}$

(2) TE = Terminal End C = Circumferential

IM = Intermediate L = Longitudinal

(3) Highest Relative Stress Point: No break postulated

TABLE 3.6.2-1 (Continued)

HIGH-ENERGY PIPE BREAK INITIAL STRESS SUMMARY RESULTS

System: Steam Generator Blowdown (Outside Containment)

Problem No.: SB-14
Revision: 0

FSAR Figure: Figure 3.6.1-1 (Sheet 6D)

NODE	TOTAL STRESS (psi)	RATIO(1)	LOCATION	TYPE OF POSTULATED BREAKS(2)
M51	12660	0.391	Containment Penetration (M-62)	TE/C
N55	6699	0.207	Anchor	TE/C
L94	9219	0.285	Normally Closed Valve	TE/C
H84	15947	0.623(4)	Elbow	~~Note 3~~ (3)

(1) Ratio = Total stress/stress limit = $\frac{\text{Total Stress}}{.8\ (1.2\ S_h + S_A)} = \frac{\text{Total Stress}}{32{,}400 \text{ psi}}$

(2) TE = Terminal End C = Circumferential

IM = Intermediate L = Longitudinal

(3) Highest Relative Stress Point: No break postulated

(4) $0.8\ (1.25_h + S_A) = 25{,}596$ psi

6122N:0252N/9

TABLE 3.6.2-1 (Continued)

HIGH-ENERGY PIPE BREAK INITIAL STRESS SUMMARY RESULTS

System: Reactor Coolant Surge Line

Problem No.: RC-01
Revision: 0

FSAR Figure: Figure 3.6.1-1 (Sheet 7A)

NODE	EQ. 10 STRESS(1) (S_m)	EQ. 12 STRESS(1) (S_m)	EQ 13 STRESS(1) (S_m)	S_m (psi)	USAGE FACTOR	LOCATION	TYPE OF BREAK POSTULATED(2)
10	5.928	1.59	2.04	16582	0.91	Pres. Nozzle	TE/C
70	5.086	1.320	1.175	16582	0.539	Elbow	IM/C/L
60	5.081	1.638	1.120	16582	0.764	Elbow	IM/C/L
50	5.0851	1.613	1.131	16582	0.776	Elbow	IM/C/L
40	4.782	1.317	1.007	16582	0.557	Elbow	IM/C/L
20	4.300	1.039	0.849	16582	0.217	L.R. Elbow	IM/C/L
25	4.259	0.631	0.858	16582	0.164	L.R. Elbow	IM/C/L
30	3.928	0.320	0.841	16582	0.142	L.R. Elbow	IM/C/L
130	3.602	0.026	0.939	16582	0.046	RC Nozzle	TE/C

(1) Ratio of actual stress to S_m

(2) TE = Terminal End C = Circumferential

IM = Intermediate L = Longitudinal

~~(3) Highest Relative Usage Factor Point: No break postulated~~

TABLE 3.6.2-1 (Continued)

HIGH-ENERGY PIPE BREAK INITIAL STRESS SUMMARY RESULTS

System: Pressurizer Spray Line

Problem No.: RC-02
Revision: 0

FSAR Figure: Figure 3.6.1-1 (Sheet 78)

NODE	EQ. 10 STRESS (1) (S_m)	EQ. 12 STRESS (1) (S_m)	EQ 13 STRESS (1) (S_m)	S_m (psi)	USAGE FACTOR	LOCATION	TYPE OF BREAK POSTULATED (2)
200	6.135	0.313	2.243	16,600	0.319	Pres. Nozzle	TE/C
301	9.084	0.594	2.803		0.213	Reducer	IM/C
302	8.905	0.557	2.732		0.206	Reducer	IM/C
223	8.449	0.457	2.517		0.299	Tee	IM/C/L
223B	5.206	0.166	1.810		0.129	Tee	IM/C/L
205	6.429	0.383	1.107		0.282	Elbow	IM/C/L
206	6.361	0.358	1.082		0.273	Elbow	IM/C/L
210	5.137	0.242	1.006		0.224	Elbow	IM/C/L
3	1.513	N/A	N/A		0.000	Elbow	TE/C
294	1.809	N/A	N/A		0.000	RC Nozzle	TE/C

(1) Ratio of actual stress to S_m

(2) TE = Terminal End C = Circumferential
IM = Intermediate L = Longitudinal

~~(3) Highest Relative Usage Factor Point: No break postulated~~

TABLE 3.6.2-1 (Continued)

HIGH-ENERGY PIPE BREAK INITIAL STRESS SUMMARY RESULTS

System: RC Loop 2 Drain to RCDT

Problem No.: RC-20
Revision: 0

FSAR Figure: Figure 3.6.1-1 (Sheet 7C)

NODE	EQ. 10 STRESS(1) (S_m)	EQ. 12 STRESS(1) (S_m)	EQ 13 STRESS(1) (S_m)	S_m (psi)	USAGE FACTOR	LOCATION	TYPE OF BREAK POSTULATED(2)
2	4.124	0.79	1.709	16,420	0.052	RC Nozzle	TE/C
5	3.771	0.783	1.651	↓	0.043	Elbow	IM/C
13	3.754	0.478	1.899	↓	0.030	Normally closed valve	TE/C

(1) Ratio of actual stress to S_m

(2) TE = Terminal End C = Circumferential

IM = Intermediate L = Longitudinal

~~(3) Highest Relative Usage Factor Point: No break postulated~~

TABLE 3.6.2-1 (Continued)

HIGH-ENERGY PIPE BREAK INITIAL STRESS SUMMARY RESULTS

System: RC Loop 2 Drain to RCDT

Problem No.: RC-19
Revision: 0

FSAR Figure: Figure 3.6.1-1 (Sheet 7C)

NODE	EQ. 10 STRESS(1) (S_m)	EQ. 12 STRESS(1) (S_m)	EQ 13 STRESS(1) (S_m)	S_m (psi)	USAGE FACTOR	LOCATION	TYPE OF BREAK POSTULATED(2)
7	4.065	0.848	1.727	16,420	0.060	RC Nozzle	TE/C
10	3.845	0.813	1.673	↓	0.049	Elbow	IM/C
18	3.828	0.572	1.847	↓	0.042	Normally closed valve	TE/C

(1) Ratio of actual stress to S_m

(2) TE = Terminal End C = Circumferential

IM = Intermediate L = Longitudinal

~~(3) Highest Relative Usage Factor Point: No break postulated~~

TABLE 3.6.2-1 (Continued)

HIGH-ENERGY PIPE BREAK INITIAL STRESS SUMMARY RESULTS

System: Residual Heat Removal (Pump A Suction: Inside Containment)
Problem No.: RHR/SI-01
Revision: 0

FSAR Figure: Figure 3.6.1-1 (Sheet 8A)

NODE	EQ. 10 STRESS(1) (S_m)	EQ. 12 STRESS(1) (S_m)	EQ 13 STRESS(1) (S_m)	S_m (psi)	USAGE FACTOR	LOCATION	TYPE OF BREAK POSTULATED(2)
135	1.669	N/A	N/A	16440	0.0001	RC Nozzle	TE/C
86	3.436	0.071	2.697	19650	0.310	Normally closed valve	TE/C
120	1.754	N/A	N/A	16440	0.0246	Elbow	- (3)

(1) Ratio of actual stress to S_m

(2) TE = Terminal End C = Circumferential

IM = Intermediate L = Longitudinal

~~(3) Highest Relative Usage Factor Point: No break postulated~~ stet

TABLE 3.6.2-1 (Continued)

HIGH-ENERGY PIPE BREAK INITIAL STRESS SUMMARY RESULTS

System: Residual Heat Removal (Pump A Suction: Inside Containment)

Problem No.: RHR/SI-09
Revision: 0

FSAR Figure: Figure 3.6.1-1 (Sheet 8B)

NODE	EQ. 10 STRESS(1) (S_m)	EQ. 12 STRESS(1) (S_m)	EQ 13 STRESS(1) (S_m)	S_m (psi)	USAGE FACTOR	LOCATION	TYPE OF BREAK POSTULATED(2)
98 ~~86~~	3.712	0.030	2.777	19650	0.0747	Normally closed valve	TE/C
135	2.164	N/A	N/A	16440	0.0001	RC Nozzle	TE/C
120	2.41	0.693	1.503	16440	0.0276	Elbow	- (3)

(1) Ratio of actual stress to S_m

(2) TE = Terminal End C = Circumferential
IM = Intermediate L = Longitudinal

(3) Highest Relative Usage Factor Point: No break postulated

TABLE 3.6.2-1 (Continued)

HIGH-ENERGY PIPE BREAK INITIAL STRESS SUMMARY RESULTS

System: Residual Heat Removal (Pump C Suction: Inside Containment)   Problem No.: RHR/SI-16
Revision: 0

FSAR Figure: Figure 3.6.1-1 (Sheet 8C)

NODE	EQ. 10 STRESS(1) (S_m)	EQ. 12 STRESS(1) (S_m)	EQ 13 STRESS(1) (S_m)	S_m (psi)	USAGE FACTOR	LOCATION	TYPE OF BREAK POSTULATED(2)
498	1.605	N/A	N/A	16825	0.0001	RC nozzle	TE/C
471C	3.766	0.128	2.958	19650	0.6982	Normally closed valve	TE/C
495	1.452	N/A	N/A	16825	0.0318	Elbow	- (3)

(1) Ratio of actual stress to S_m

(2) TE = Terminal End   C = Circumferential

IM = Intermediate   L = Longitudinal

(3) Highest Relative Usage Factor Point: No break postulated

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TABLE 3.6.2-1 (Continued)

HIGH-ENERGY PIPE BREAK INITIAL STRESS SUMMARY RESULTS

System: Safety Injection to Hot Hot Leg Loop 1 (Inside Containment)

Problem No.: RHR/SI-05
Revision: 0

FSAR Figure: Figure 3.6.1-1 (Sheet 8D)

NODE	EQ. 10 STRESS(1) (S_m)	EQ. 12 STRESS(1) (S_m)	EQ 13 STRESS(1) (S_m)	S_m (psi)	USAGE FACTOR	LOCATION	TYPE OF BREAK POSTULATED(2)

~~PSSG to Provide~~

"Later"

(to HL&P by 11/8/85)

(1) Ratio of actual stress to S_m

(2) TE = Terminal End C = Circumferential
IM = Intermediate L = Longitudinal

(3) Highest Relative Usage Factor Point: No break postulated

TABLE 3.6.2-1 (Continued)

HIGH-ENERGY PIPE BREAK INITIAL STRESS SUMMARY RESULTS

System: Safety Injection to Hot Hot Leg Loop 2 (Inside Containment)

Problem No.: RHR/SI-13
Revision: 0

FSAR Figure: Figure 3.6.1-1 (Sheet 8E)

NODE	EQ. 10 STRESS(1) (S_m)	EQ. 12 STRESS(1) (S_m)	EQ 13 STRESS(1) (S_m)	S_m (psi)	USAGE FACTOR	LOCATION	TYPE OF BREAK POSTULATED(2)

~~PSSG to Provide~~

"Later"
(To HL&P by 11/8/85)

(1) Ratio of actual stress to S_m

(2) TE = Terminal End C = Circumferential
IM = Intermediate L = Longitudinal

(3) Highest Relative Usage Factor Point: No break postulated

TABLE 3.6.2-1 (Continued)

HIGH-ENERGY PIPE BREAK INITIAL STRESS SUMMARY RESULTS

System: Safety Injection to Hot Leg Loop 3 (Inside Containment)

Problem No.: RHR/SI-20
Revision: 0

FSAR Figure: Figure 3.6.1-1 (Sheet 8F)

NODE	EQ. 10 STRESS(1) (S_m)	EQ. 12 STRESS(1) (S_m)	EQ 13 STRESS(1) (S_m)	S_m (psi)	USAGE FACTOR	LOCATION	TYPE OF BREAK POSTULATED(2)

~~PSSG~~ to Provide

"Later"

(To HL&P by 11/8/85)

(1) Ratio of actual stress to S_m

(2) TE = Terminal End C = Circumferential

IM = Intermediate L = Longitudinal

(3) Highest Relative Usage Factor Point: No break postulated

TABLE 3.6.2-1 (Continued)

HIGH-ENERGY PIPE BREAK INITIAL STRESS SUMMARY RESULTS

System: Accumulator to Cold Leg A

Problem No.: RHR/SI-02
Revision: 0

FSAR Figure: Figure 3.6.1-1 (Sheet 8G)

NODE	EQ. 10 STRESS(1) (S_m)	EQ. 12 STRESS(1) (S_m)	EQ 13 STRESS(1) (S_m)	S_m (psi)	USAGE FACTOR	LOCATION	TYPE OF BREAK POSTULATED(2)

~~PSSG to Provide~~

"Later"
(to HL&P by 11/8/85)

(1) Ratio of actual stress to S_m

(2) TE = Terminal End C = Circumferential

IM = Intermediate L = Longitudinal

(3) Highest Relative Usage Factor Point: No break postulated

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TABLE 3.6.2-1 (Continued)

HIGH-ENERGY PIPE BREAK INITIAL STRESS SUMMARY RESULTS

System: Accumulator to Cold Leg B

Problem No.: RHR/SI-10
Revision: 0

FSAR Figure: Figure 3.6.1-1 (Sheet 8H)

NODE	EQ. 10 STRESS(1) (S_m)	EQ. 12 STRESS(1) (S_m)	EQ 13 STRESS(1) (S_m)	S_m (psi)	USAGE FACTOR	LOCATION	TYPE OF BREAK POSTULATED(2)

~~PSSG to Provide~~

"Later"

(To HL&P by 11/8/85)

(1) Ratio of actual stress to S_m

(2) TE = Terminal End C = Circumferential
IM = Intermediate L = Longitudinal

(3) Highest Relative Usage Factor Point: No break postulated

TABLE 3.6.2-1 (Continued)

HIGH-ENERGY PIPE BREAK INITIAL STRESS SUMMARY RESULTS

System: Accumulator to Cold Leg C

Problem No.: RHR/SI-17
Revision: 0

FSAR Figure: Figure 3.6.1-1 (Sheet 8I)

NODE	EQ. 10 STRESS(1) (S_m)	EQ. 12 STRESS(1) (S_m)	EQ 13 STRESS(1) (S_m)	S_m (psi)	USAGE FACTOR	LOCATION	TYPE OF BREAK POSTULATED(2)

~~PSSG to Provide~~

"Later"
(to NRC by 11/8/85)

(1) Ratio of actual stress to S_m

(2) TE = Terminal End C = Circumferential

IM = Intermediate L = Longitudinal

(3) Highest Relative Usage Factor Point: No break postulated

TABLE 3.6.2-1 (Continued)

HIGH-ENERGY PIPE BREAK INITIAL STRESS SUMMARY RESULTS

System: Accumulator Drain to the Reactor Coolant Drain Tank

Problem No.: RHR/SI-06, 14, 22
Revision: 0

FSAR Figure: Figure 3.6.1-1 (Sheet 8J)

NODE	TOTAL STRESS (psi)	RATIO(1)	LOCATION	TYPE OF POSTULATED BREAKS(2)
140	12784	0.318	Acc. Inj. A Line Nozzle	TE/C
139	10993	0.274	Normally Closed Valve	TE/C
11	11229	0.280	Acc. Inj. B Line Nozzle	TE/C
12	10149	0.253	Normally Closed Valve	TE/C
89	15532	0.387	Acc. Inj. C Line Nozzle	TE/C
70	10112	0.252	Normally Closed Valve	TE/C

(1) Ratio = Total stress/stress limit = $\frac{\text{Total Stress}}{.8\ (1.2\ S_h + S_A)} = \frac{\text{Total Stress}}{40{,}144\text{ psi}}$

(2) TE = Terminal End　　C = Circumferential

IM = Intermediate　　L = Longitudinal

TABLE 3.6.2-1 (Continued)

HIGH-ENERGY PIPE BREAK INITIAL STRESS SUMMARY RESULTS

System: Chemical Volume and Control System Letdown from Cross Over Leg to Regenerative Heat Exchanger

Problem No.: CV-01
Revision: 0

FSAR Figure: Figure 3.6.1-1 (Sheet 9A)

NODE	EQ. 10 STRESS(1) (S_m)	EQ. 12 STRESS(1) (S_m)	EQ 13 STRESS(1) (S_m)	S_m (psi)	USAGE FACTOR	LOCATION	TYPE OF BREAK POSTULATED(2)
101	3.571	0.219	2.958	17400	0.0531	Normally open valve	IM/C/L
106	3.498	0.211	2.868	17400	0.0530	Normally open valve	IM/C/L
110	3.477	0.216	2.82	17400	0.0529	Normally open valve	IM/C/L
115	3.532	0.221	2.868	17400	0.0466	Normally open valve	IM/C/L
127	3.477	0.258	2.778	17400	0.0476	Normally open valve	IM/C/L
133	3.475	0.29	2.761	17400	0.0487	Normally open valve	IM/C/L
142	0.986	N/A	N/A	17400	0.0183	RCS Nozzle	TE/C
151	3.518	0.945	2.132	13860	0.4360	Normally closed valve	TE/C
5A	See Note 4			N/A	N/A	Regenerative Heat Exchanger	TE/C
15	See Note 5			N/A	N/A	Elbow	(3)

(1) Ratio of actual stress to S_m

(2) TE = Terminal End; C = Circumferential

IM = Intermediate; L = Longitudinal

TABLE 3.6.2-1 (Continued)

HIGH-ENERGY PIPE BREAK INITIAL STRESS SUMMARY RESULTS

System: Chemical Volume and Control System Letdown from Cross Over Leg to Regenerative Heat Exchanger (CON'T)

Problem No.: CV-01
Revision: 0

FSAR Figure: Figure 3.6.1-1 (Sheet 9A8) 6

NODE	EQ. 10 STRESS (S_m)	EQ. 12 STRESS (S_m)	EQ 13 STRESS (S_m)	S_m (psi)	USAGE FACTOR	LOCATION	TYPE OF BREAK POSTULATED

(3) Highest Relative Usage Factor Point: No break postulated

(4) Total Stress = Equation 9 + Equation 10 Stress = 10224 psi; Ratio = Total Stress/.8(1.2 S_h + S_A) = 10224/32840 = 0.311

(5) Total Stress = 8177 psi; Ratio = 8172/32840 = 0.249

TABLE 3.6.2-1 (Continued)

HIGH-ENERGY PIPE BREAK INITIAL STRESS SUMMARY RESULTS

System: Chemical Volume and Control (Letdown Outside Containment)

Problem No.: CV-11L
Revision: 0

FSAR Figure: Figure 3.6.1-1 (Sheet 9B)

~~M~~ N ODE	TOTAL STRESS (psi)	RATIO (1)	LOCATION	TYPE OF POSTULATED BREAKS (2)
815	6570	.200	Containment Penetration (M-46)	TE/C
315	12653	.385	Reheat Heat Exchanger Nozzle	TE/C
604	6976	.206 (4)	Normally closed valve	TE/C
581	10894	.331	Normally closed valve	TE/C
50	4634	.141	Reheat Heat Exchanger Nozzle	TE/C
500	4793	.146	Letdown Heat Exchanger Nozzle	TE/C
556	14668	.446	~~Elbow~~ Valve	(3)

(1) Ratio = Total stress/stress limit = $\frac{\text{Total Stress}}{.8\ (1.2\ S_h + S_A)} = \frac{\text{Total Stress}}{31{,}891\ \text{psi}}$

(2) TE = Terminal End   C = Circumferential

IM = Intermediate   L = Longitudinal

(3) Highest Relative Stress Point: No break postulated

(4) Ratio = $\frac{\text{Total Stress}}{.8\ (1.2_h S\ + S_h\ )} = \frac{\text{Total Stress}}{33912\ \text{psi}}$

6122N:0252N/20

TABLE 3.6.2-1 (Continued)

HIGH-ENERGY PIPE BREAK INITIAL STRESS SUMMARY RESULTS

System: Chemical Volume and Control
Normal Charging Inside Containment

Problem No.: CV-05
Revision: 0

FSAR Figure: Figure 3.6.1-1 (Sheet 9C)

NODE	EQ. 10 STRESS (S_m)	EQ. 12 STRESS (S_m)	EQ 13 STRESS (S_m)	S_m (psi)	USAGE FACTOR	LOCATION	TYPE OF BREAK POSTULATED

~~PSSG to Provide~~

"Later"

(to HL&P by 11/8/85)

(1) Ratio of actual stress to S_m

(2) TE = Terminal End — C = Circumferential

IM = Intermediate — L = Longitudinal

(3) Highest Relative Usage Factor Point: No break postulated

TABLE 3.6.2-1 (Continued)

HIGH-ENERGY PIPE BREAK INITIAL STRESS SUMMARY RESULTS

System: Chemical Volume and Control
Auxiliary Pressurizer Spray

Problem No.: CV-07
Revision: 0

FSAR Figure: Figure 3.6.1-1 (Sheet 9D)

NODE	EQ. 10 STRESS (S_m)	EQ. 12 STRESS (S_m)	EQ 13 STRESS (S_m)	S_m (psi)	USAGE FACTOR	LOCATION	TYPE OF BREAK POSTULATED

~~PSSG~~ to Provide

"Later"
(To HL&P by 11/8/85)

(1) Ratio of actual stress to S_m

(2) TE = Terminal End C = Circumferential

IM = Intermediate L = Longitudinal

(3) Highest Relative Usage Factor Point: No break postulated

TABLE 3.6.2-1 (Continued)

HIGH-ENERGY PIPE BREAK INITIAL STRESS SUMMARY RESULTS

System: Chemical Volume and Control
Alternate Charging Line to Loop 3

Problem No.: CV-06
Revision: 0

FSAR Figure: Figure 3.6.1-1 (Sheet 9E)

NODE	EQ. 10 STRESS (S_m)	EQ. 12 STRESS (S_m)	EQ 13 STRESS (S_m)	S_m (psi)	USAGE FACTOR	LOCATION	TYPE OF BREAK POSTULATED

~~PSSG to Provide~~

"Later"
(To HL&P by 11/8/88)

(1) Ratio of actual stress to S_m

(2) TE = Terminal End C = Circumferential

IM = Intermediate L = Longitudinal

(3) Highest Relative Usage Factor Point: No break postulated

TABLE 3.6.2-1 (Continued)

HIGH-ENERGY PIPE BREAK INITIAL STRESS SUMMARY RESULTS

System: Chemical Volume and Control
Excess Letdown from Loop 4

Problem No.: CV-17
Revision: 0

FSAR Figure: Figure 3.6.1-1 (Sheet 9F)

NODE	EQ. 10 STRESS (S_m)	EQ. 12 STRESS (S_m)	EQ 13 STRESS (S_m)	S_m (psi)	USAGE FACTOR	LOCATION	TYPE OF BREAK POSTULATED

~~PSSG~~ to Provide

"Later"
(TO HCSV tag 11/8/85)

(1) Ratio of actual stress to S_m

(2) TE = Terminal End C = Circumferential

IM = Intermediate L = Longitudinal

(3) Highest Relative Usage Factor Point: No break postulated

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TABLE 3.6.2-1 (Continued)

HIGH-ENERGY PIPE BREAK INITIAL STRESS SUMMARY RESULTS

System: Chemical Volume and Control
Excess Letdown to Heat Exchanger

Problem No.: CV-19
Revision: 0

FSAR Figure: Figure 3.6.1-1 (Sheet 9G)

NODE	EQ. 10 STRESS (S_m)	EQ. 12 STRESS (S_m)	EQ 13 STRESS (S_m)	S_m (psi)	USAGE FACTOR	LOCATION	TYPE OF BREAK POSTULATED

~~PSSG to Provide~~

"Later"
(HL&P by 11/8/85)

(1) Ratio of actual stress to S_m

(2) TE = Terminal End C = Circumferential
IM = Intermediate L = Longitudinal

(3) Highest Relative Usage Factor Point: No break postulated

6122N:0252N/38

TABLE 3.6.2-1 (Continued)

HIGH-ENERGY PIPE BREAK INITIAL STRESS SUMMARY RESULTS

System: Chemical Volume and Control
Excess Letdown to Containment Penetration

Problem No.: CV-02
Revision: 0

FSAR Figure: Figure 3.6.1-1 (Sheet 9H)

NODE	TOTAL STRESS (psi)	RATIO (1)	LOCATION	TYPE OF POSTULATED BREAKS (2)
6	6051	0.152	Containment Penetration (M-46)	TE/C
169	7500	0.198	Regenerative Ht. Exchanger Outlet	TE/C
543	11775	0.318	Normally Closed valve	TE/C
713	8194	0.222	Normally Closed Valve	TE/C

(1) Ratio = Total stress/stress limit = $\frac{\text{Total Stress}}{.8\ (1.2\ S_h + S_A)} = \frac{\text{Total Stress}}{39{,}810\ \text{psi}}$

(2) TE = Terminal End   C = Circumferential

IM = Intermediate   L = Longitudinal

(3) Highest Relative Stress Point: No break postulated

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TABLE 3.6.2-2

HIGH-ENERGY PIPE BREAK EFFECTS ANALYSIS RESULTS

Room No.: Later

I. Room Break Locations

"Later"

II. Safety Related Equipment Located within Room:

"Later"

III. Effects Analysis

A. Pipe Whip/Jet: Later

B. Flooding: Later

C. Pressure Temperature: Later

Insert 3.6.2-2

40

Insert 3.6.2-2

ISOLATION VALVE CUBICLE (IVC)

I. Break Locations

A. Breaks were conservatively postulated in the Main Steam and Feedwater system branch piping at terminal ends and each intermediate fitting (e.g. short- and long-radius elbows, tees and reducers, welded attachments and valves).

B. Breaks were postulated in accordance with FSAR Section 3.6.2.1.1(2) criteria for the Steam Generator Blowdown System Piping (Figure 3.6.1-1 Sheets 6A-6D). Since the auxiliary feedwater pumps are not used for normal plant operational modes, the criteria of FSAR Section 3.6.1.1(1) was used to determine the high energy piping and postulated break locations between the isolation check valve and the containment penetration, as shown on FSAR Figures 3.6.1-1 Sheets 4A-4D.

II. Effects Analysis

A. Pipe Whip/Jet

An evaluation was performed to identify those systems, structures and components necessary for safe shutdown following the jet and whip effects of the breaks postulated above.

Due to the complete separation design concept of the IVC structure (see FSAR Figure 1.2-21 through 1.2-25) and the multiple (4) train systems (AFW, MS, MFW, SB) enclosed by the structure, all mechanical equipment (piping, pumps, HVAC, etc.), control (MSIV, MFWIV, containment isolation valves) and electrical (power and control circuits) devices within an effected compartment do not require additional protection for the direct jet or whip interaction from the postulated break locations. However, in order to prevent cross communication between cubicles and to maintain the complete separation concept, the IVC walls, slabs and floors were analyzed to withstand the direct pipe whip and jet effects. Therefore, no additional protective devices are necessary.

B. Flooding

A review of the high energy lines within the IVC showed that a non-mechanistic break of the main feedwater line in each cubicle determined the maximum flood level in that cubicle. Blowdown was conservatively calculated from both the S/G and the feedwater pumps as well as consideration of auxiliary feedwater flow into the S/G subsequent to a low level signal in the affected S/G.

In the auxiliary feedwater compartments (see Figures 1.2-21 through 1.2-25), the maximum flood level calculated is 28 feet above the cubicle floor. Although the affected train of auxiliary feedwater train could be damaged and a second auxiliary feedwater train could be inoperable due to a limiting single failure, the remaining ~~two~~ auxiliary feedwater ~~trains~~ would be sufficient for safe shutdown following the postulated MFW line break. The maximum calculated flood level for the North stairwell (or common) compartment of the IVC is 9.08 feet above the floor. Since the penetration openings between the pump rooms and the North stairwell are designed to be watertight, this flood level does not affect essential systems and components within the IVC.

Therefore, safe shutdown is assured following the flooding effects from postulated high energy line breaks within the IVC.

C. Pressure/Temperature Effects

See appendix 3.6A for a discussion of the pressure and temperature parameters for postulated High Energy Line breaks within the IVC. These parameters are used for structural design and environmental qualification of enclosed safety related equipment. (See Section 3.11 for the environmental qualification of safety related equipment.)

MECHANICAL AUXILIARY BUILDING (MAB)

I. Break Locations

A. Breaks are conservatively postulated in the non-nuclear Auxiliary Steam piping at terminal ends and each intermediate fitting (e.g. short- and long-radius elbows, tees and reducers, welded attachments and valves).

B. In accordance with the criteria described in FSAR Section 3.6.2.1.1(2) breaks were postulated in the Chemical Volume and Control System letdown line located within the MAB (see FSAR Figure 3.6.1-1 Sheet 9B). In addition, breaks were initially postulated in the CVCS centrifugal charging pump discharge piping per FSAR Section 3.6.2.1.1(2).

II. Effects Analysis

A. Pipe Whip/Jet

Safety related systems, components and structures impacted by the jet and whip from the above postulated letdown line and auxiliary steam line breaks ~~are~~ were either analyzed to withstand the jet/whip effects (e.g. impacted protective walls and slabs) or determined not essential for each postulated break (e.g. safe shutdown could be obtained with loss of the impacted safety related components). Subsequent to the initial postulated break locations in the CVCS centrifugal charging pump discharge piping, an evaluation demonstrated an insufficient level of stored energy exists to impair the safety function of any structure, system or component to an unacceptable level.

B. Flooding

"Later"

C. Pressure/Temperature

Subcompartment Pressure and Temperature analysis for the high energy breaks postulated for the CVCS letdown and the auxiliary steam piping using conservative non-mechanistic or "break everywhere" criteria. The methodology used is similar to the methodology used in the IVC subcompartment evaluation described in Appendix 3.6A. The analysis for the MAB took credit for the safety related high temperature detectors and associated isolation valve interlocks in the affected areas that limit the mass and energy release.

Pressure and temperature profiles for the letdown heat exchanger room (FSAR Figure 1.2-23) are presented in ~~Tables 3.6.1-XX and~~ Figures ~~3.6.1-XX~~ 3.6.2-5 and 6.

The result of the subcompartment analysis is used as the basis for the environmental qualification of mechanical and electrical equipment (FSAR Section 3.11) as well as factored into the design of affected structures.

REACTOR CONTAINMENT BUILDING (RCB)

I. Break Locations

A. Partial Stress Summaries and break types for the containment high energy piping systems are presented in FSAR Table 3.6.2-1.

B. Break locations and types are shown for the containment high energy piping systems in FSAR Figure 3.6.1-1.

II. Effects Analysis

A. Pipe Whip/Jet

Safety related systems, structures and components impacted by the jet/whip from the above postulated breaks are analyzed to withstand the jet/whip effects (e.g. impacted protective walls and slabs), determined not to be essential for each postulated break (e.g. safe shutdown could be obtained with loss of the impacted safety related components) or determined to be essential and the appropriate protective devices (pipe whip restraint, jet barrier, etc.) are incorporated into the plant design.

The pipe whip restraint (pwr) devices that have been incorporated into the STP design are shown in FSAR Figures 3.6.1-1 along with the applicable break location and restraint load summary.

FSAR Figures 3.6.1-1 will be updated to incorporate necessary additional devices (e.g. jet barriers) subsequent to the review of ~~available~~ field routed safety related components (i.e. electrical components).

B. Flooding

The containment flooding analysis has shown that the maximum volume of water discharged to the RCB occurs as a result of a Loss of Coolant Accident (LOCA), and water from the RCS and the accumulators are assumed to spill into the RCB floor. This analysis has been performed in accordance with the criteria and methodology described in FSAR Section 3.4.3 and 4.

FSAR Table 3.6.1-XX provides a listing of safety related components within the calculated flood level. An evaluation will be performed to confirm safe shutdown capability assuming these components are inoperable.

C. Pressure/Temperature Effects

FSAR Section 6.2.1 describes the pressure and temperature effects for selected subcompartments inside the containment.

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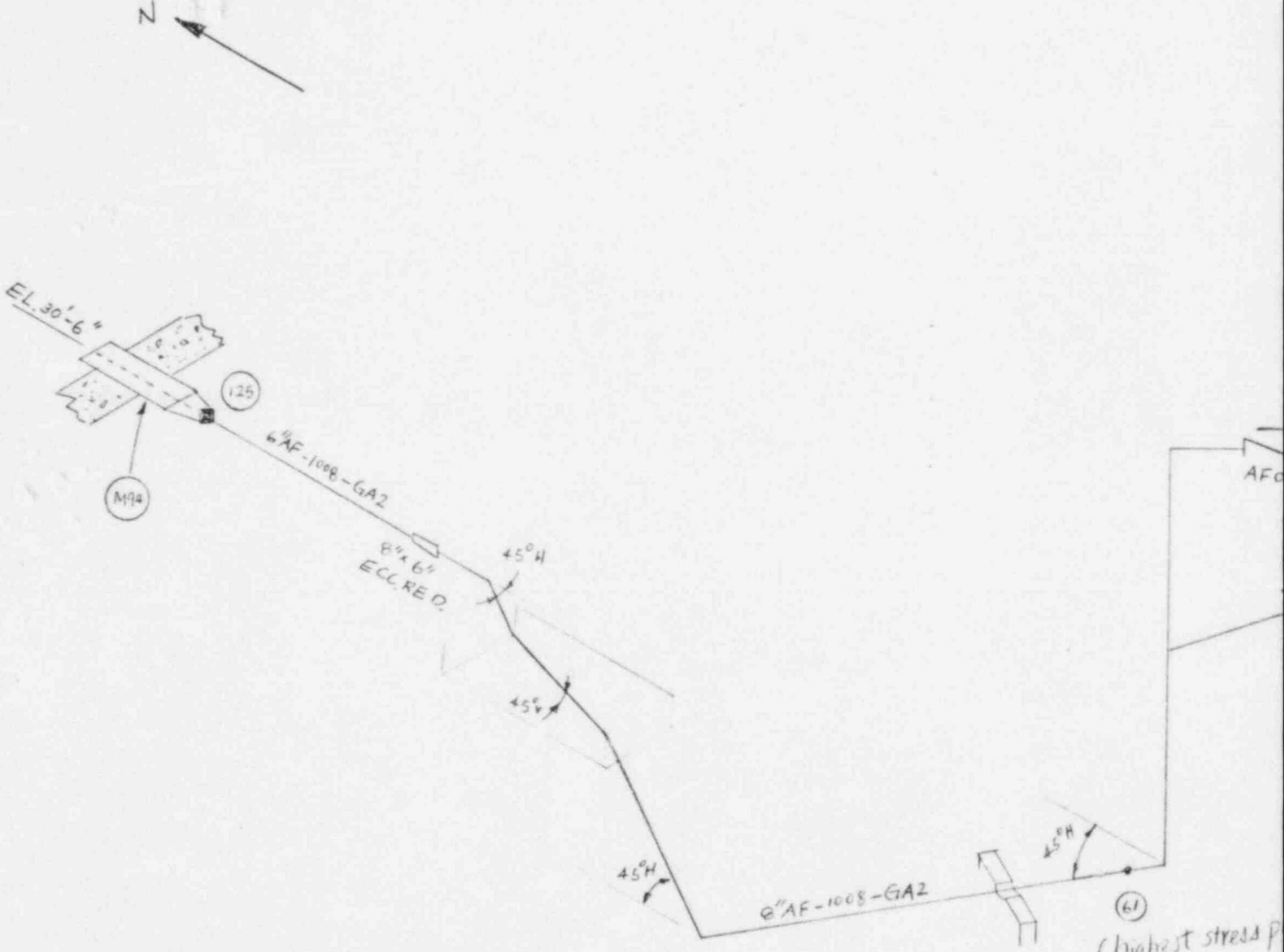
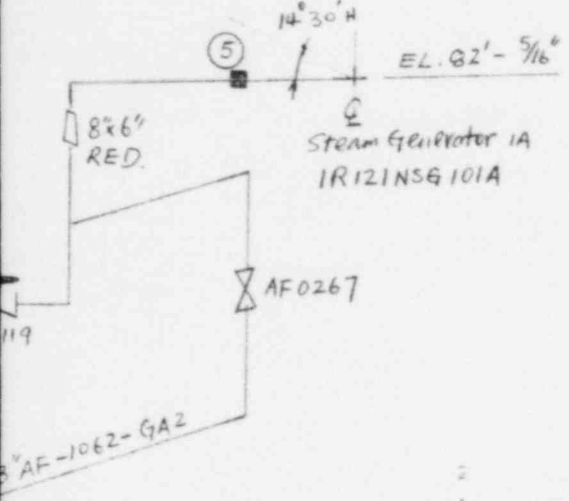


RESTRAINT LOAD SUMMARY

RESTRAINT NUMBER	RESTRAINT DESCRIPTION	DESIGN LOAD (KIPS) BREAK LOCATION
None		



See Initial Stress Summary Results Table 3.6.2-1, SH 3A

LEGEND

■ POSTULATED BREAK POINT

➞ ENERGY ABSORBING RESTRAINT

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POSTULATED BREAK POINTS AND RESTRAINT LOCATIONS

Auxiliary Feedwater Loop 1 (Outside Containment)

Figure 3.6.1-1 Sh 3A

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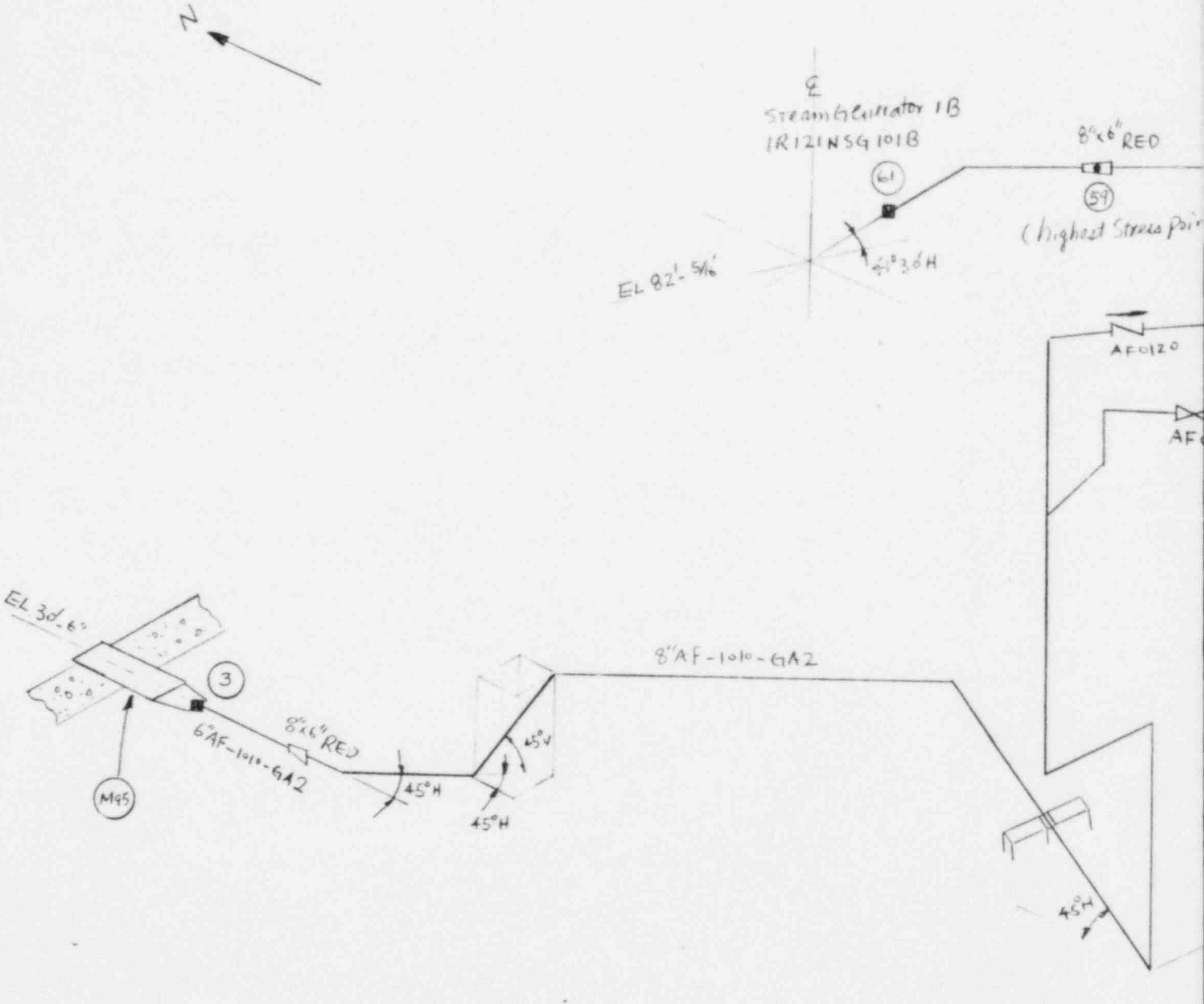

RESTRAINT LOAD SUMMARY

RESTRAINT NUMBER	RESTRAINT DESCRIPTION	DESIGN LOAD (KIPS) BREAK LOCATION
None		

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See Initial Stress Summary Results Table 3.6.2-1, SH 3B

LEGEND

■ POSTULATED BREAK POINT

⟶ ENERGY ABSORBING RESTRAINT

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POSTULATED BREAK POINTS AND RESTRAINT LOCATIONS

Auxiliary Feedwater Loop 2
(Inside Containment)

Figure 3.6.1-1 Ch 3B

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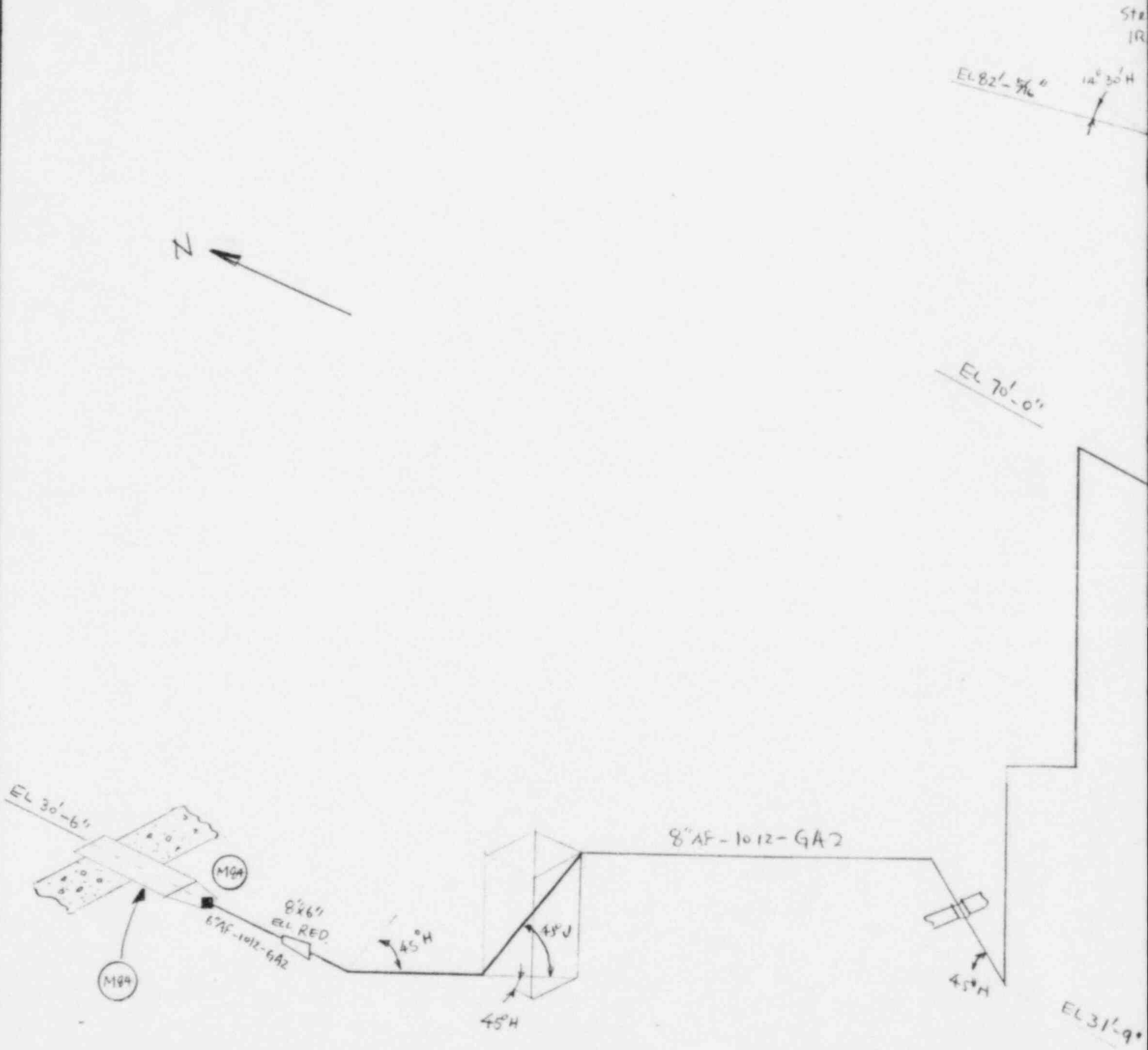
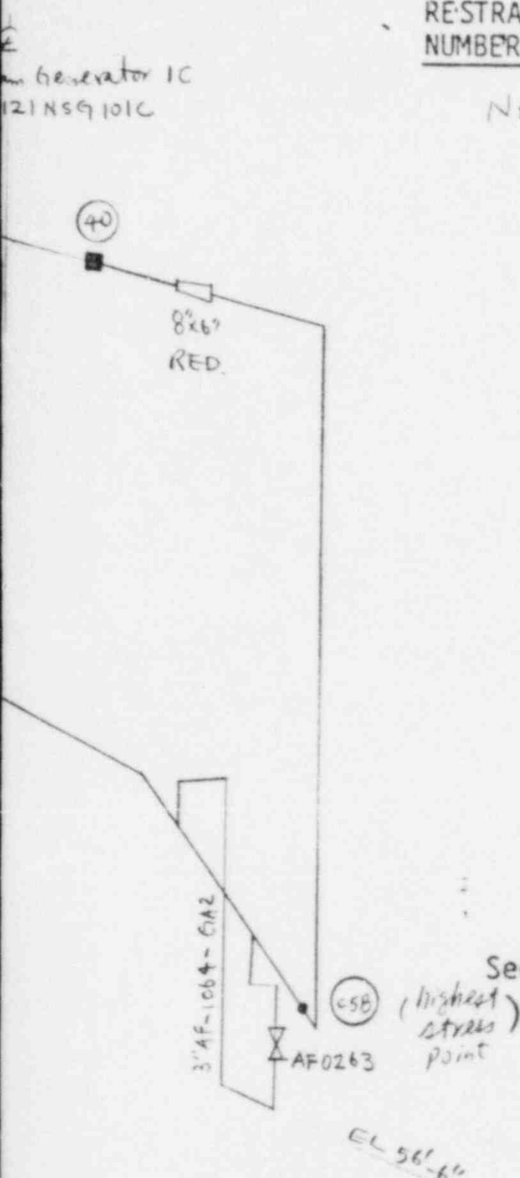


RESTRAINT LOAD SUMMARY

RESTRAINT NUMBER	RESTRAINT DESCRIPTION	DESIGN LOAD (KIPS) BREAK LOCATION
None		



See Initial Stress Summary Results Table 3.6.2-1, SH 3C

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LEGEND

■ POSTULATED BREAK POINT

→ ENERGY ABSORBING RESTRAINT

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POSTULATED BREAK POINTS AND RESTRAINT LOCATIONS

Auxiliary Feedwater Loop 3 (Outside Containment)

Figure 3.6.1-1 Sh 3C

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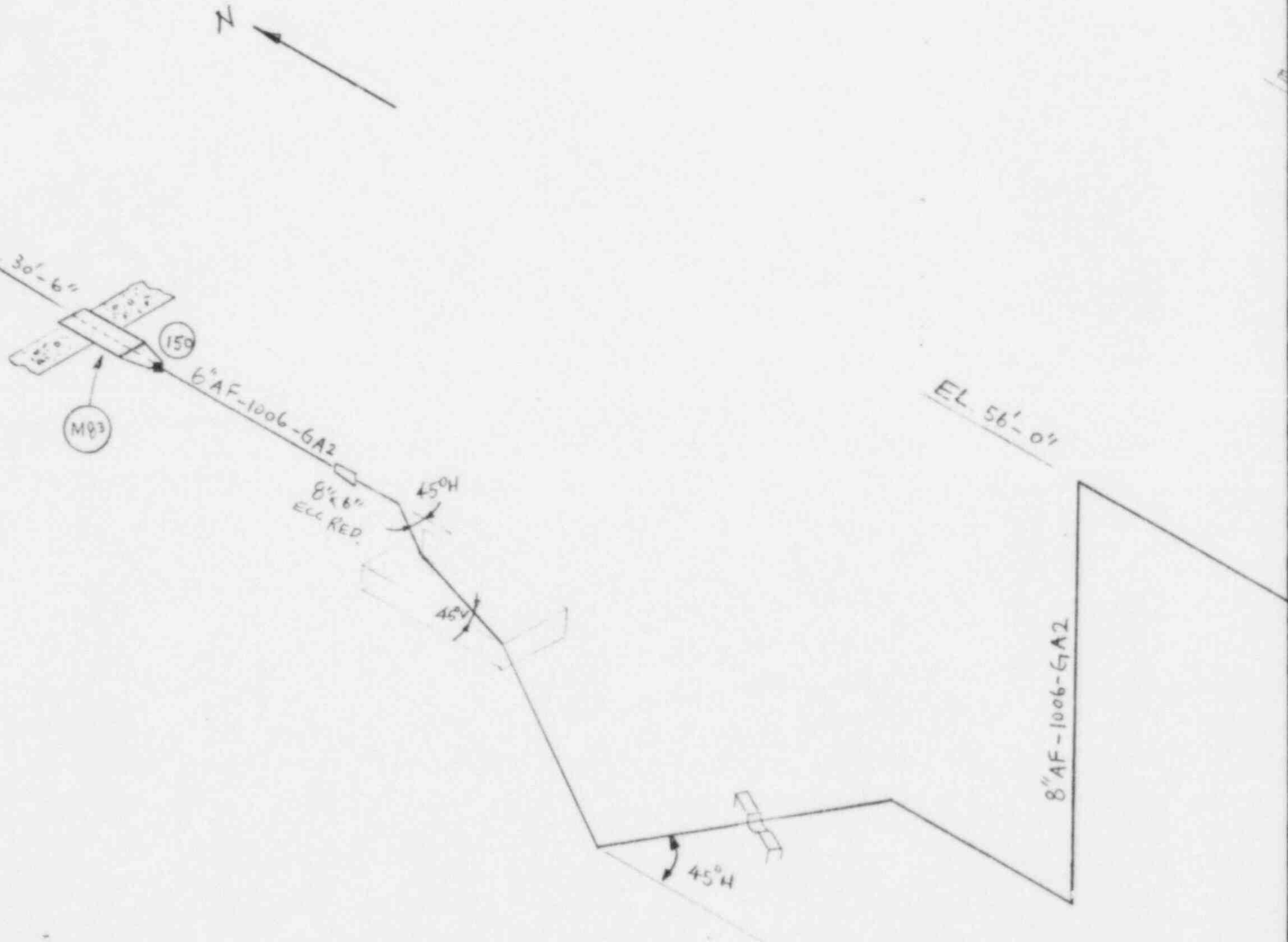
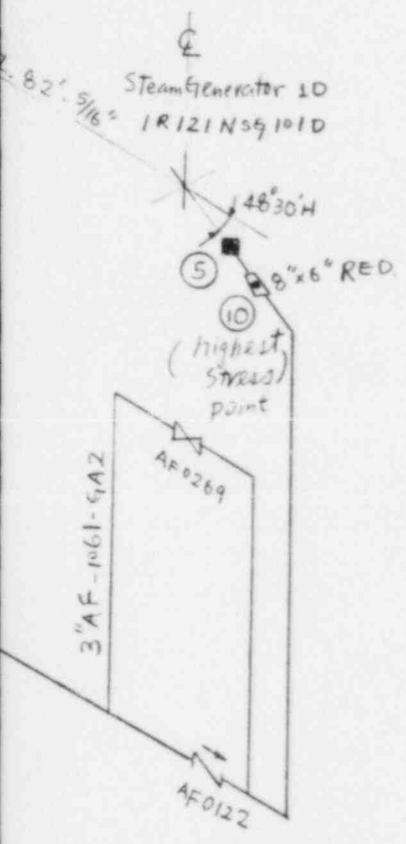


RESTRAINT LOAD SUMMARY

RESTRAINT NUMBER	RESTRAINT DESCRIPTION	DESIGN LOAD (KIPS) BREAK LOCATION
None		



See Initial Stress Summary Results Table 3.6.2-1, SH 3D

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■ POSTULATED BREAK POINT

⟶ ENERGY ABSORBING RESTRAINT

⟶▷ RIGID GUIDE

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POSTULATED BREAK POINTS AND RESTRAINT LOCATIONS

Auxiliary Feedwater Loop 4 (Inside Containment)

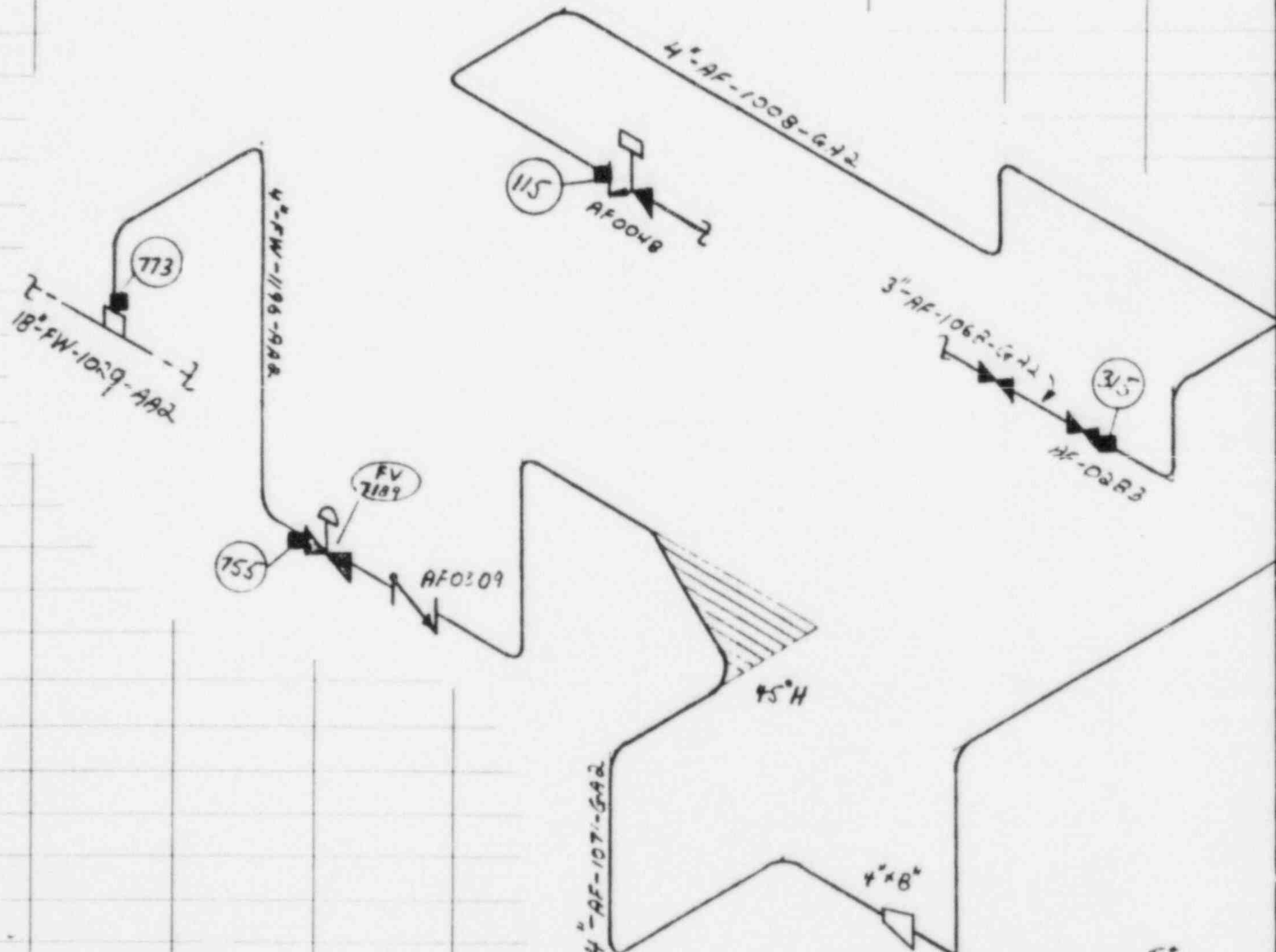
Figure 3.6.1-1 Sheet 3D

SHEET ________ OF ____

JOB NO. ____________________

BY: ____________________

DATE: ____________________



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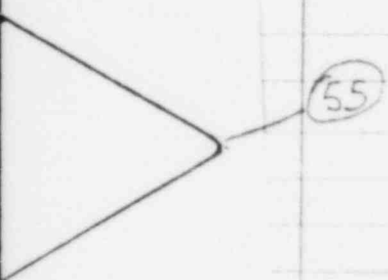


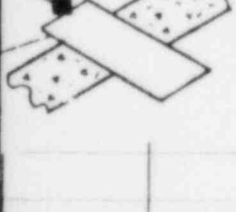
Restraint Load Summary

Restraint Number	Restraint Description	Design Load (Kips) Break Location
NONE		

See Initial Stress Summary table 3.6.2-1 Sh. 4A

LEGEND

- ■ POSTULATED BREAK POINT
- ➔ ENERGY ABSORBING RESTRAINT
- —▷ RIGID GUIDE



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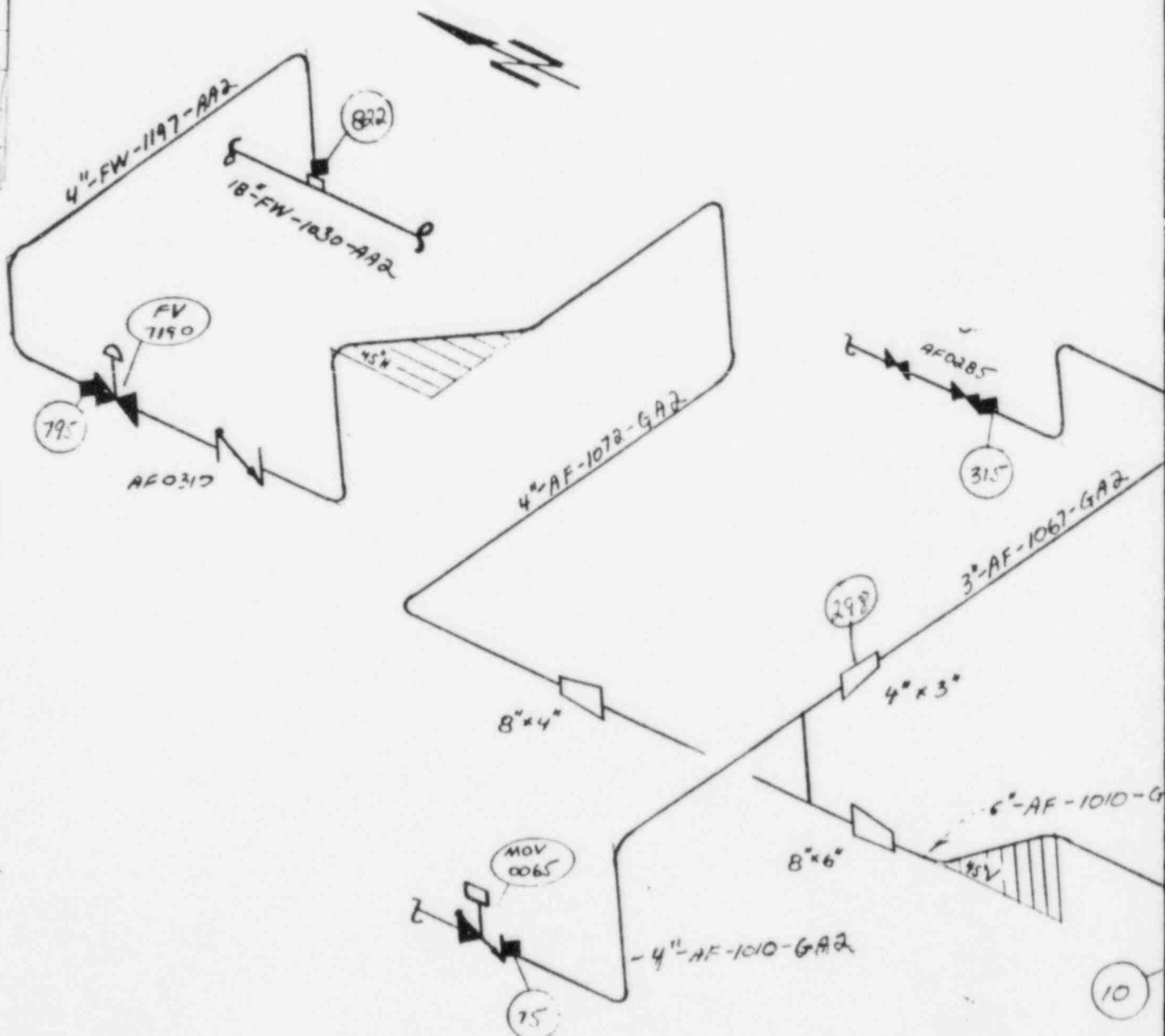
POSTULATED BREAK POINTS AND
RESTRAINT LOCATIONS
Auxiliary Feedwater
Loop 1 (Outside Containment)

Figure 3.6.1-1 sheet 4A

JC
B'
D.


4"-FW-1197-AA2
822
18"-FW-1030-AA2
FV 7190
795
45°H
AF0317
4"-AF-1072-GA2
AF0285
315
3"-AF-1067-GA2
298
8"x4"
4"x3"
6"-AF-1010-G
8"x6"
45°V
MOV 0065
4"-AF-1010-GA2
75
10

Restraint Load Summary

Restraint Number	Restraint Description	Design Load (Kips) Break Location
	NONE	

See Initial Stress Summary table 3.6.2-1 Sh. 4B

LEGEND

■ POSTULATED BREAK POINT
→ ENERGY ABSORBING RESTRAINT
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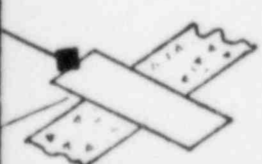

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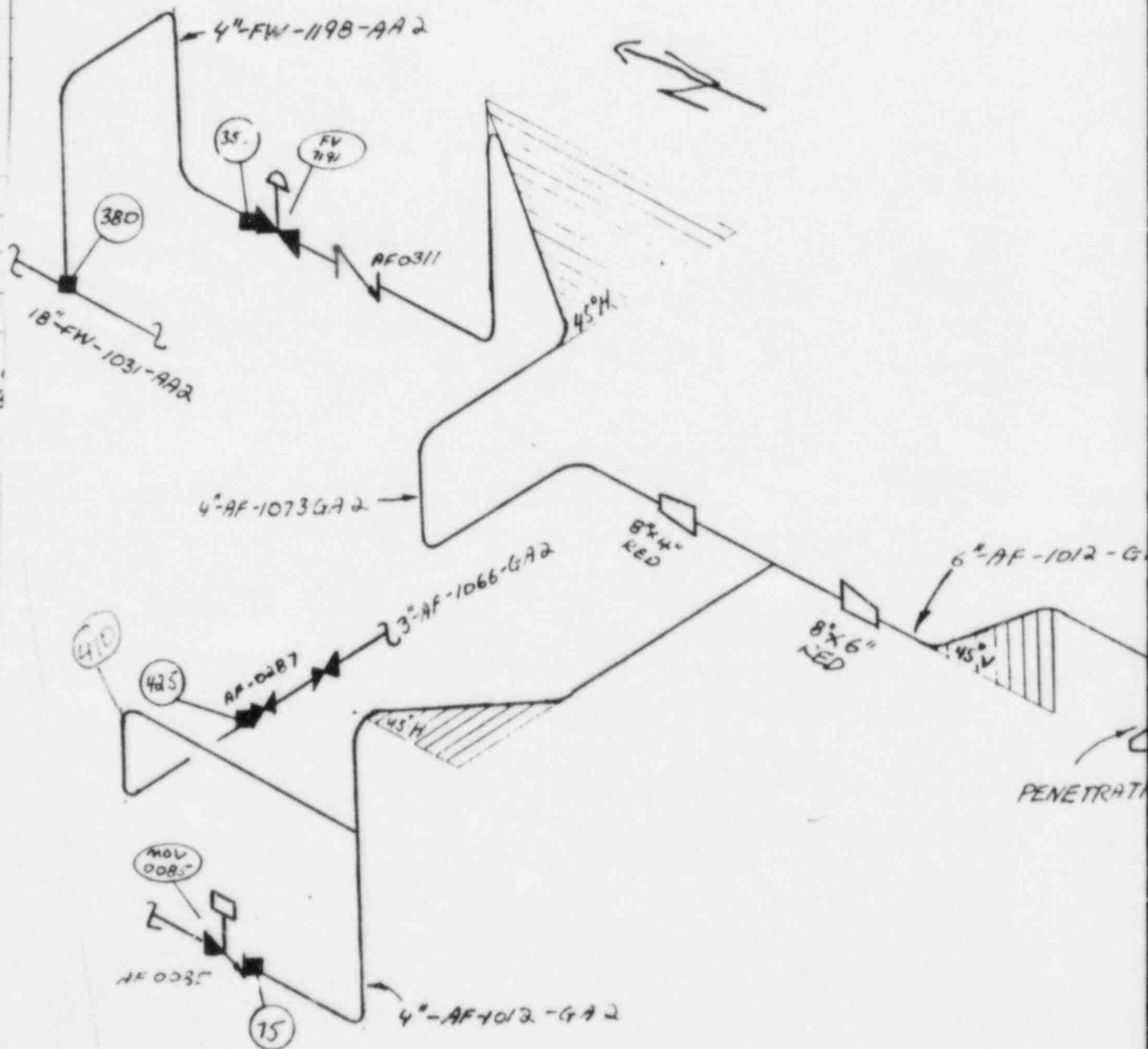
POSTULATED BREAK POINTS AND
RESTRAINT LOCATIONS
Auxiliary Feedwater
Loop 2, Outside Containment

Figure 3.6.1-1 sheet 4B

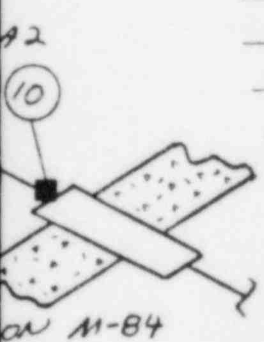
JC
B'
D.


4"-FW-1198-AA2
35
FV 7191
380
AF0311
18"-FW-1031-AA2
45°H
4"-AF-1073GA2
8"x4" RED
3"-AF-1066-GA2
6"-AF-1012-G
8"x6" RED
45°V
410
425
AF-0287
45°H
PENETRATI
MOV 0085
AF0085
75
4"-AF-1012-GA2

Restraint Load Summary

Restraint Number	Restraint Description	Design Load (Kips) Break Location
NONE		

See Initial Stress Summary table 3.6.2-1 Sh. 4C



LEGEND

■ POSTULATED BREAK POINT

→ ENERGY ABSORBING RESTRAINT

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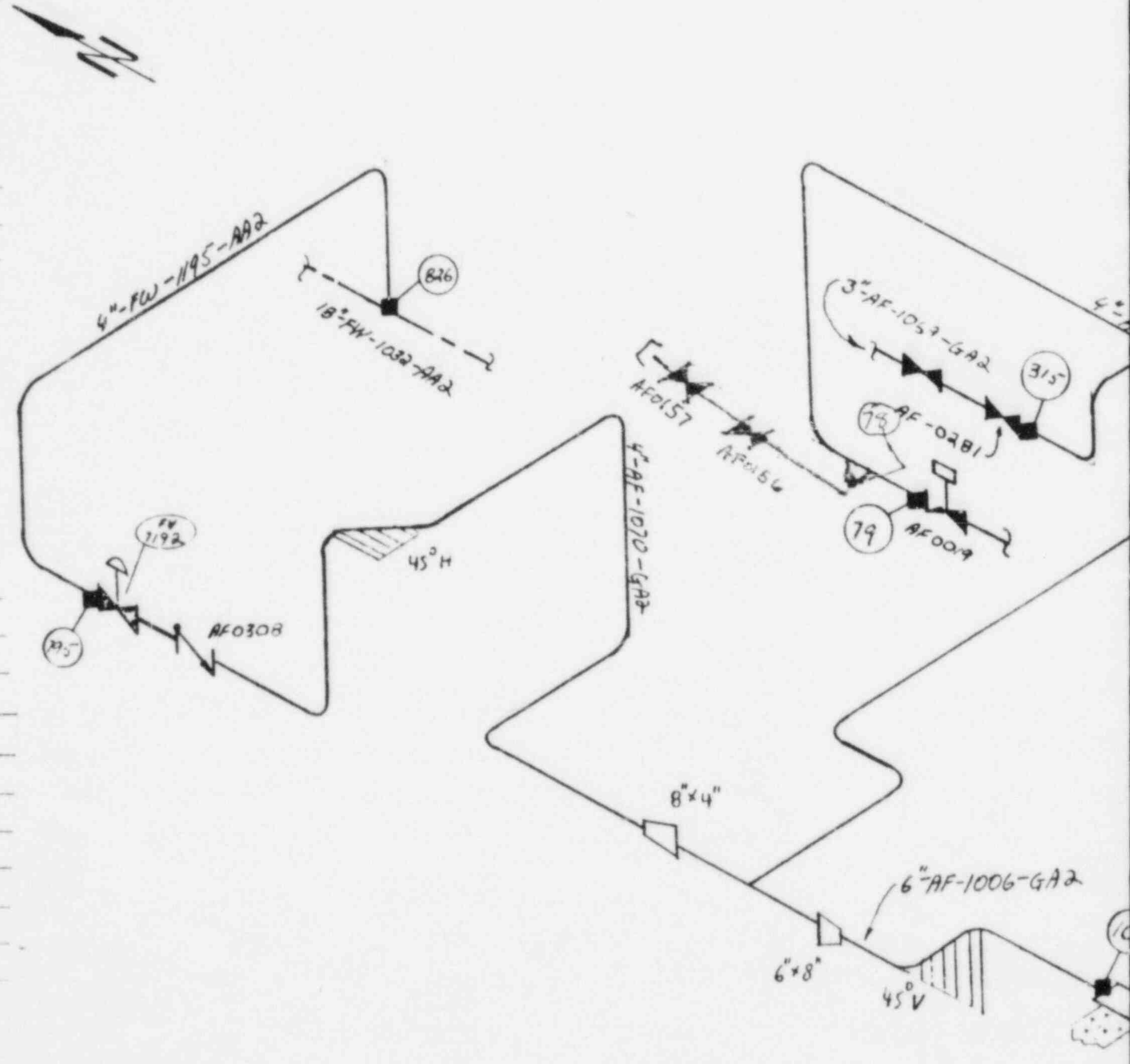
POSTULATED BREAK POINTS AND
RESTRAINT LOCATIONS

Auxiliary Feedwater
Loop 3, Outside Containment

Figure 3.6.1-1 sheet 4C

JC
B'
D.


4"-FW-1195-AA2
826
18"-FW-1032-AA2
FW 1192
795
AF0308
45° H
4"-AF-1070-GA2
AF0157
AF0156
3"-AF-1057-GA2
315
78
AF-0281
79
AF0019
8"x4"
6"-AF-1006-GA2
6"x8"
45° V

Restraint Load Summary

Restraint Number	Restraint Description	Design Load (Kips) Break Location
	NONE	

See Initial Stress Summary table 3.6.2-1 Sh. 4D

LEGEND

■ POSTULATED BREAK POINT

⟶ ENERGY ABSORBING RESTRAINT

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POSTULATED BREAK POINTS AND
RESTRAINT LOCATIONS

Auxiliary Feedwater
Loop 4 Outside Containment
Sheet 4D

Figure 3.6.1-1

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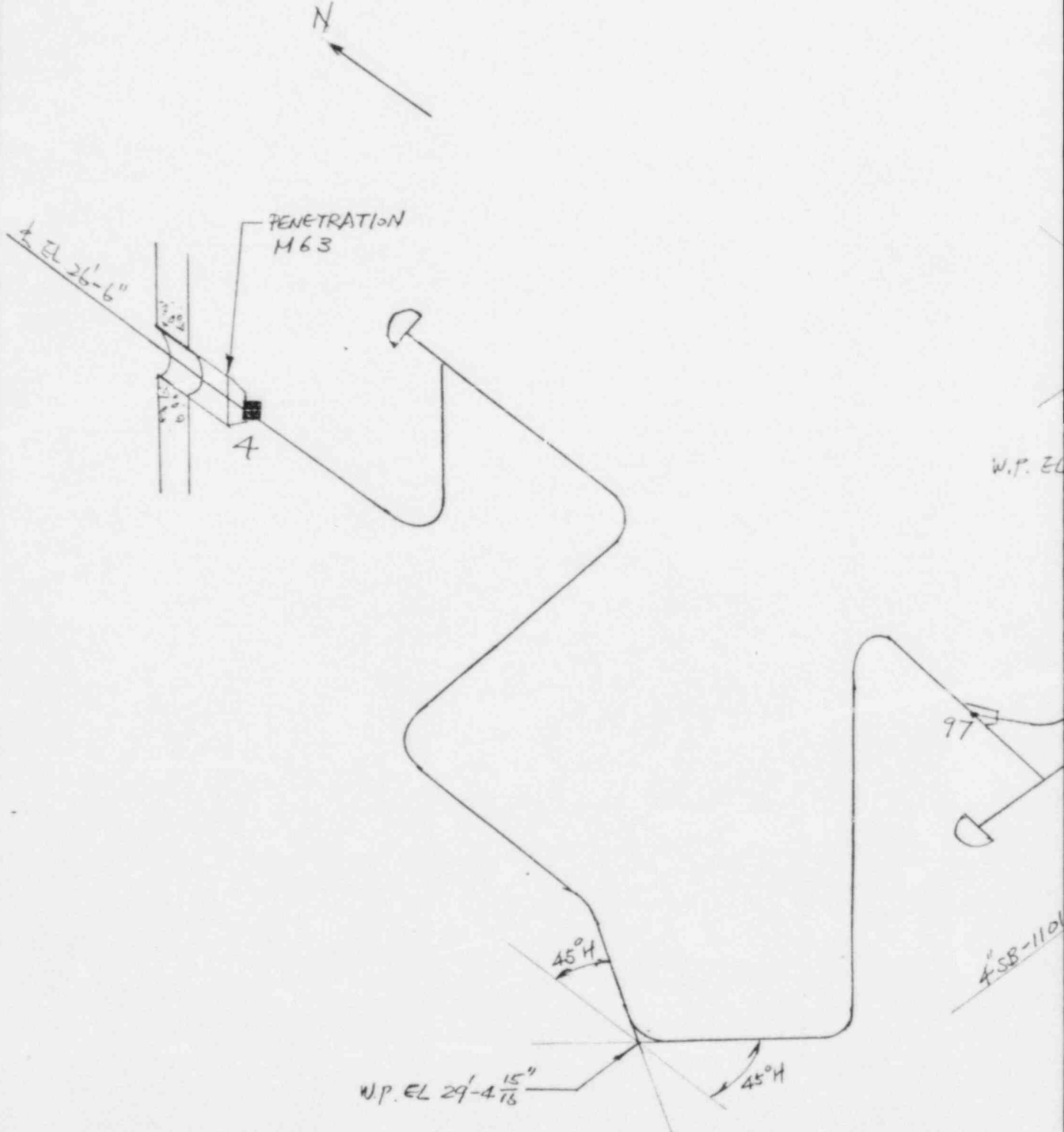

RESTRAINT LOAD SUMMARY

RESTRAINT NUMBER	RESTRAINT DESCRIPTION	DESIGN LOAD (KIPS) BREAK LOCATION

NoNe

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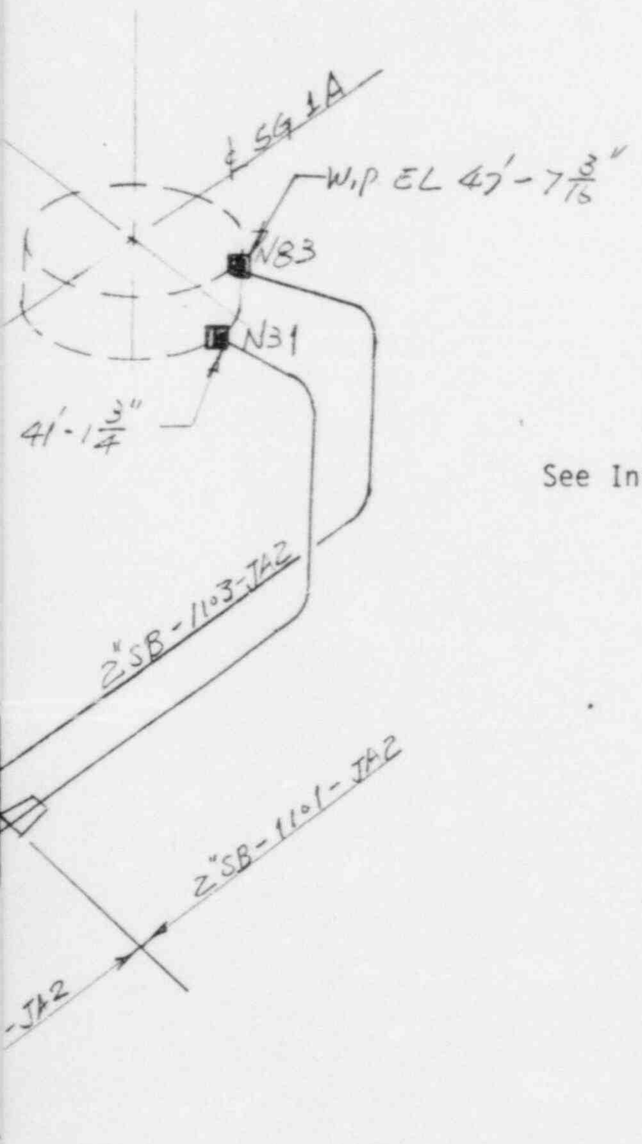

See Initial Stress Summary Results Table 3.6.2-1, SH 5A

LEGEND

■ POSTULATED BREAK POINT

→ ENERGY ABSORBING RESTRAINT

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POSTULATED BREAK POINTS AND RESTRAINT LOCATIONS

Steam Generator Blowdown Loop 1, Inside Containment

Figure 3.6.1-1 Sheet 5A

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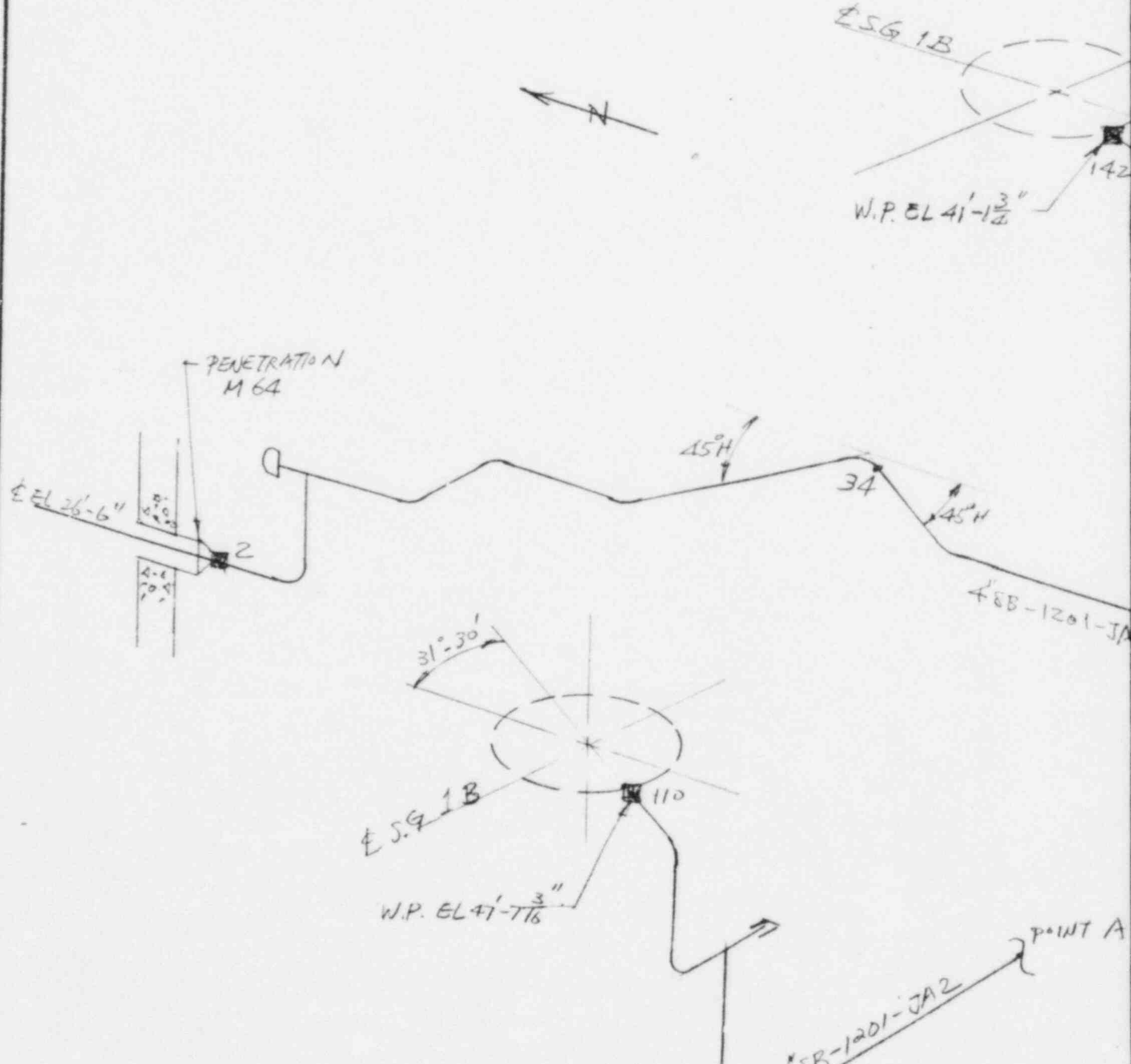
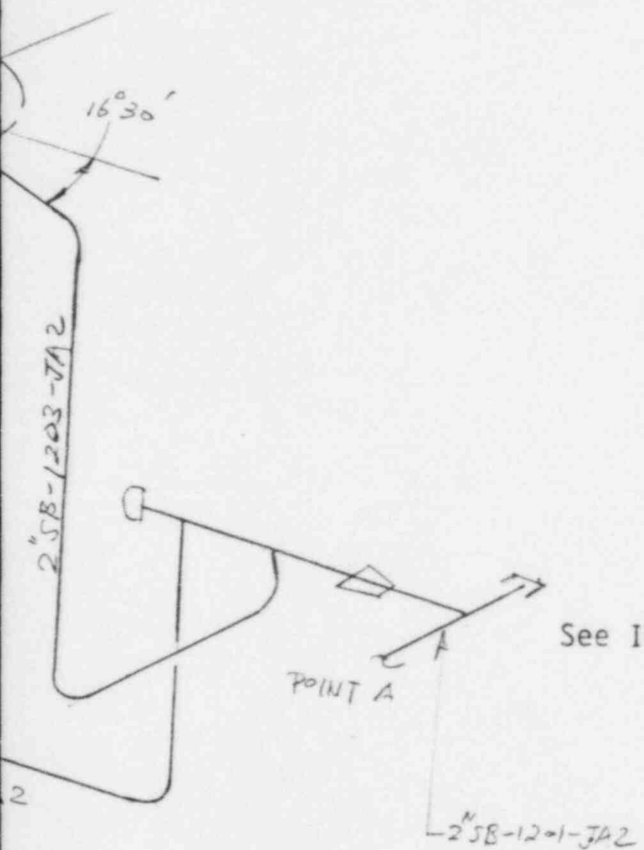


RESTRAINT LOAD SUMMARY

RESTRAINT NUMBER	RESTRAINT DESCRIPTION	DESIGN LOAD (KIPS) BREAK LOCATION
None		



See Initial Stress Summary Results Table 3.6.2-1, SH 5B

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■ POSTULATED BREAK POINT

→ ENERGY ABSORBING RESTRAINT

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POSTULATED BREAK POINTS AND RESTRAINT LOCATIONS

Steam Generator Blowdown Loop 2, Inside Containment

Figure 3.6.1-1 sheet 5B

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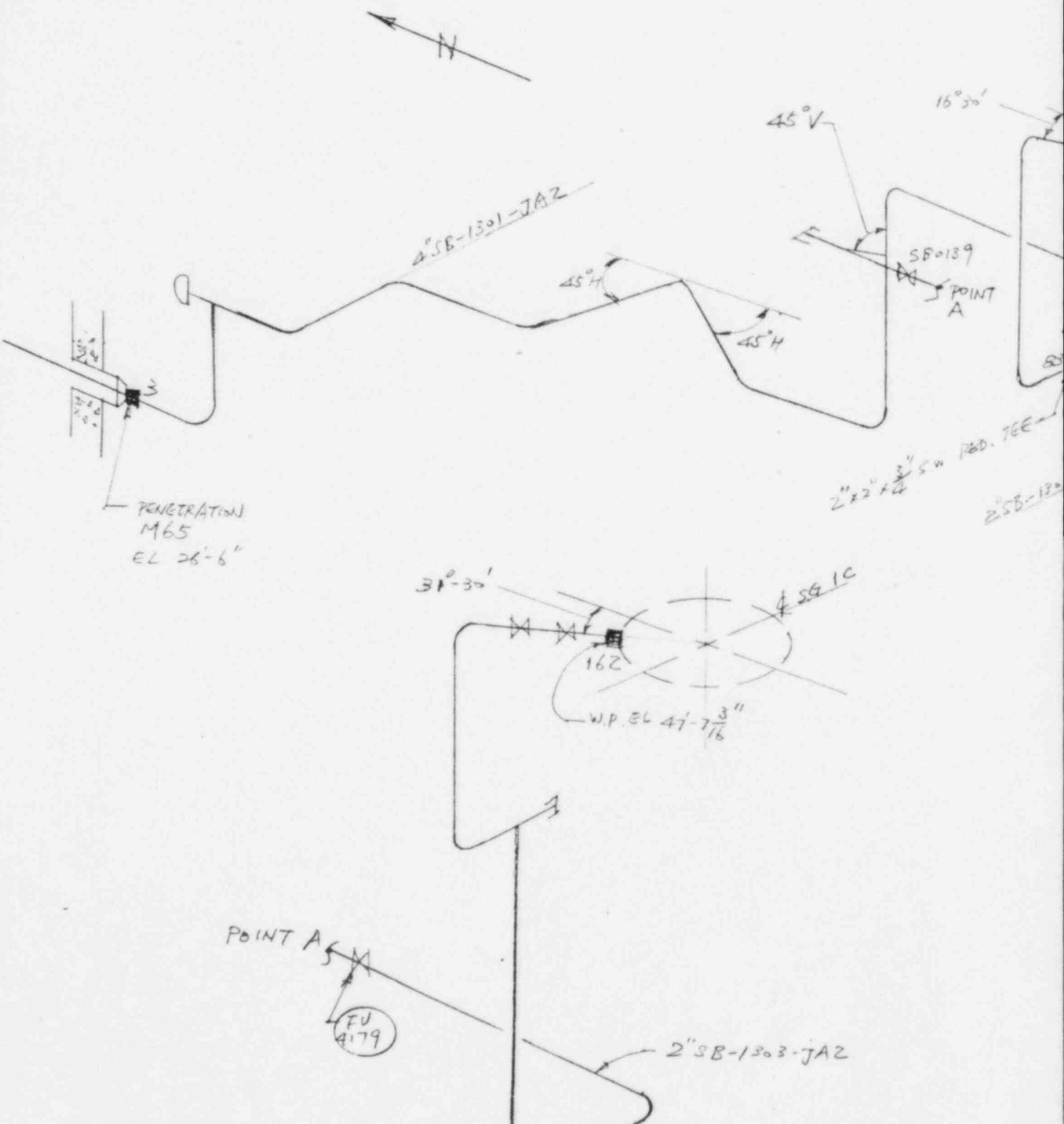
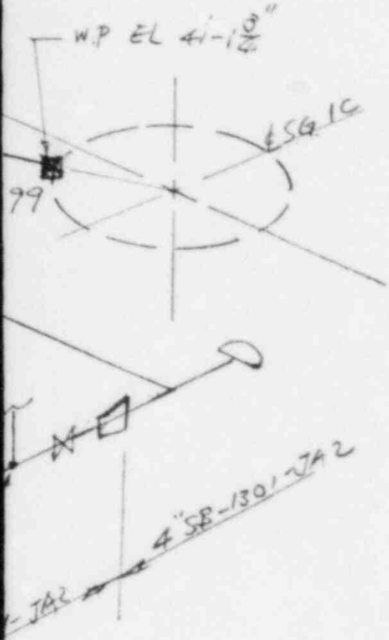


RESTRAINT LOAD SUMMARY

RESTRAINT NUMBER	RESTRAINT DESCRIPTION	DESIGN LOAD (KIPS) BREAK LOCATION

None



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See Initial Stress Summary Results Table 3.6.2-1, SH

LEGEND

■ POSTULATED BREAK POINT

→ ENERGY ABSORBING RESTRAINT

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SOUTH TEXAS PROJECT
UNITS 1 & 2

POSTULATED BREAK POINTS AND RESTRAINT LOCATIONS

Steam Generator Blowdown

Loop 3, Inside Containment

Figure 3.6.1-1 sheet 8C

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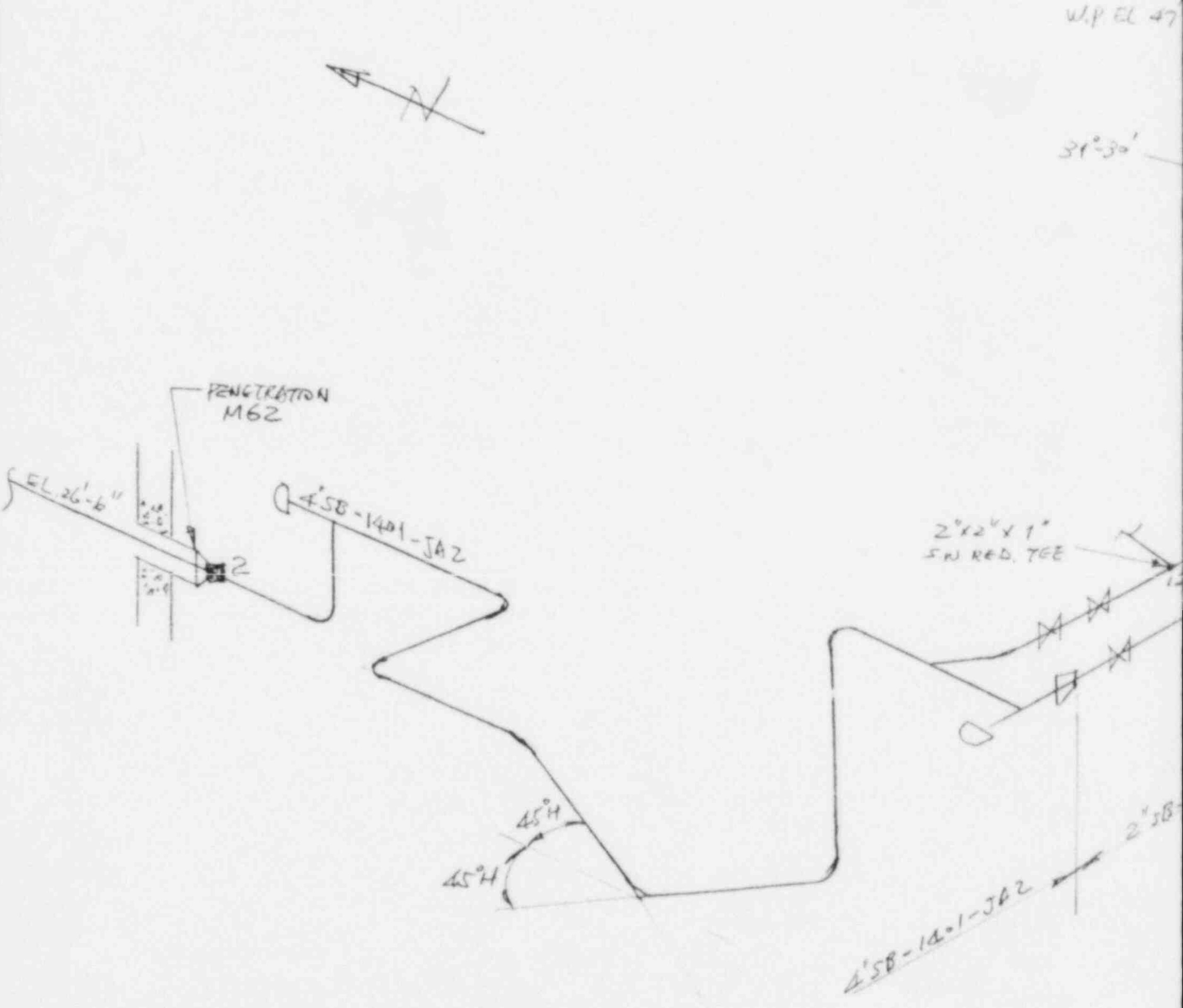
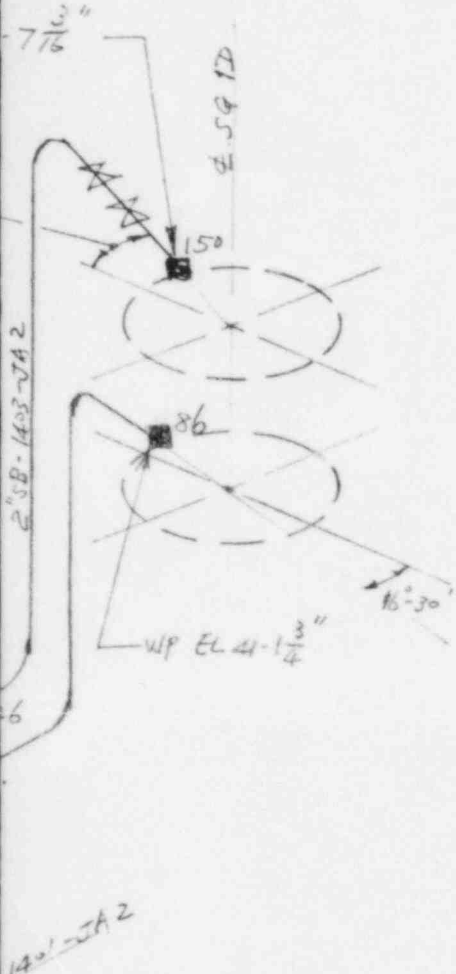


RESTRAINT LOAD SUMMARY

RESTRAINT NUMBER	RESTRAINT DESCRIPTION	DESIGN LOAD (KIPS) BREAK LOCATION
None		



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See Initial Stress Summary Results Table 3.6.2-1, SH 5D

LEGEND

■ POSTULATED BREAK POINT

→ ENERGY ABSORBING RESTRAINT

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SOUTH TEXAS PROJECT
UNITS 1 & 2

POSTULATED BREAK POINTS AND RESTRAINT LOCATIONS
Steam Generator Blowdown
Loop 4, Inside Containment

Figure 3.6.1-1 Sheet 5D

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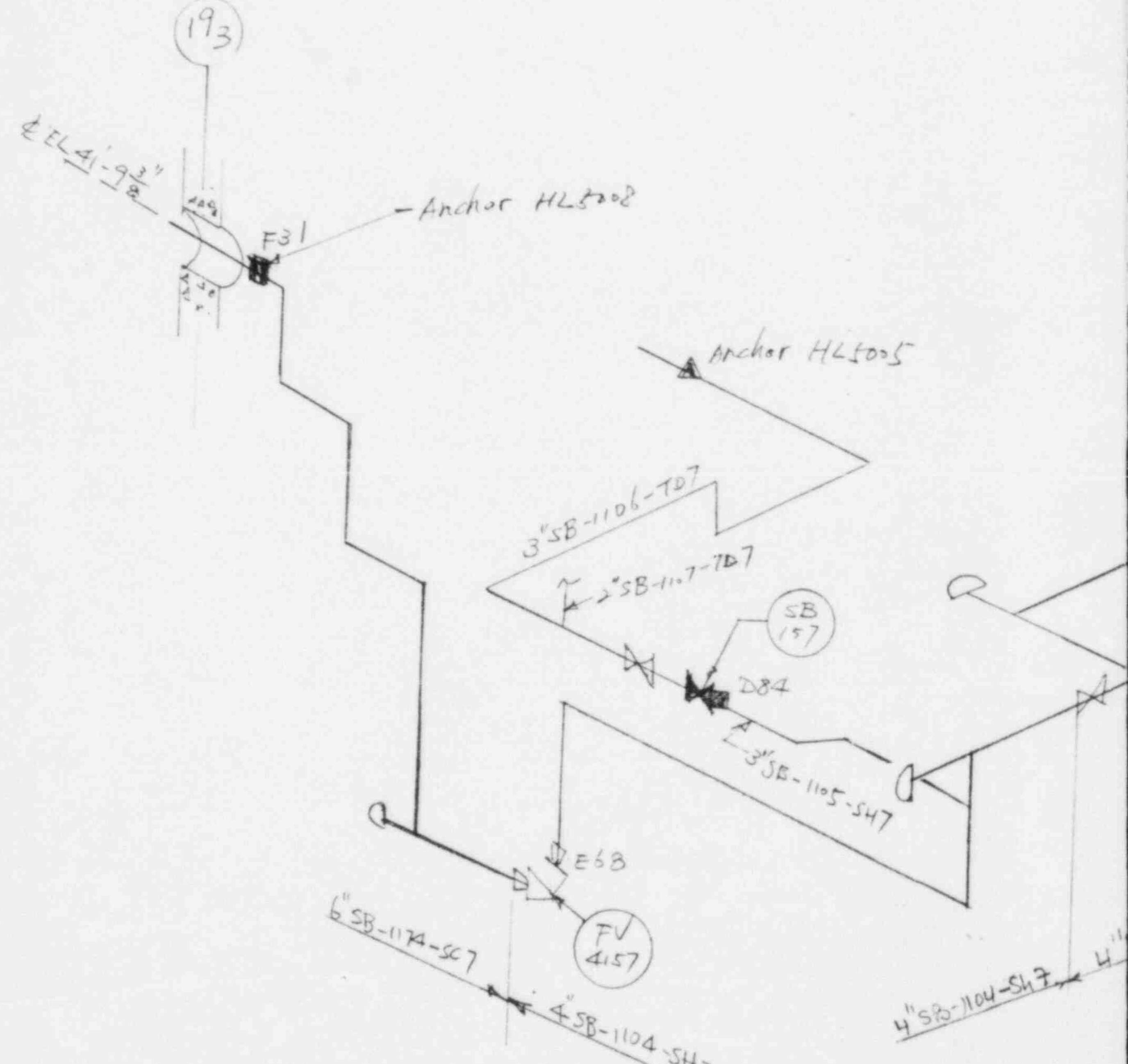

RESTRAINT LOAD SUMMARY

RESTRAINT NUMBER	RESTRAINT DESCRIPTION	DESIGN LOAD (KIPS) BREAK LOCATION

None

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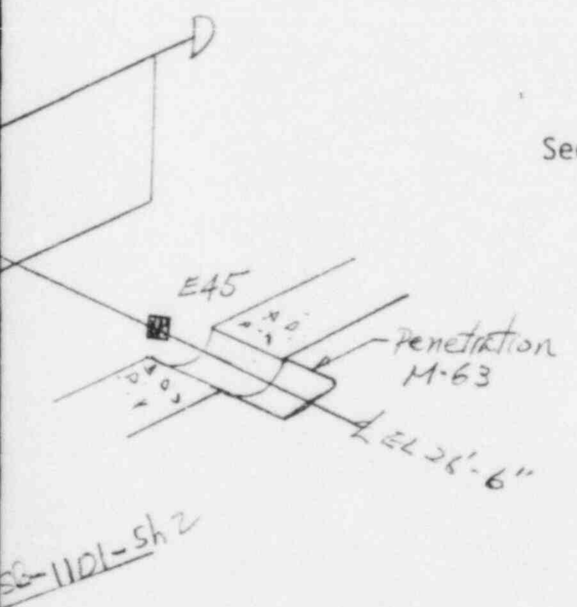

See Initial Stress Summary Results Table 3.6.2-1, SH 6A

LEGEND

■ POSTULATED BREAK POINT

➞ ENERGY ABSORBING RESTRAINT

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POSTULATED BREAK POINTS AND RESTRAINT LOCATIONS
Steam Generator Blowdown
Loop 1, Outside Containment

Figure 3.6.1-1 Sheet 6A

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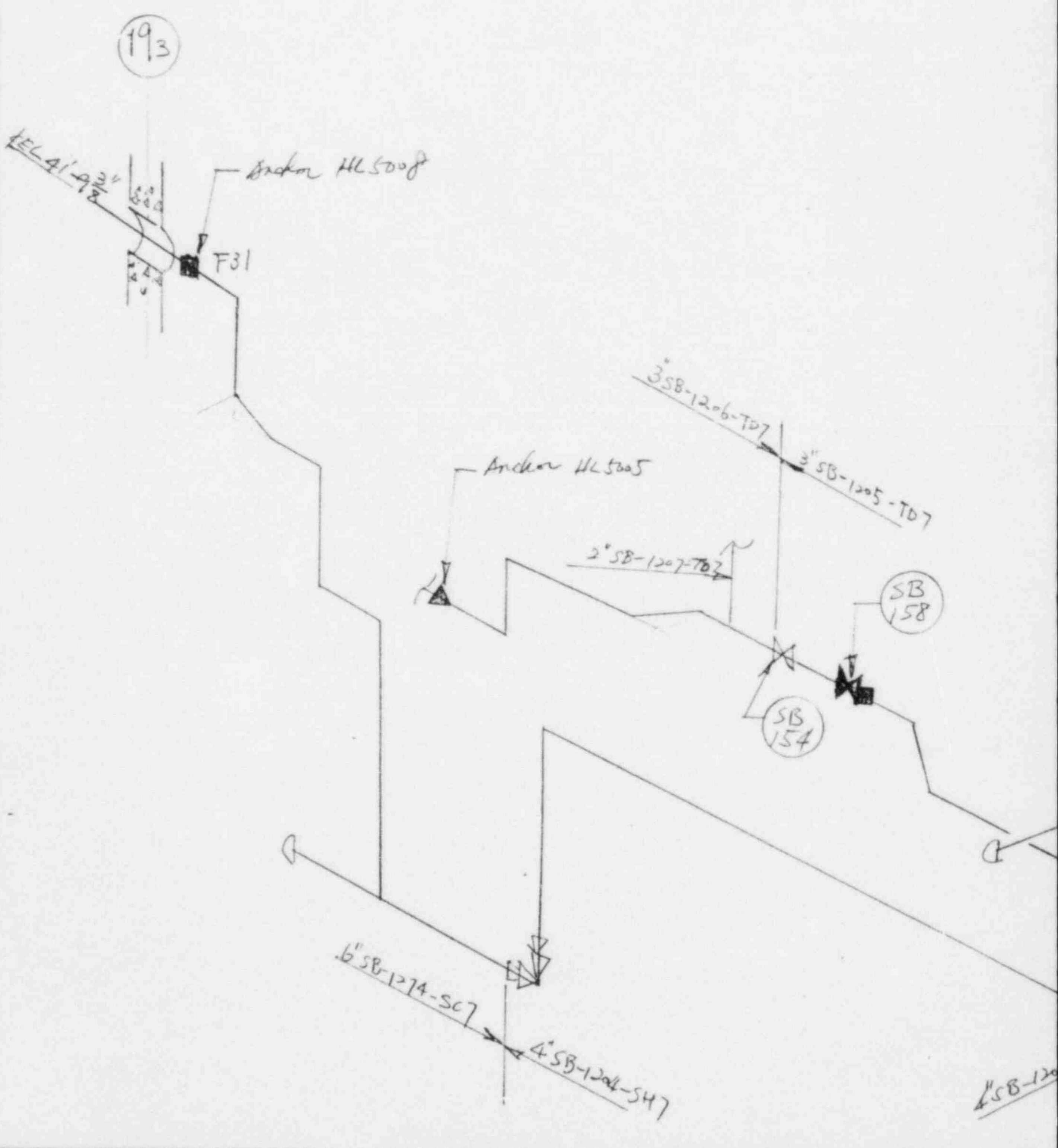


RESTRAINT LOAD SUMMARY

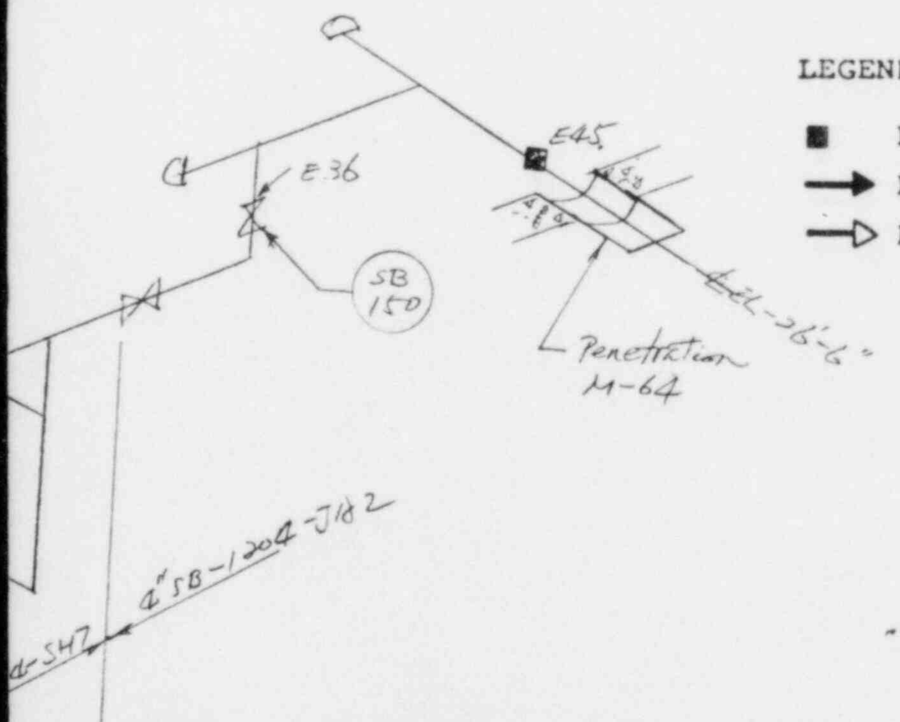
RESTRAINT NUMBER	RESTRAINT DESCRIPTION	DESIGN LOAD (KIPS) BREAK LOCATION

None

TI APERTURE CARD

Also Available On Aperture Card

See Initial Stress Summary Results Table 3.6.2-1, SH 6B



LEGEND

■ POSTULATED BREAK POINT

→ ENERGY ABSORBING RESTRAINT

—▷ RIGID GUIDE

8510180333-14

SOUTH TEXAS PROJECT UNITS 1 & 2

POSTULATED BREAK POINTS AND RESTRAINT LOCATIONS

Steam Generator Blowdown Loop 2, Outside Containment

Figure 3.6.1-1 Sheet 6B

ATTACHMENT 1
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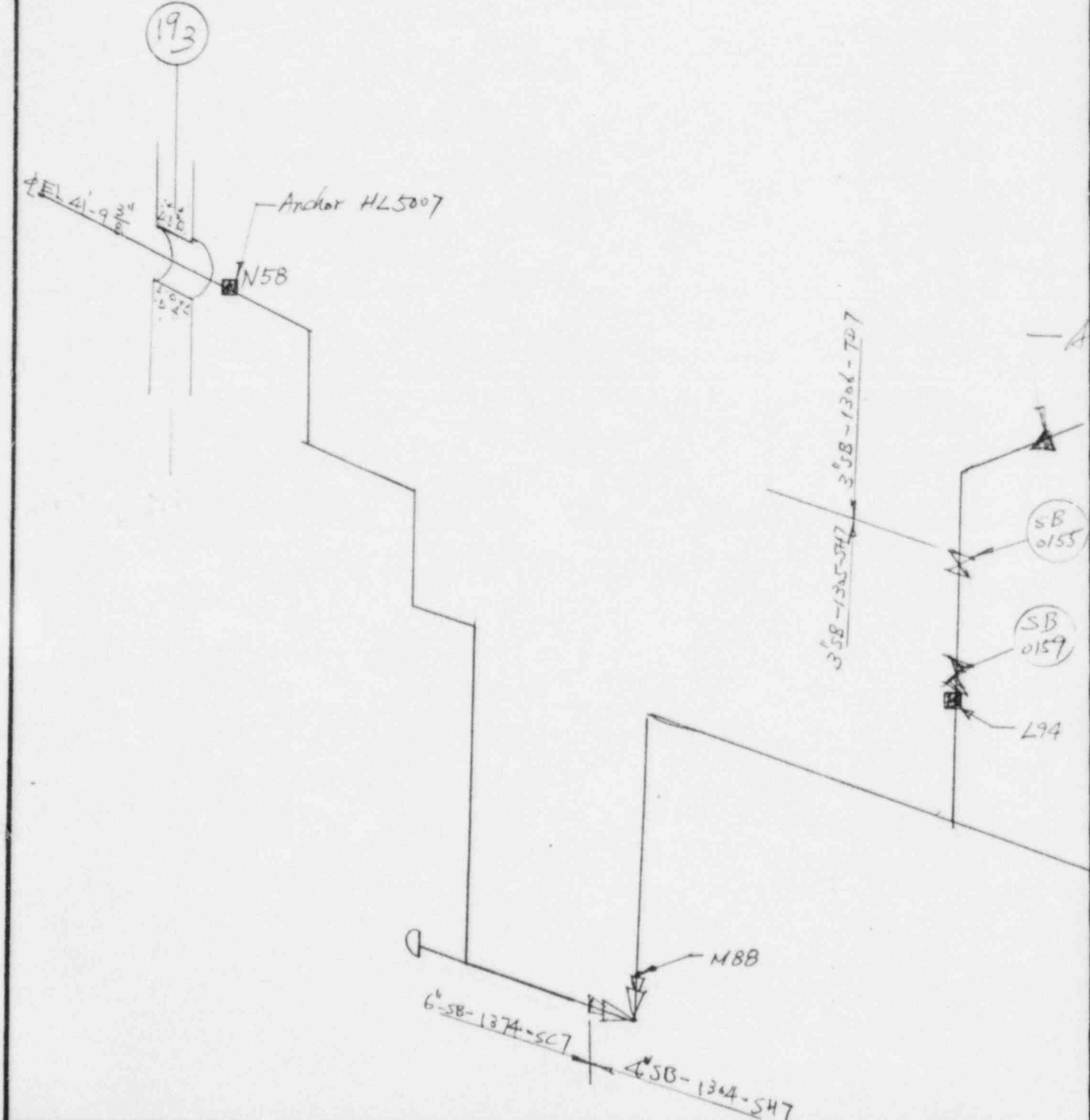


RESTRAINT LOAD SUMMARY

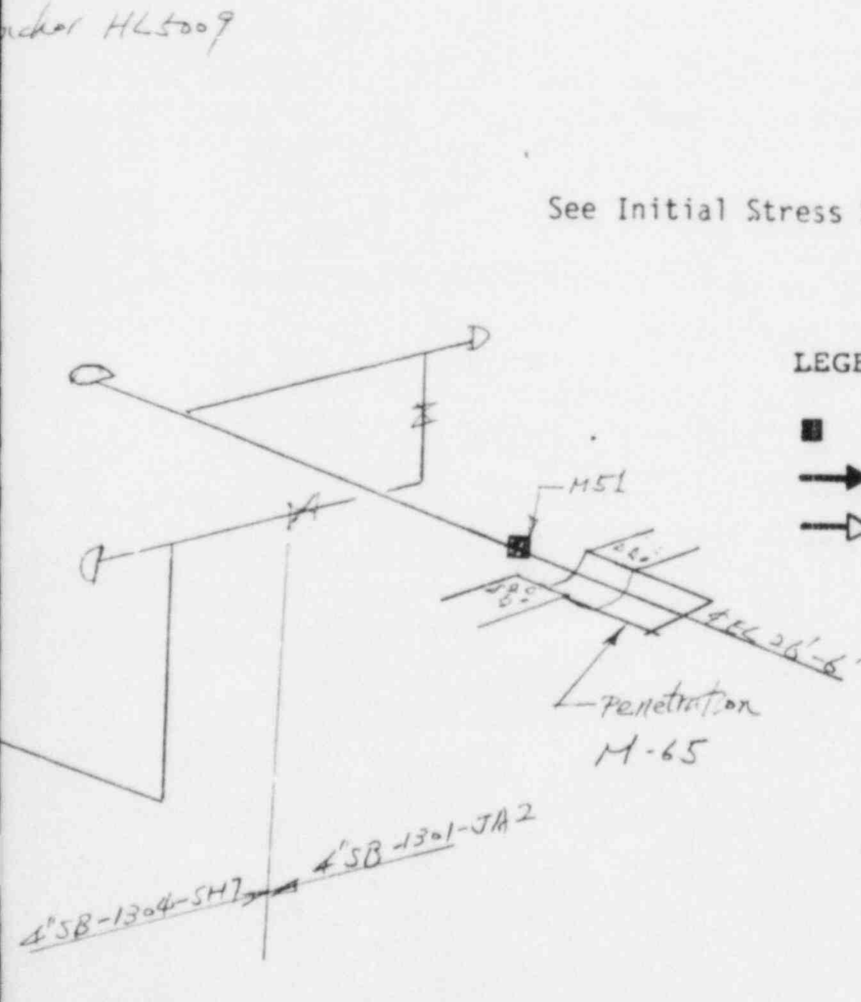
RESTRAINT NUMBER	RESTRAINT DESCRIPTION	DESIGN LOAD (KIPS) BREAK LOCATION

None

TI APERTURE CARD

Also Available On Aperture Card

See Initial Stress Summary Results Table 3.6.2-1, SH 6C



LEGEND

■ POSTULATED BREAK POINT

➞ ENERGY ABSORBING RESTRAINT

—▷ RIGID GUIDE

8510180333-15

SOUTH TEXAS PROJECT UNITS 1 & 2

POSTULATED BREAK POINTS AND RESTRAINT LOCATIONS

Steam Generator Blowdown Loop 3, Outside Containment

Figure 3.6.1-1 Sheet 6C

ATTACHMENT 1
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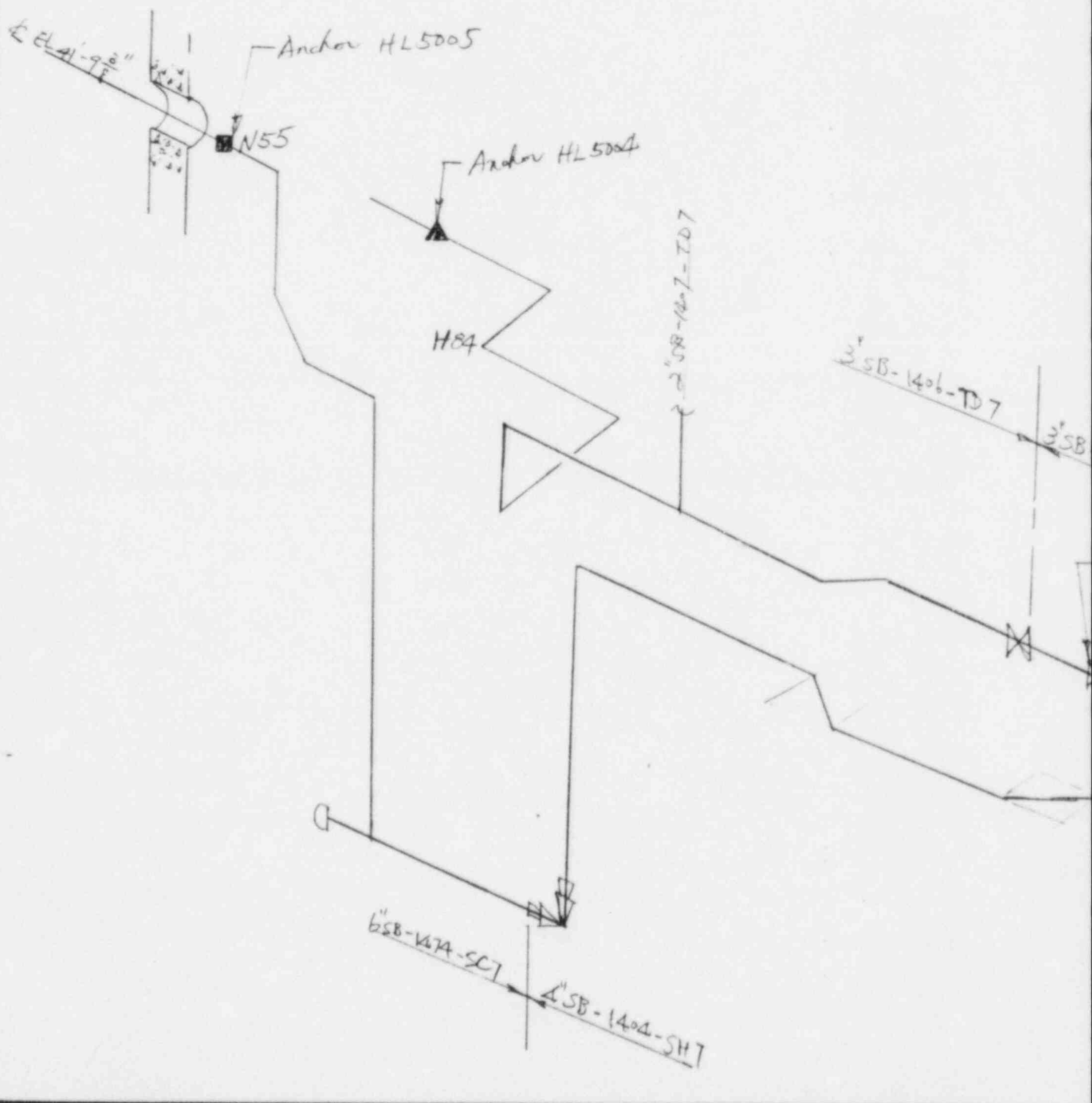


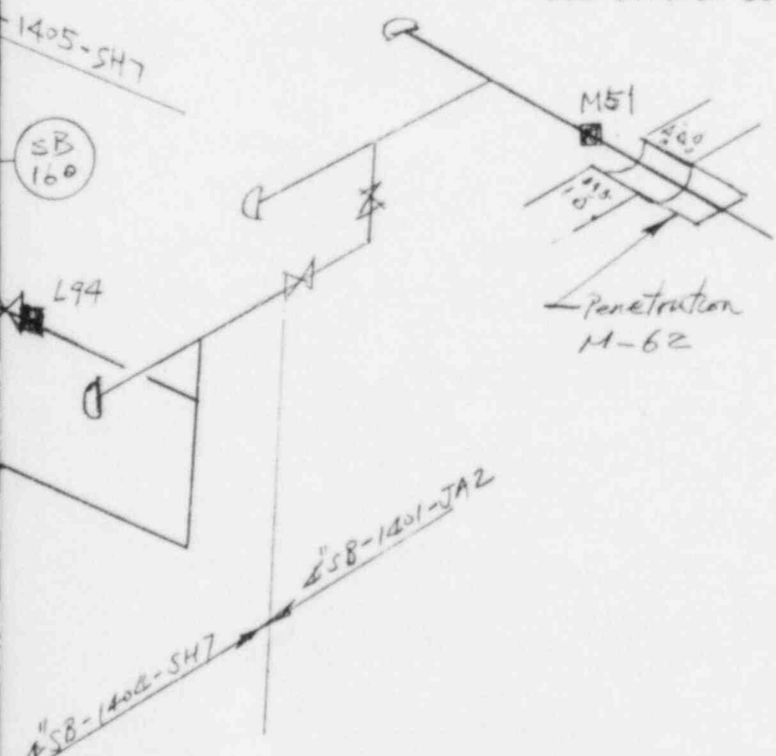
RESTRAINT LOAD SUMMARY

RESTRAINT NUMBER	RESTRAINT DESCRIPTION	DESIGN LOAD (KIPS) BREAK LOCATION
	None	

TI APERTURE CARD

Also Available On Aperture Card

See Initial Stress Summary Results Table 3.6.2-1, SH 6.D



LEGEND

■ POSTULATED BREAK POINT

→ ENERGY ABSORBING RESTRAINT

—▷ RIGID GUIDE

8510180333-16

SOUTH TEXAS PROJECT UNITS 1 & 2

POSTULATED BREAK POINTS AND RESTRAINT LOCATIONS

Steam Generator Blowdown Loop 4, Outside Containment

Figure 3.6.1-1 Sheet 6D

ATTACHMENT 1
ST-HL-AE-1389
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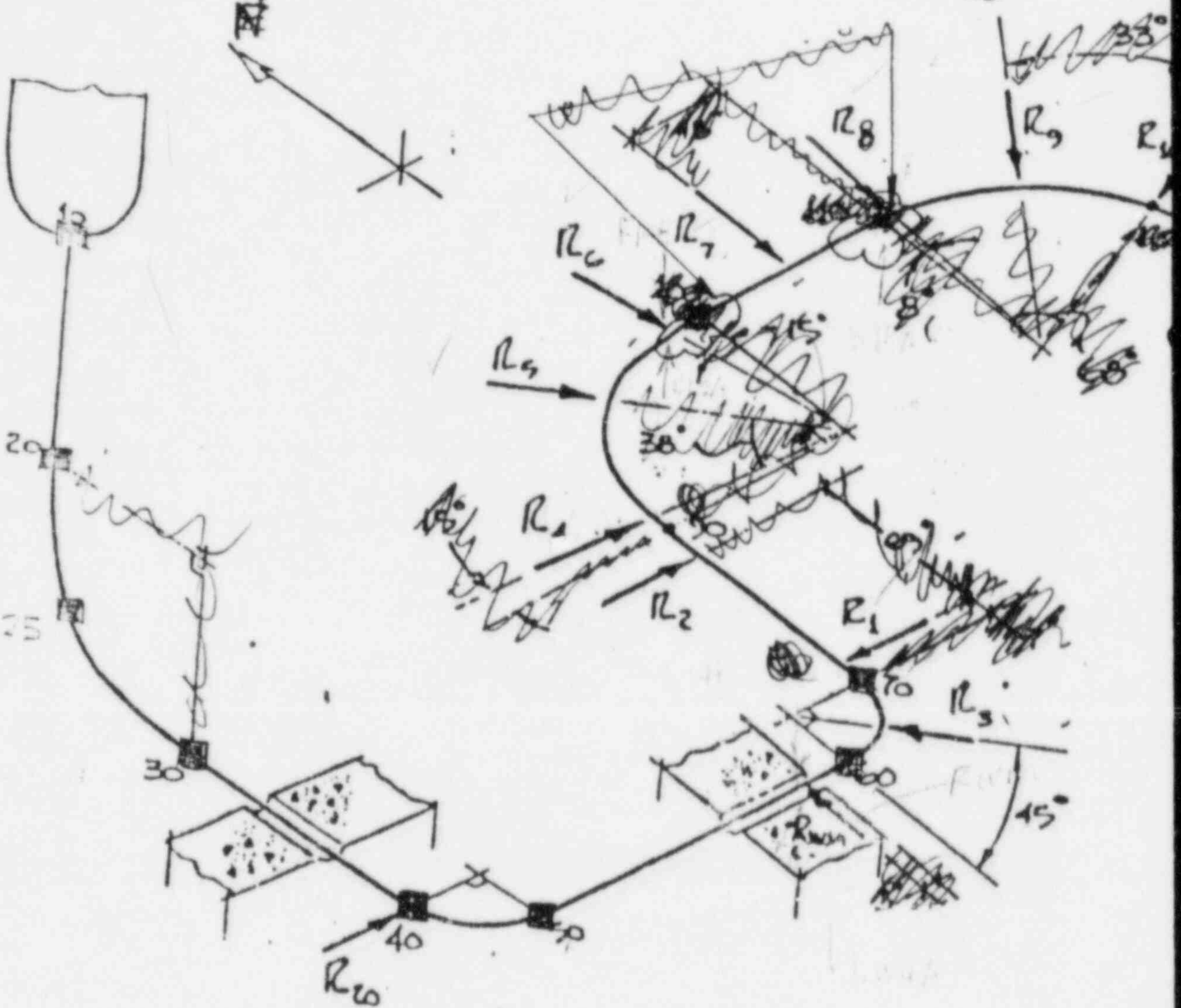
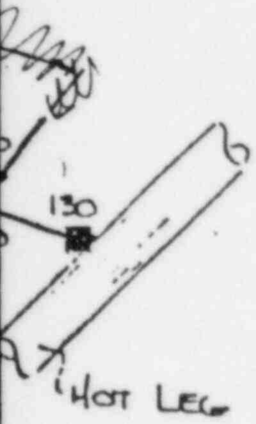




RESTRAINT LOAD SUMMARY

RESTRAINT NUMBER	RESTRAINT DESCRIPTION	DESIGN LOAD (KIPS) BREAK LOCATION 130	70	60
RC 1412-R1	EAM	270		300
RC-1412 R11A			250	250
RC-1412 R11B			250	250
RC-1412-R2		200	200	
RC-1412-R5	EAM	300	300	300
RC-1412-R6	EAM		250	250
R14A	RIGID	34	34	34
R14B	RIGID	34	34	34
R8	EAM	250	250	
R15A	RIGID	34	34	34
R15B	RIGID	34	34	34
R9	EAM	250	250	
RW1A	RIGID	400	610	
RW4A			230	410
RW4B			230	410

See Initial Stress Summary Results Table 3.6.2-1, SH 7A

LEGEND

■ POSTULATED BREAK POINT

➔ ENERGY ABSORBING RESTRAINT

—▷ RIGID GUIDE

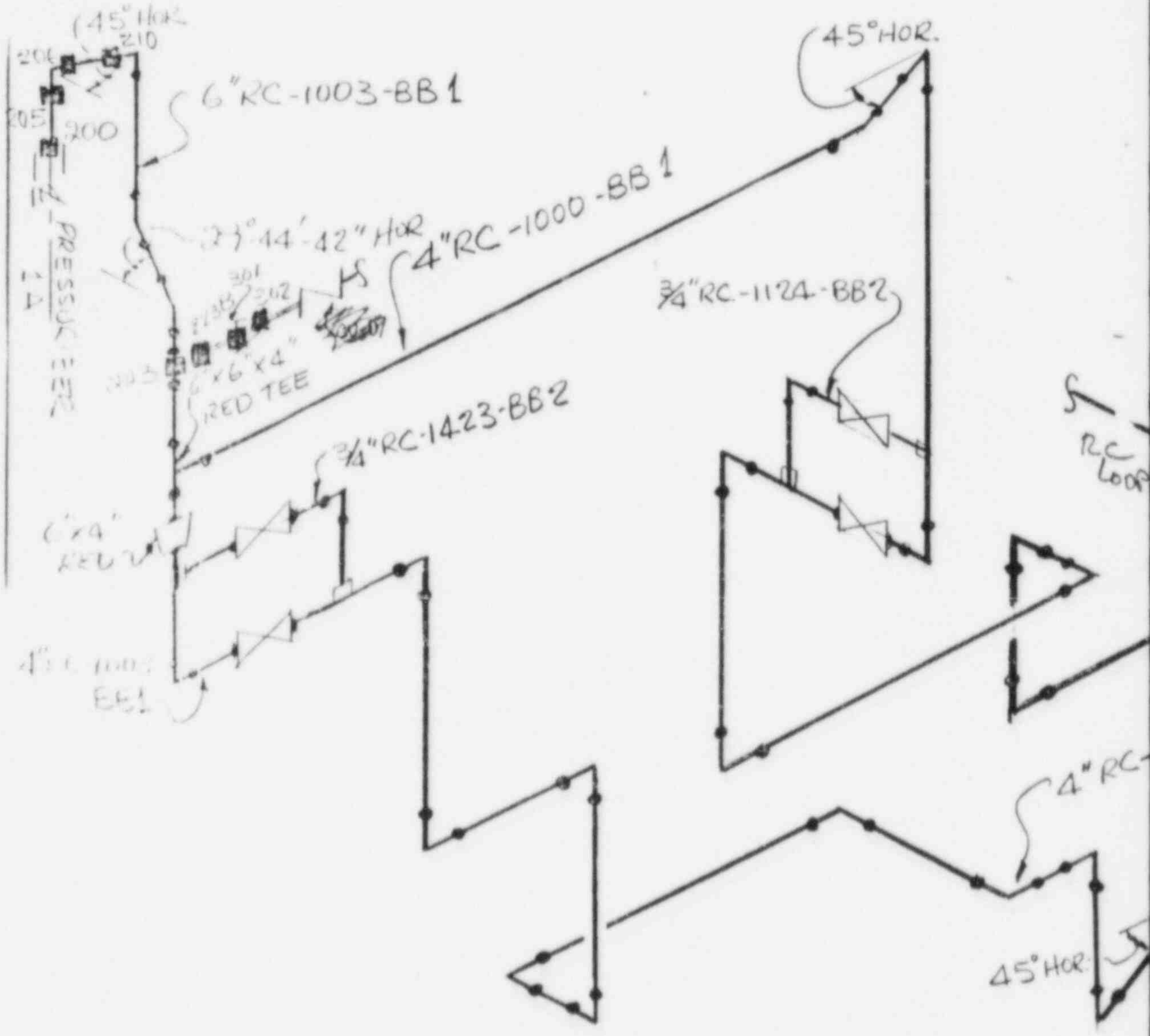
SOUTH TEXAS PROJECT UNITS 1 & 2

POSTULATED BREAK POINTS AND RESTRAINT LOCATIONS

RCS Surge Line

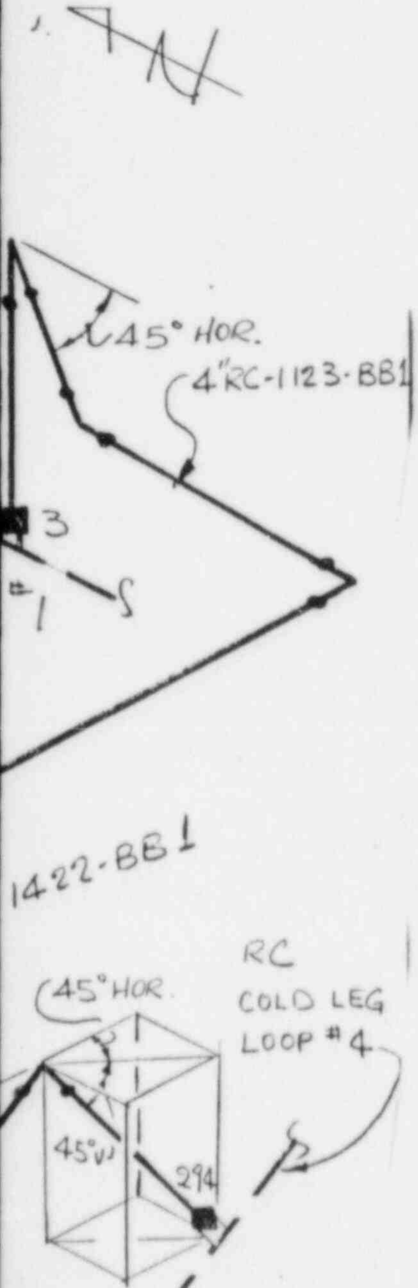
Figure 3.6.1-1 Sheet 7A

ATTACHMENT 1
ST-HL-AE-1389
PAGE 69 OF 124



RESTRAINT LOAD SUMMARY

RESTRAINT NUMBER	RESTRAINT DESCRIPTION	DESIGN LOAD (KIPS) BREAK LOCATION
NONE		



TI
APERTURE
CARD

Also Available On
Aperture Card

See Initial Stress Summary Results Table 3.6.2-1, SH 7B

LEGEND

■ POSTULATED BREAK POINT

➞ ENERGY ABSORBING RESTRAINT

—▷ RIGID GUIDE

SOUTH TEXAS PROJECT
UNITS 1 & 2

POSTULATED BREAK POINTS AND RESTRAINT LOCATIONS

Pressurizer Spray Line

8510180333-18

Figure 3.6.1-1 Sheet 7B

ATTACHMENT 1
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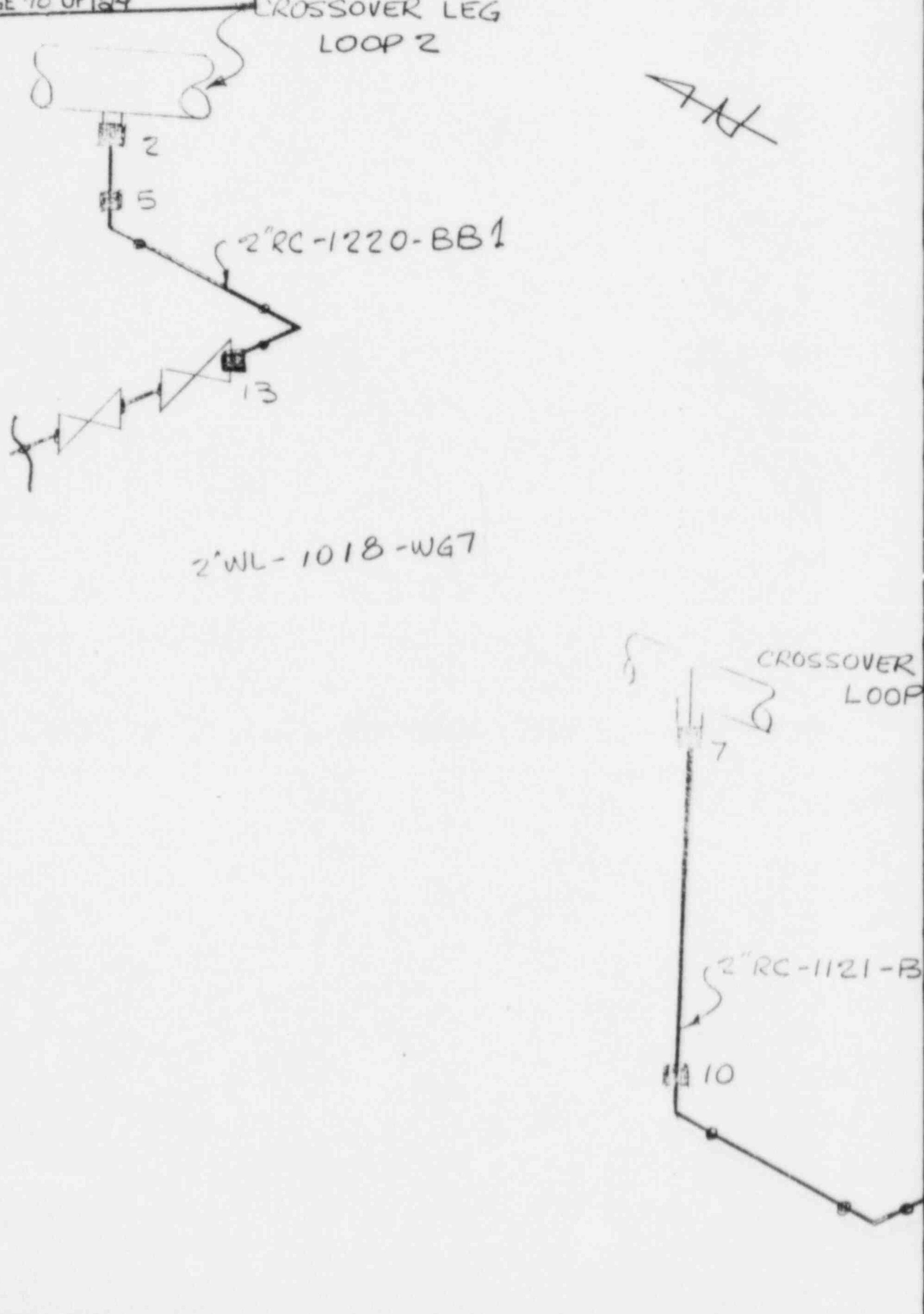


RESTRAINT LOAD SUMMARY

RESTRAINT NUMBER	RESTRAINT DESCRIPTION	DESIGN LOAD (KIPS) BREAK LOCATION

NONE

TI APERTURE CARD

Also Available On Aperture Card

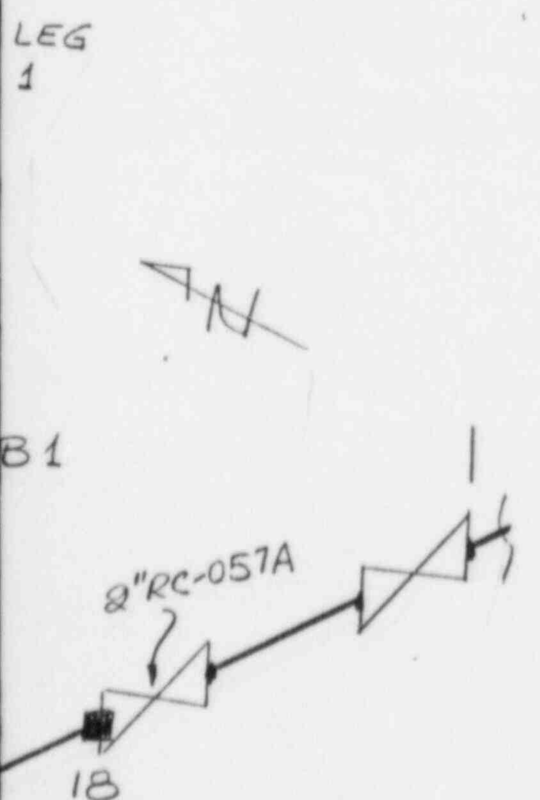
See Initial Stress Summary Results Table 3.6.2-1, SH 7C & 7D

LEGEND

■ POSTULATED BREAK POINT

→ ENERGY ABSORBING RESTRAINT

—▷ RIGID GUIDE



SOUTH TEXAS PROJECT UNITS 1 & 2

POSTULATED BREAK POINTS AND RESTRAINT LOCATIONS

Reactor Coolant Loop 1 and 2 Drain Lines

Figure 3.6.1-1 Sh 7C

8510180333-19

ATTACHMENT 1
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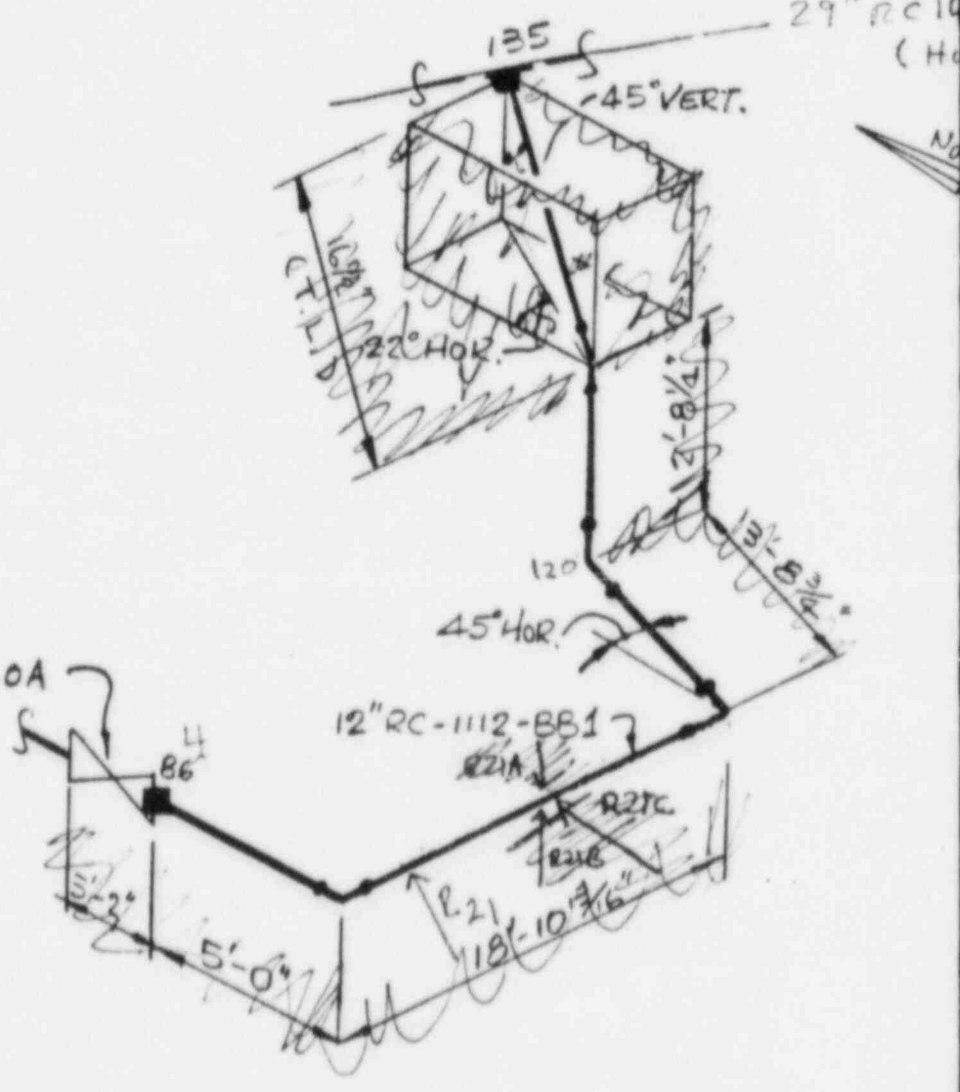

RESTRAINT LOAD SUMMARY

RESTRAINT NUMBER	RESTRAINT DESCRIPTION	DESIGN LOAD (KIPS) BREAK LOCATION
		~~8~~4
RC-1112-R21	~~RIGID~~ EAM	350

ILNSS
t Leg: Loop A)

See Initial Stress Summary Results Table 3.6.2-1, SH 8A

TI APERTURE CARD

Also Available On Aperture Card

LEGEND

■ POSTULATED BREAK POINT

→ ENERGY ABSORBING RESTRAINT

—▷ RIGID GUIDE

SOUTH TEXAS PROJECT UNITS 1 & 2

POSTULATED BREAK POINTS AND RESTRAINT LOCATIONS

Residual Heat Removal Pump A Suction: Inside Containment

Figure 3.6.1-1 Sheet 8A

8510180333-20

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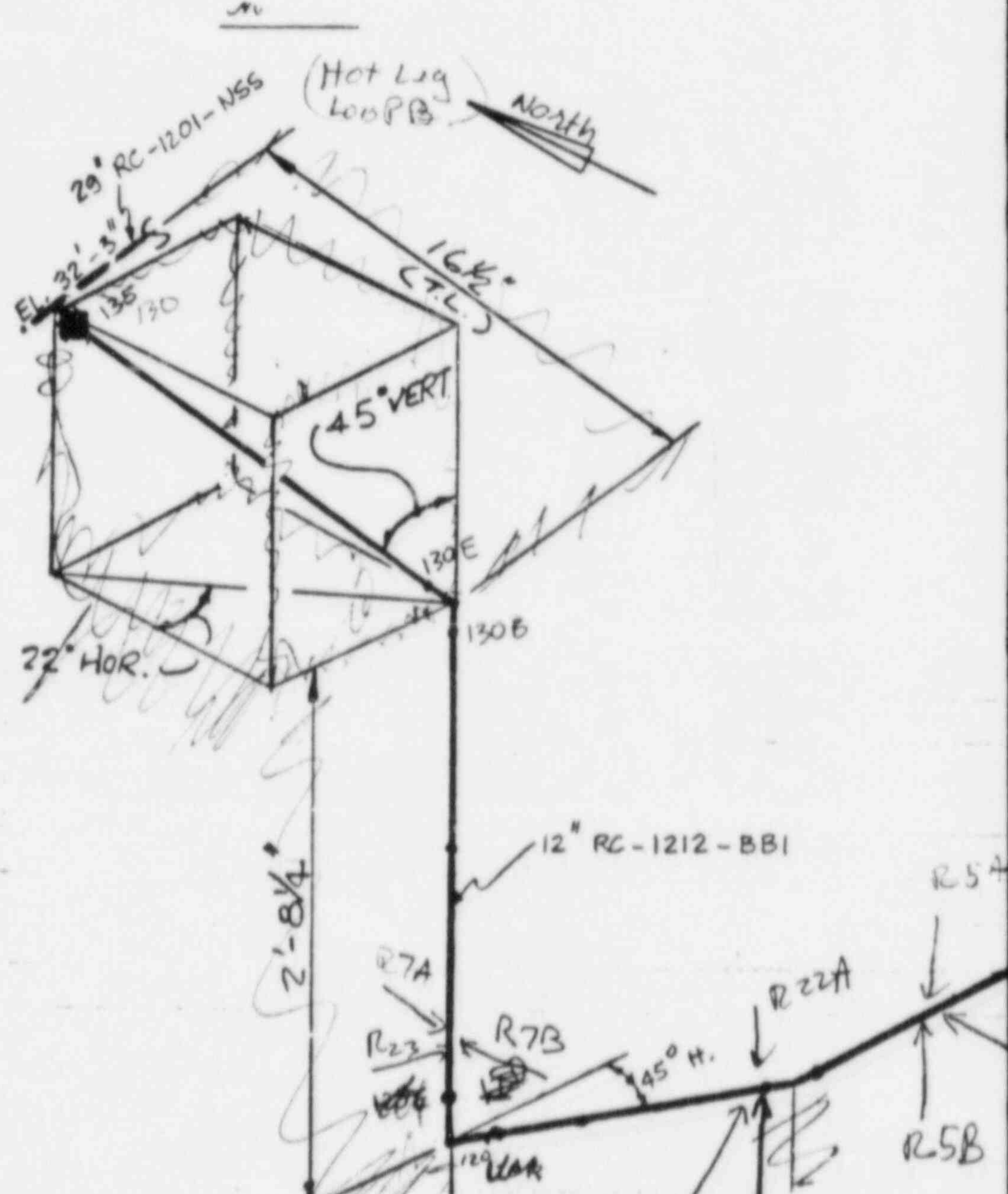

RESTRAINT LOAD SUMMARY

RESTRAINT NUMBER	RESTRAINT DESCRIPTION	DESIGN LOAD (KIPS) BREAK LOCATION	
		98 → 8C 135	
RC-1221-R5A	RIGID	21	
R5B	RIGID	110	
R9B	RIGID	140	
R22	EAM	250	
22A	RIGID	23	
22B	RIGID	170	
R23	EAM	175	175
R7A	RIGID	21	23
R7B	RIGID	21	150

TI APERTURE CARD

Also Available On Aperture Card

See Initial Stress Summary Results Table 3.6.2-1, SH 8C

LEGEND

■ POSTULATED BREAK POINT

→ ENERGY ABSORBING RESTRAINT

—▷ RIGID GUIDE

8510180333-21

SOUTH TEXAS PROJECT UNITS 1 & 2

POSTULATED BREAK POINTS AND RESTRAINT LOCATIONS

Residual Heat Removal Pump B Suction: Inside Containment

Figure 3.6.1-1 Sheet 8B

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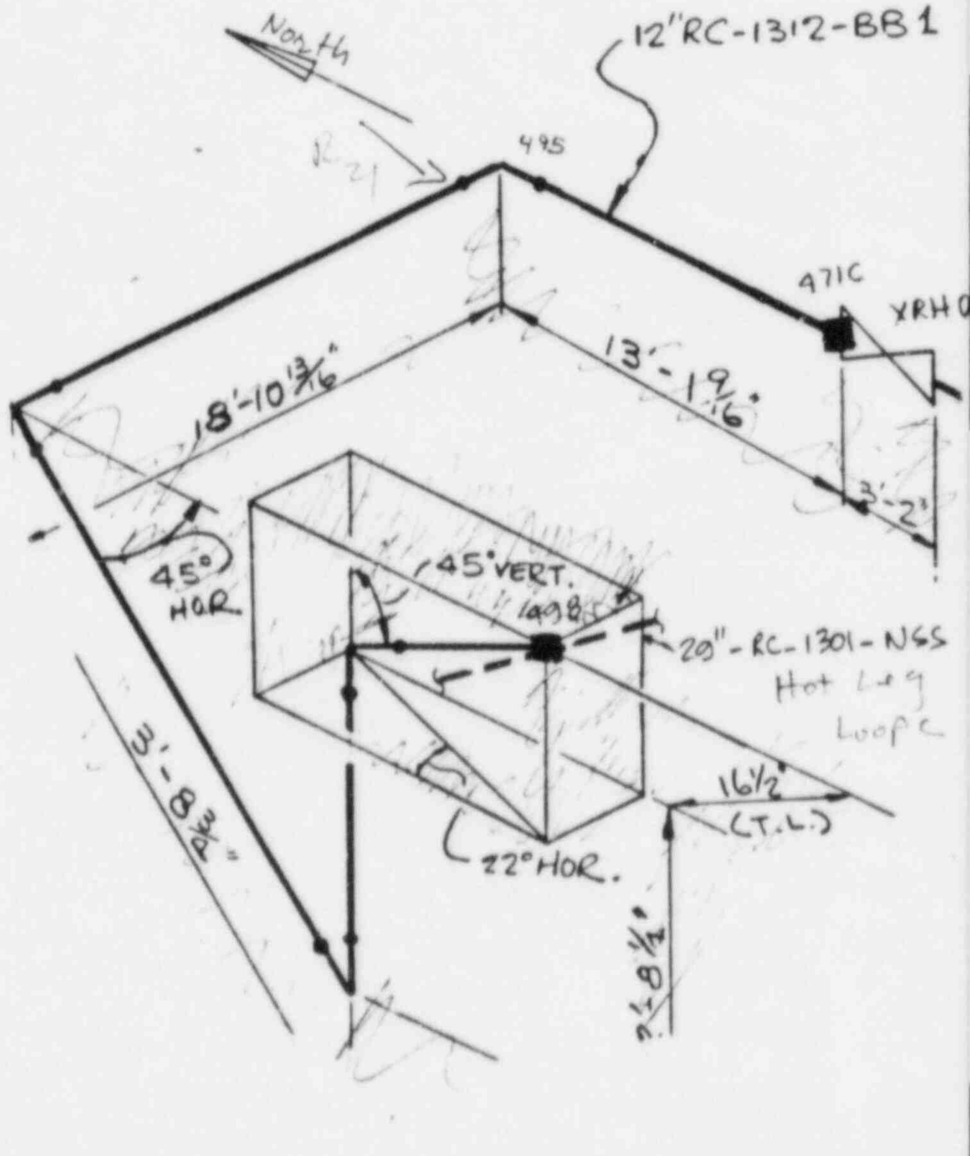


RESTRAINT LOAD SUMMARY

RESTRAINT NUMBER	RESTRAINT DESCRIPTION	DESIGN LOAD (KIPS) BREAK LOCATION 47C
RC-1312-R21	EAM	350

0060C

TI APERTURE CARD

Also Available On Aperture Card

See Initial Stress Summary Results Table 3.6.2-1, SH 8C

LEGEND

■ POSTULATED BREAK POINT

→ ENERGY ABSORBING RESTRAINT

▷ RIGID GUIDE

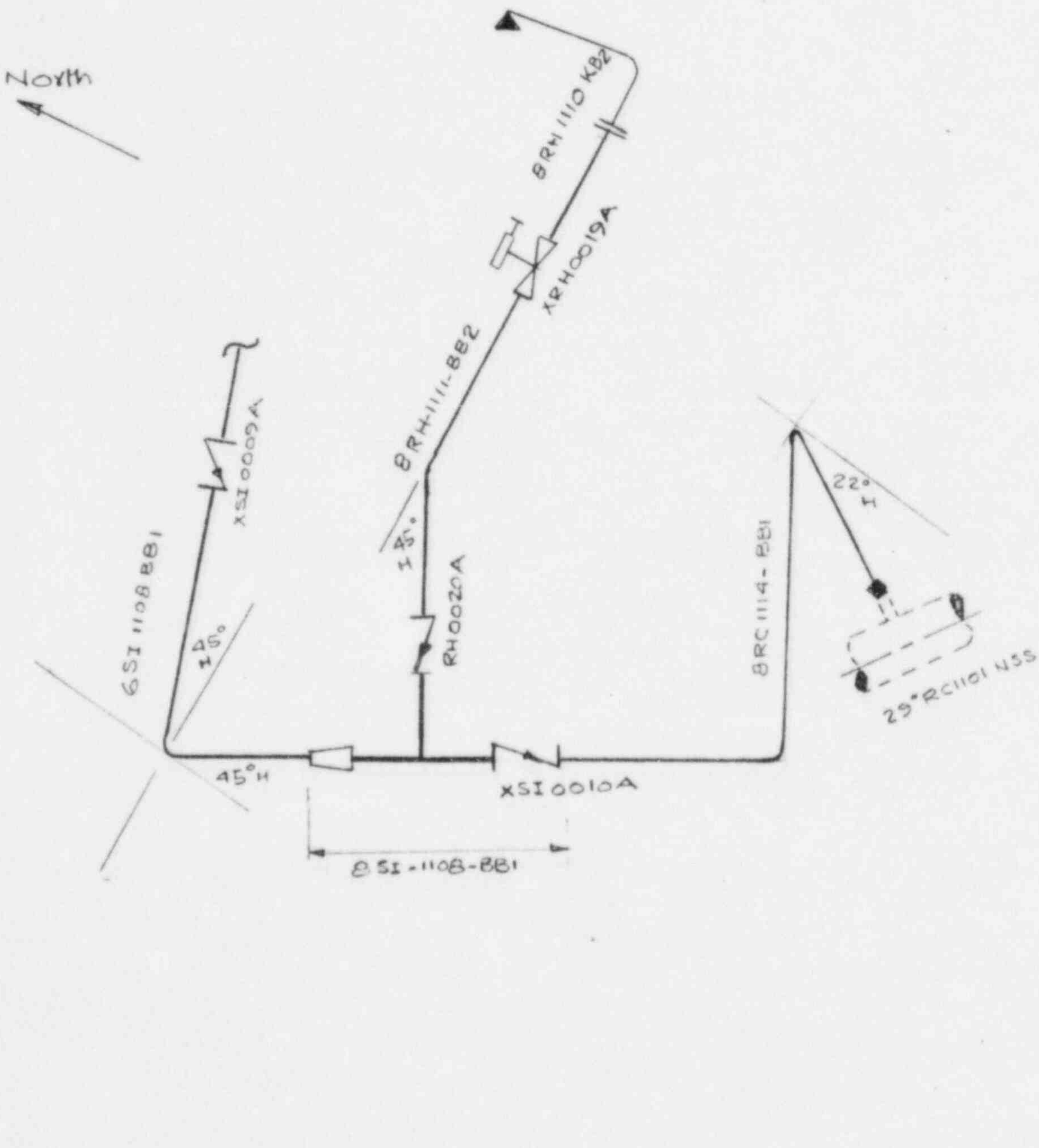
8510180333-22

SOUTH TEXAS PROJECT
UNITS 1 & 2

POSTULATED BREAK POINTS AND RESTRAINT LOCATIONS

Residual Heat Removal Pump C Suction: Inside Containment

Figure 3.6.1-1 Sheet 8C


North
8RH 1110 KB2
XRH0019A
8RH-1111-BB2
45°
RH0020A
XSI0009A
6SI 1108 BB1
45°
45° H
XSI0010A
8SI-1108-BB1
8RC1114-BB1
22°
29" RC1101 NSS

RESTRAINT LOAD SUMMARY

RESTRAINT NUMBER	RESTRAINT DESCRIPTION	DESIGN LOAD (KIPS) BREAK LOCATION

None

TI APERTURE CARD

Also Available On Aperture Card

See Initial Stress Summary Results Table 3.6.2-1, SH 8D

LEGEND

■ POSTULATED BREAK POINT

→ ENERGY ABSORBING RESTRAINT

▷ RIGID GUIDE

SOUTH TEXAS PROJECT
UNITS 1 & 2

POSTULATED BREAK POINTS AND RESTRAINT LOCATIONS

RHR/SI Loop 1
Hot Leg Injection

Figure 3.6.1-1 Sheet 8D

8510180333-23

ATTACHMENT 1
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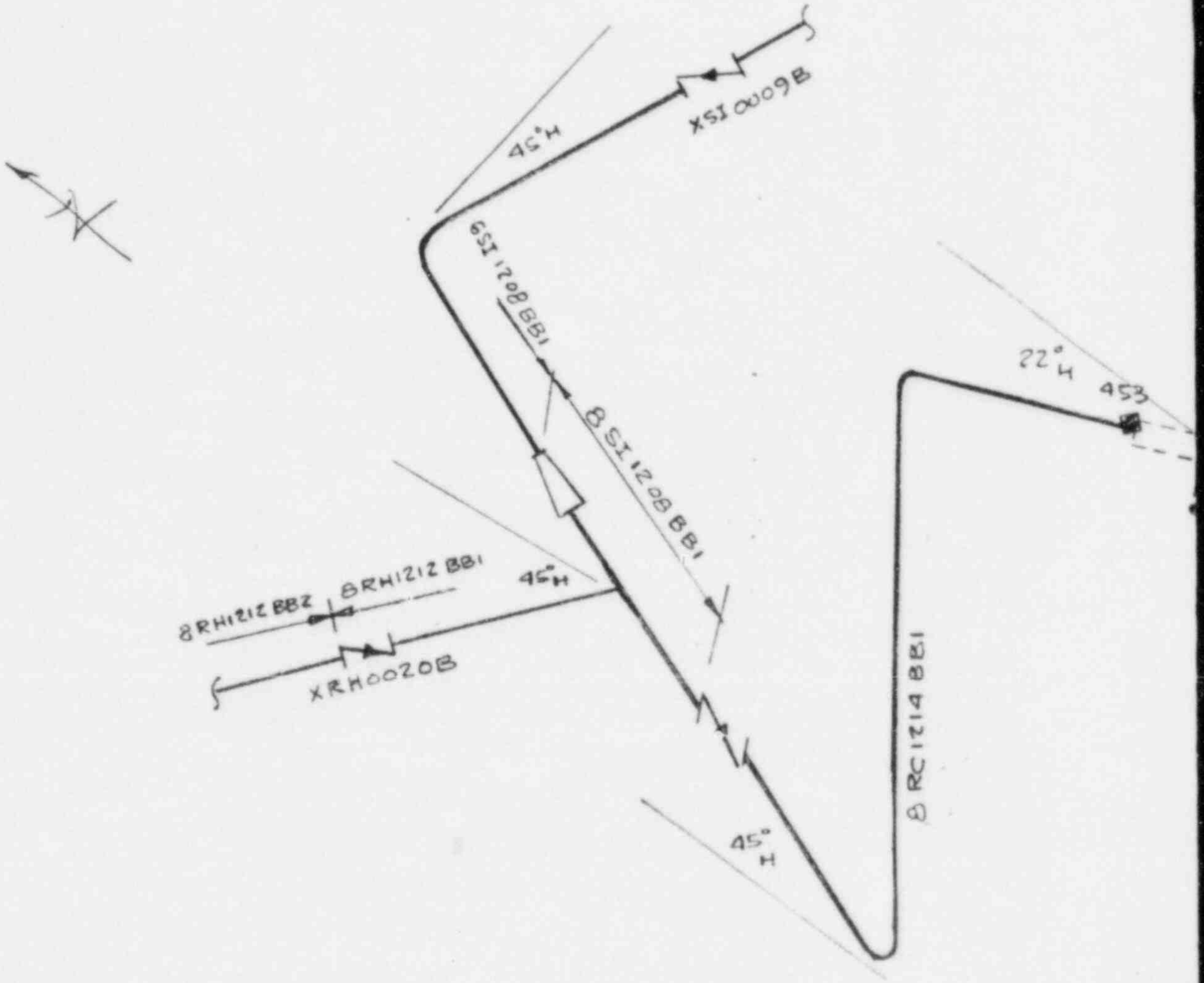

RESTRAINT LOAD SUMMARY

RESTRAINT NUMBER	RESTRAINT DESCRIPTION	DESIGN LOAD (KIPS) BREAK LOCATION
	None	

Z91DRC1201NSS

TI APERTURE CARD

Also Available On Aperture Card

See Initial Stress Summary Results Table 3.6.2-1, SH 8E

LEGEND

■ POSTULATED BREAK POINT

⟶ ENERGY ABSORBING RESTRAINT

▷ RIGID GUIDE

SOUTH TEXAS PROJECT UNITS 1 & 2

POSTULATED BREAK POINTS AND RESTRAINT LOCATIONS
RHR/SI Loop2
Hot Leg Injection

8510180333-24

Figure 3.6.1-1 Sheet 8E

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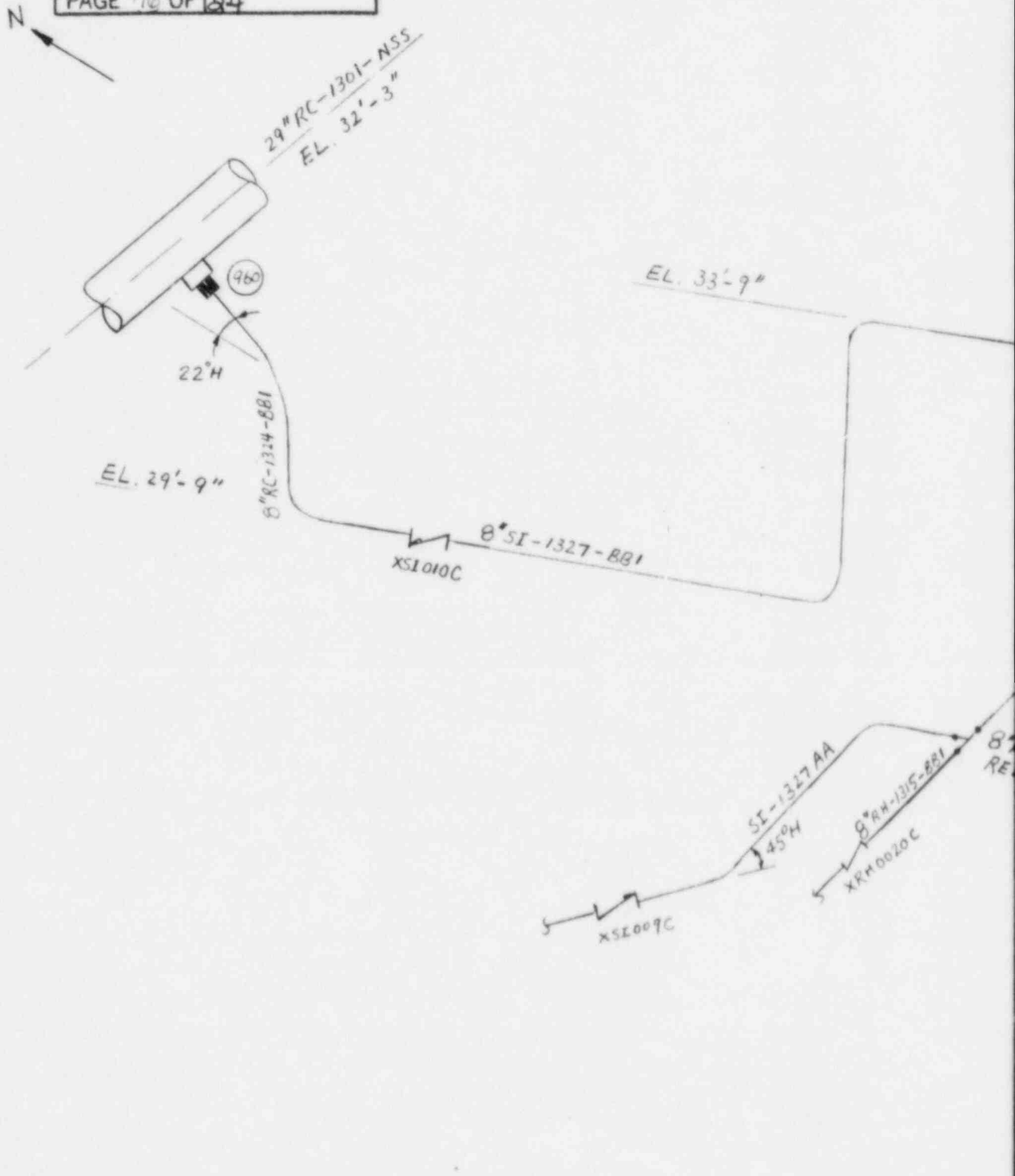

RESTRAINT LOAD SUMMARY

RESTRAINT NUMBER	RESTRAINT DESCRIPTION	DESIGN LOAD (KIPS) BREAK LOCATION
None		

TI APERTURE CARD

Also Available On Aperture Card

8"x6" ... TEE

See Initial Stress Summary Results Table 3.6.2-1, SH 8F

LEGEND

■ POSTULATED BREAK POINT

⟶ ENERGY ABSORBING RESTRAINT

—▷ RIGID GUIDE

SOUTH TEXAS PROJECT
UNITS 1 & 2

POSTULATED BREAK POINTS AND RESTRAINT LOCATIONS

RHR/SI, Loop 3 Hot Leg Injection

Figure 3.6.1-1 Sheet 8F

8510180333-25

ATTACHMENT I
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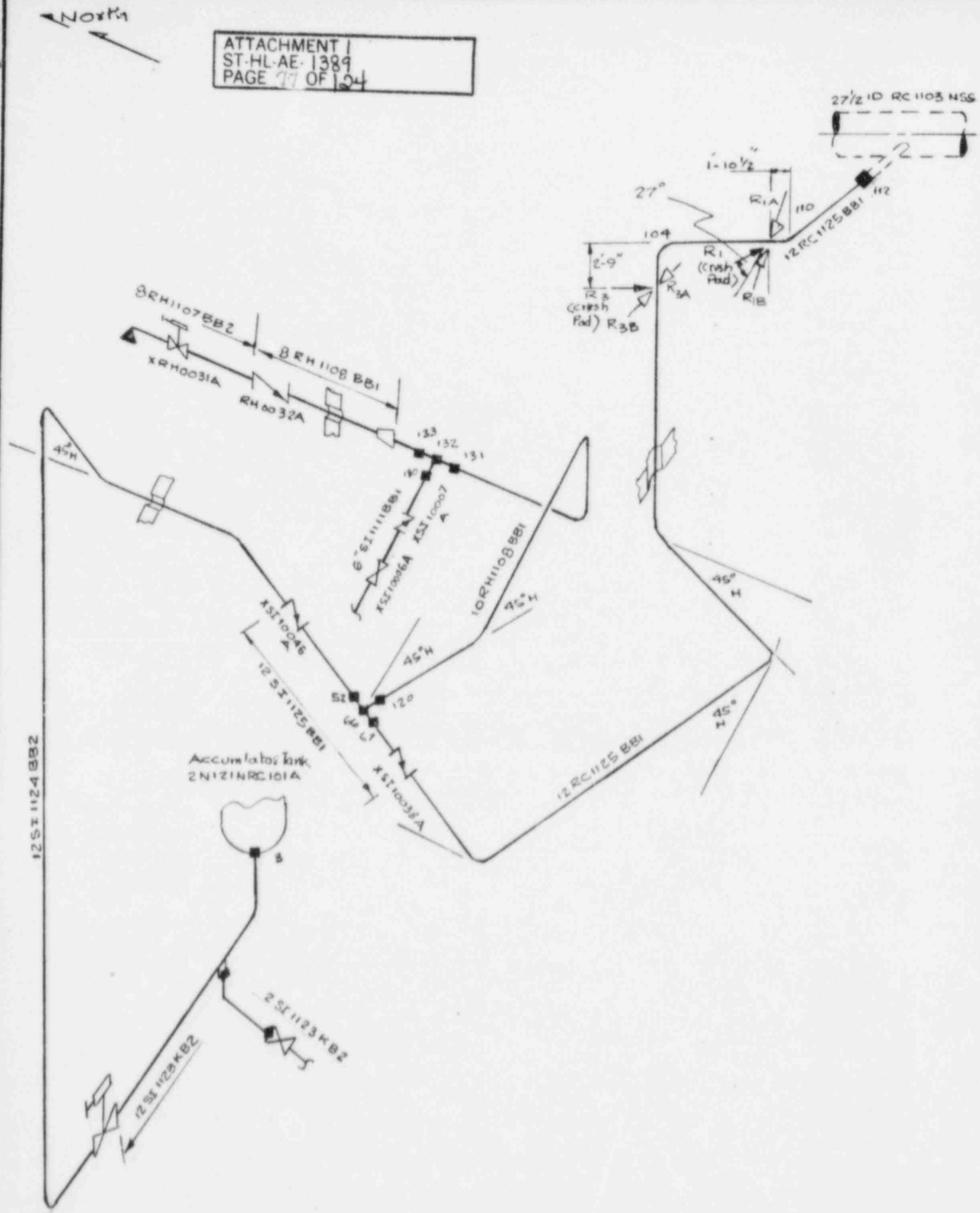

RESTRAINT LOAD SUMMARY

RESTRAINT NUMBER	RESTRAINT DESCRIPTION	DESIGN LOAD (KIPS) BREAK LOCATION 102
RC-1125 – R_1	~~Crush Pad~~ EAM	200
R_{1A}	Rigid Guide	80
R_{1B}	Rigid Guide	20
R_3	~~Crush Pad~~ EAM	200
R_{3A}	Rigid Guide	90
R_{3B}	Rigid Guide	20

See Initial Stress Summary Results Table 3.6.2-1, SH 8G

LEGEND

■ POSTULATED BREAK POINT

→ ENERGY ABSORBING RESTRAINT

—▷ RIGID GUIDE

SOUTH TEXAS PROJECT
UNITS 1 & 2

POSTULATED BREAK POINTS AND RESTRAINT LOCATIONS
Accumulator to RC Leg A
(Inside Containment)

Figure 3.6.1-1 Sheet 8G

8510180333-26

ATTACHMENT I
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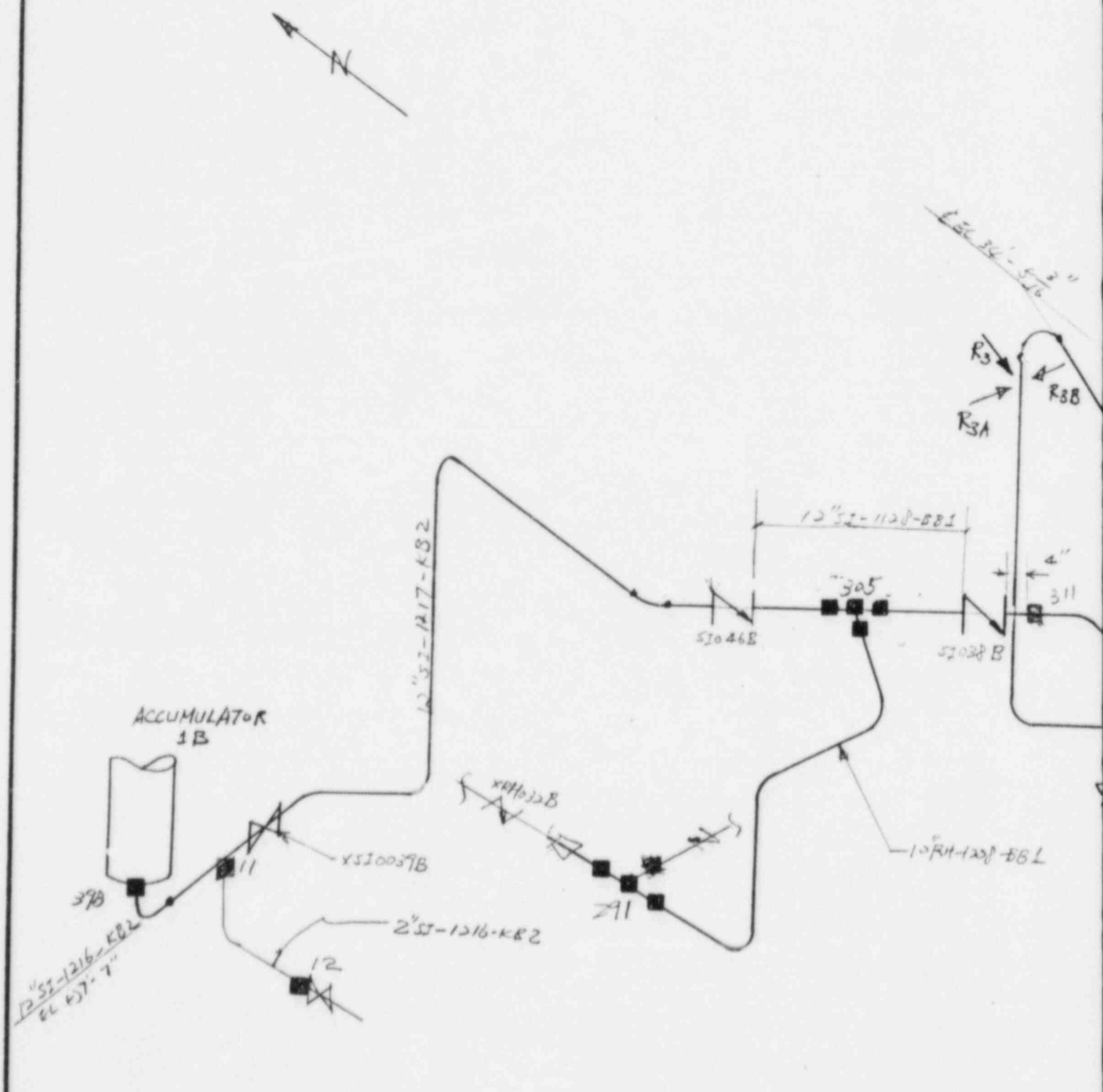
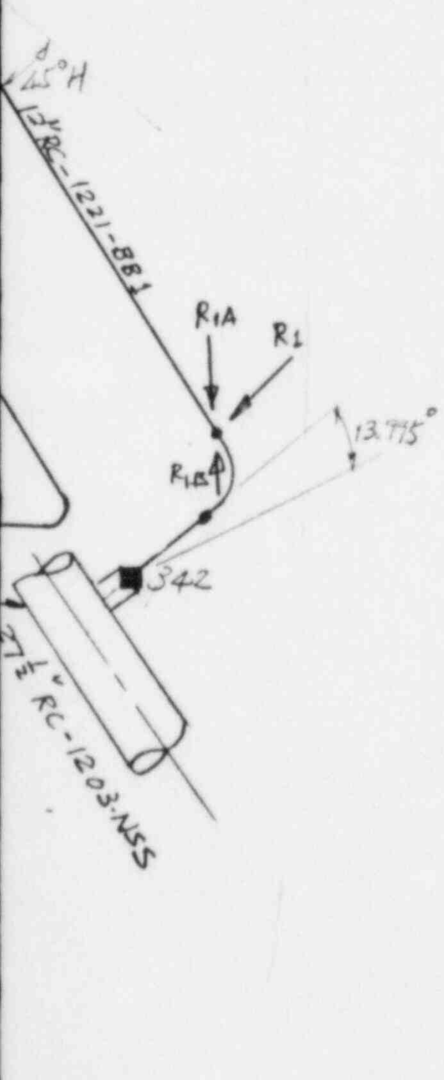


RESTRAINT LOAD SUMMARY

RESTRAINT NUMBER	RESTRAINT DESCRIPTION	DESIGN LOAD (KIPS) BREAK LOCATION 342
RC-1221 – R_1	~~Crash pad~~ EAM	200 (342)
R_{1A}	Rigid	60 ~~80~~ (342)
R_{1B}	Rigid	20 (342)
R_3	~~Crash pad~~ EAM	200 (342)
R_{3A}	Rigid	80 ~~[illegible]~~ (342)
R_{3B}	Rigid	20 (342)



See Initial Stress Summary Results Table 3.6.2-1, SH 8H

LEGEND

- ■ POSTULATED BREAK POINT
- ➞ ENERGY ABSORBING RESTRAINT
- —▷ RIGID GUIDE

8510180333-27

SOUTH TEXAS PROJECT
UNITS 1 & 2

POSTULATED BREAK POINTS AND RESTRAINT LOCATIONS

RHR/SI – Accumulator Injection Loop 2, Inside Containment

Figure 3.6.1-1 (sheet 8H) ~~RHR/SI – 10~~

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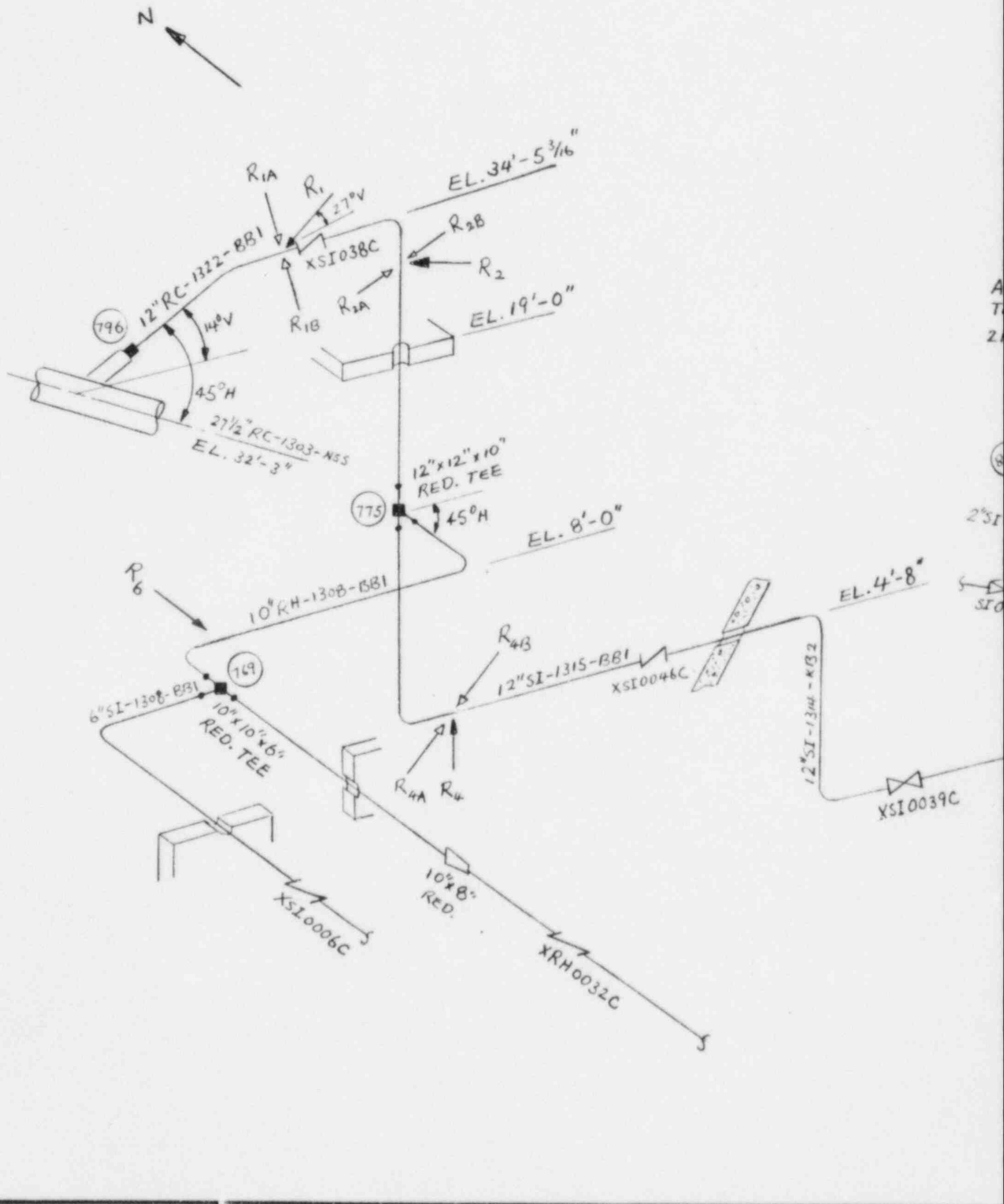
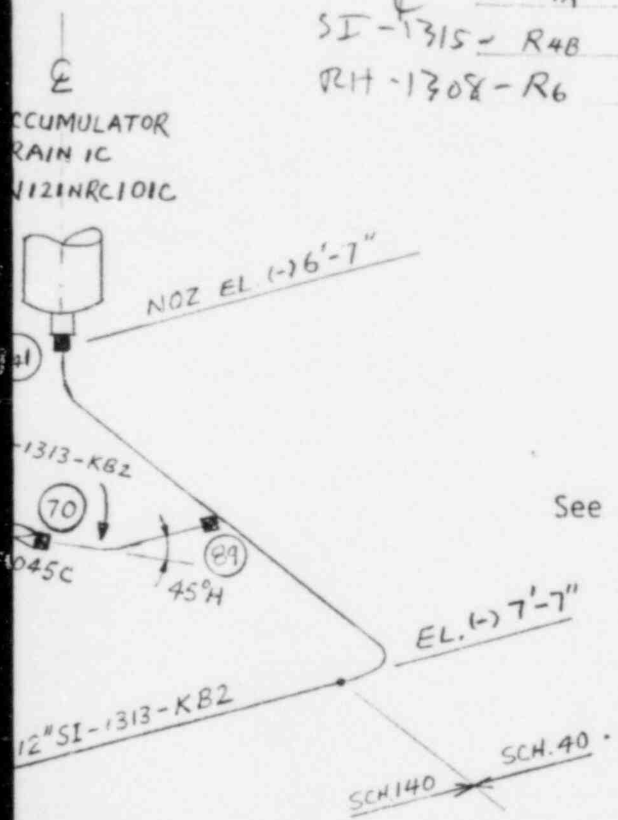


RESTRAINT LOAD SUMMARY

	RESTRAINT NUMBER	RESTRAINT DESCRIPTION	DESIGN LOAD (KIPS)	BREAK LOCATION 796 775 769
RC-1322 —	R_1	~~Crushpad~~ EAM	200	(796)
	R_{1A}	Rigid Guide	60	(796)
	R_{1B}	Rigid Guide	20	(796)
	R_2	~~Crushpad~~ EAM	200	(796)
	R_{2A}	Rigid Guide	80	(796)
RC1322 —	R_{2B}	Rigid Guide	20	(796)
SI-1315 —	R_4	~~Crushpad~~ EAM	162	(775)
	R_{4A}	Rigid Guide	11	(775)
SI-1315 —	R_{4B}	Rigid Guide	11	(775)
RH-1308 —	R_6	U-Bar	166	(769)



See Initial Stress Summary Results Table 3.6.2-1, SH 8I

LEGEND

■ POSTULATED BREAK POINT

→ ENERGY ABSORBING RESTRAINT

—▷ RIGID GUIDE

SOUTH TEXAS PROJECT
UNITS 1 & 2

POSTULATED BREAK POINTS AND RESTRAINT LOCATIONS

Accumulator to Cold Leg C
(Inside containment)

Figure 3.6.1-1 Sheet 8I

8510180333-28

ATTACHMENT I
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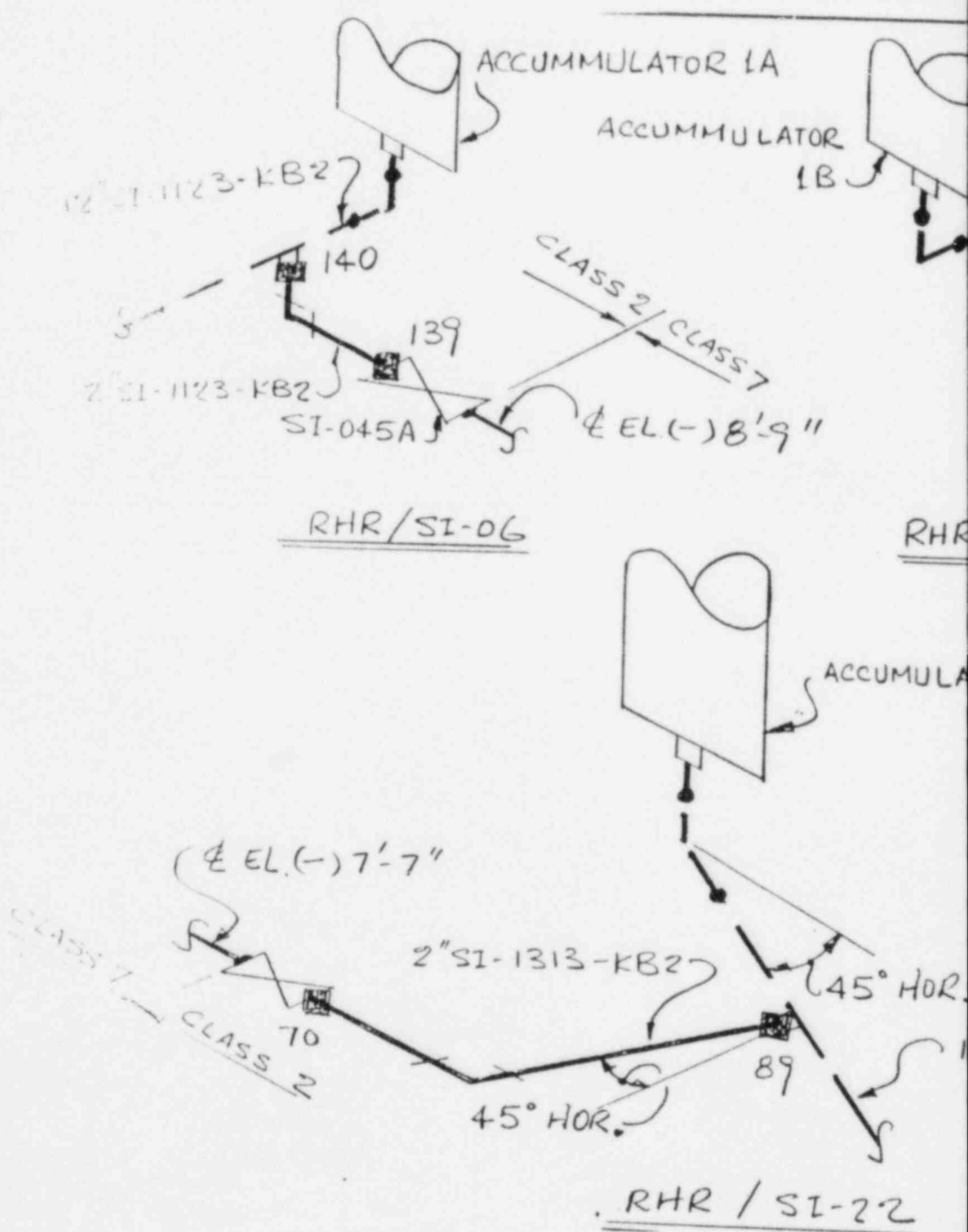
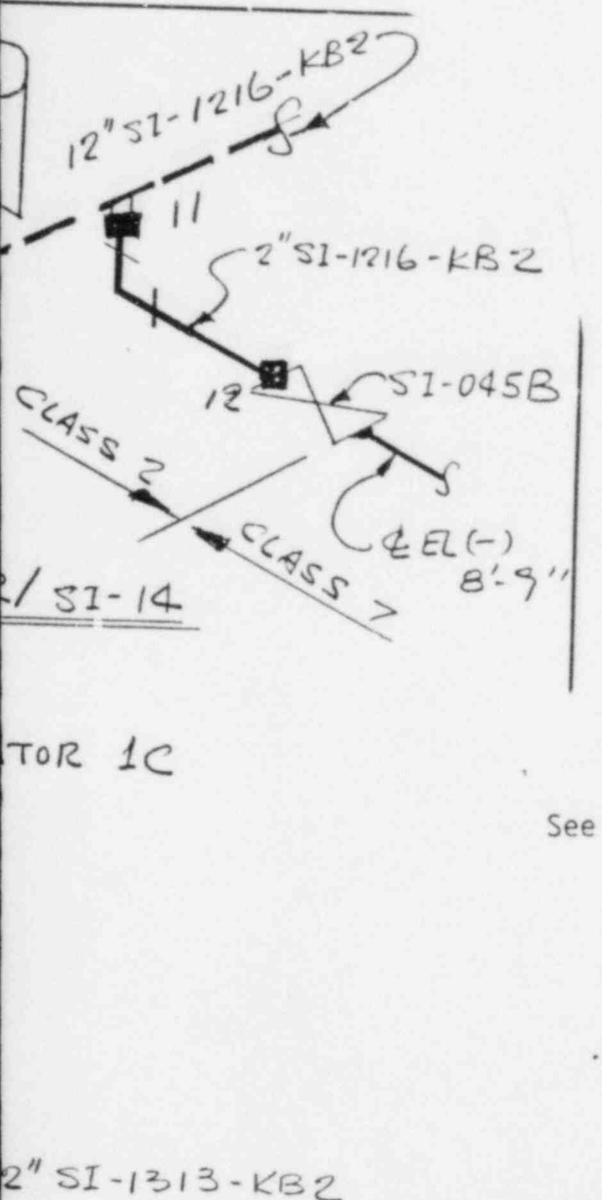


RESTRAINT LOAD SUMMARY

RESTRAINT NUMBER	RESTRAINT DESCRIPTION	DESIGN LOAD (KIPS) BREAK LOCATION
	None	



TI APERTURE CARD

Also Available On Aperture Card

See Initial Stress Summary Results Table 3.6.2-1, SH 8J

LEGEND

■ POSTULATED BREAK POINT

→ ENERGY ABSORBING RESTRAINT

▷ RIGID GUIDE

SOUTH TEXAS PROJECT UNITS 1 & 2

POSTULATED BREAK POINTS AND RESTRAINT LOCATIONS

Accumulators Drain to the RCDT

Figure 3.6.1-1 Sheet 8J

8510180333-29

ATTACHMENT
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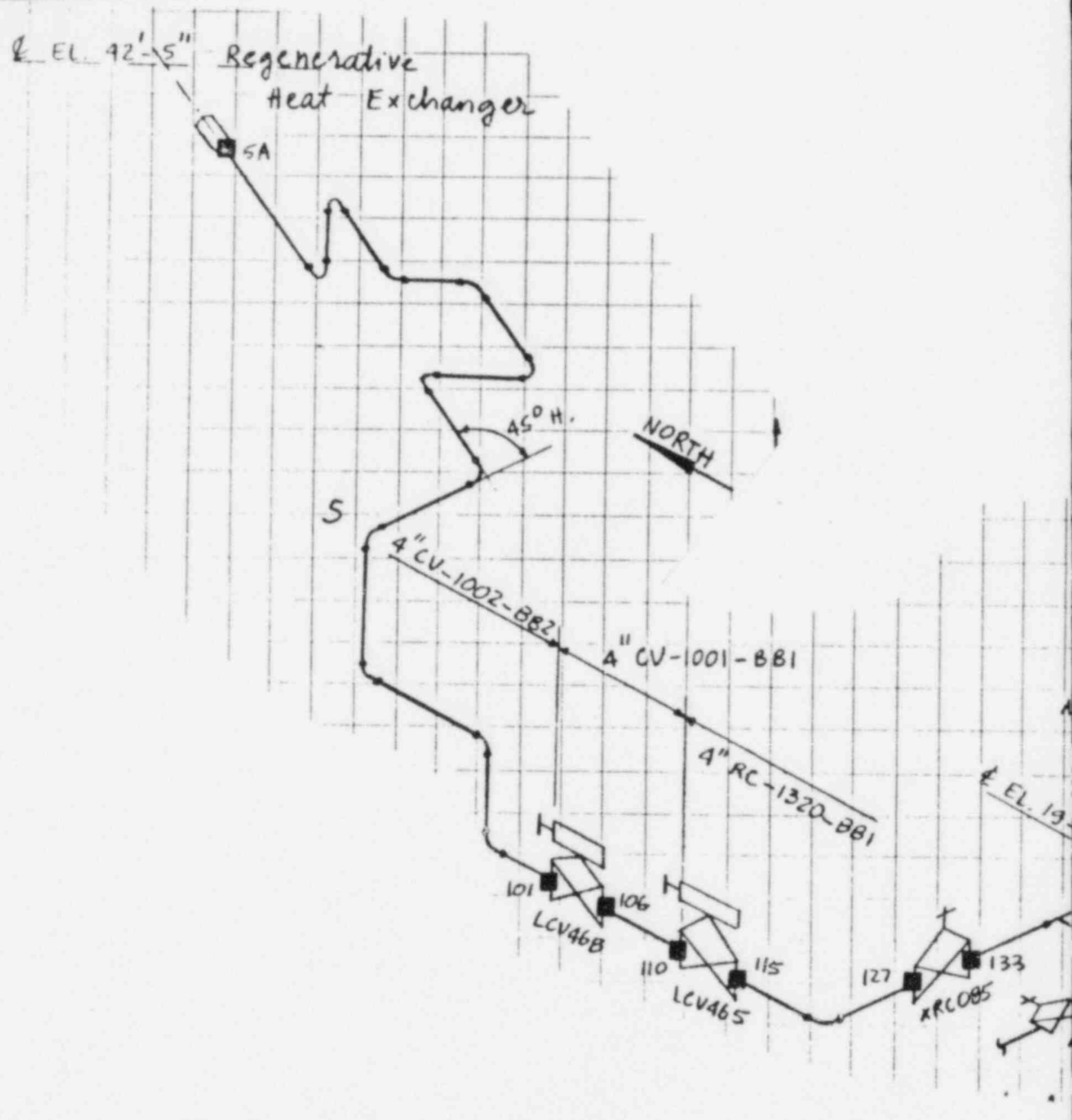


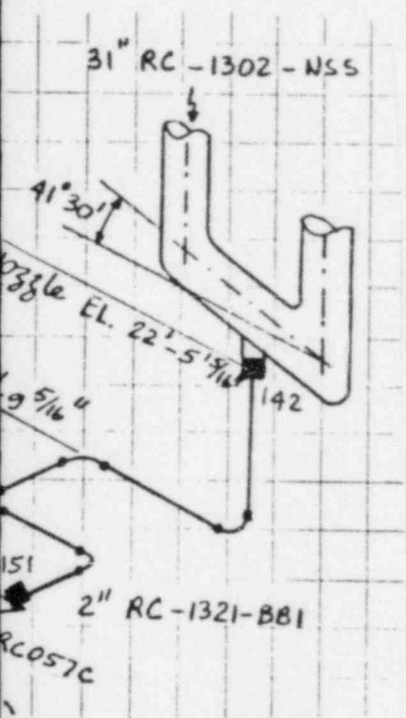
RESTRAINT LOAD SUMMARY

RESTRAINT NUMBER	RESTRAINT DESCRIPTION	DESIGN LOAD (KIPS) BREAK LOCATION

NONE

TI APERTURE CARD

Also Available On Aperture Card



See Initial Stress Summary Results Table 3.6.2-1, SH 9A1 & 2

LEGEND

■ POSTULATED BREAK POINT

→ ENERGY ABSORBING RESTRAINT

▷ RIGID GUIDE

SOUTH TEXAS PROJECT
UNITS 1 & 2

POSTULATED BREAK POINTS AND RESTRAINT LOCATIONS

Chemical Volume and Control System Letdown from crossover leg to Regenerative Heat Exchanger

Figure 3.6.1-1 (Sheet 9A

8510180333-30

ATTACHMENT 1
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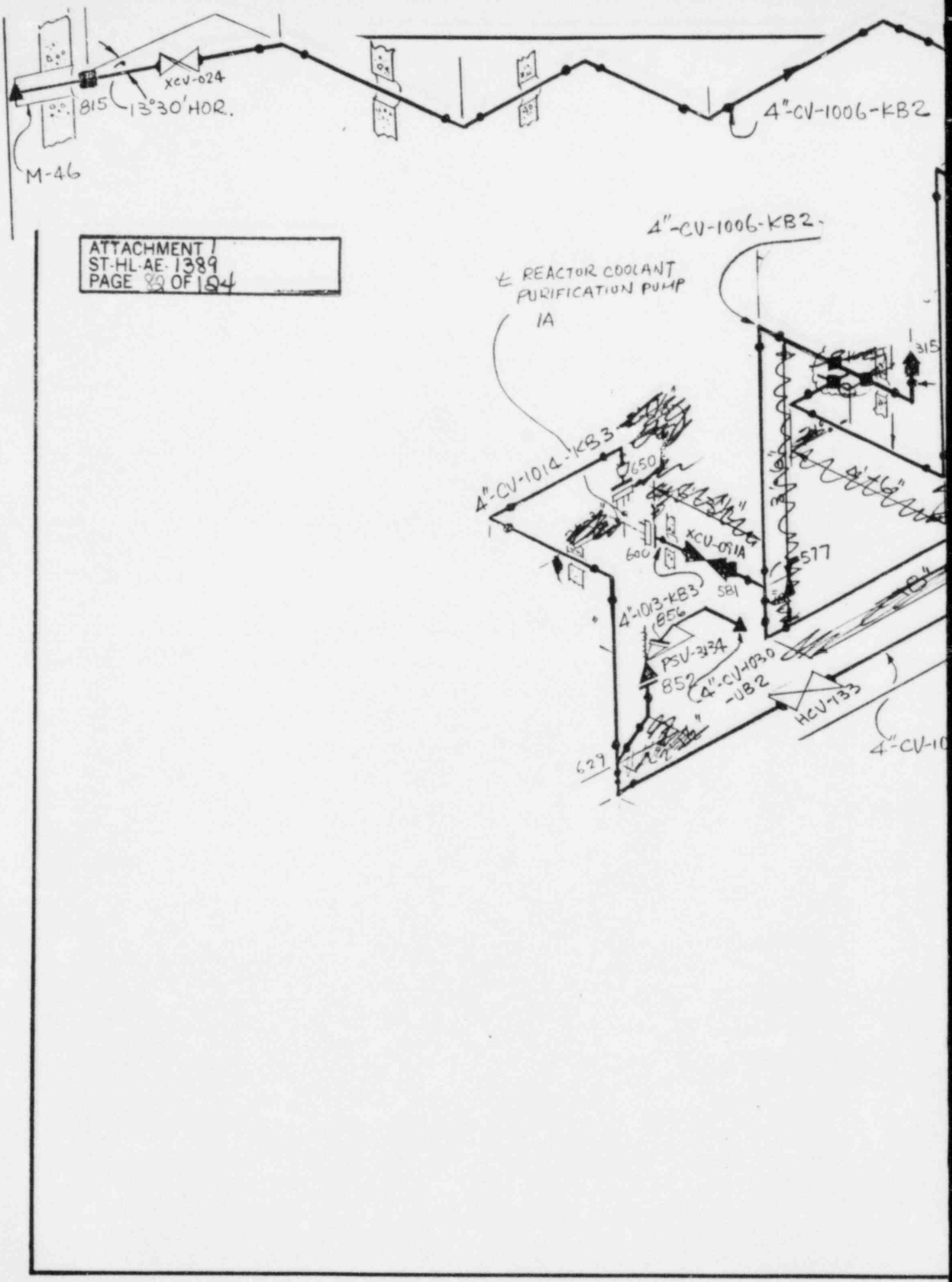
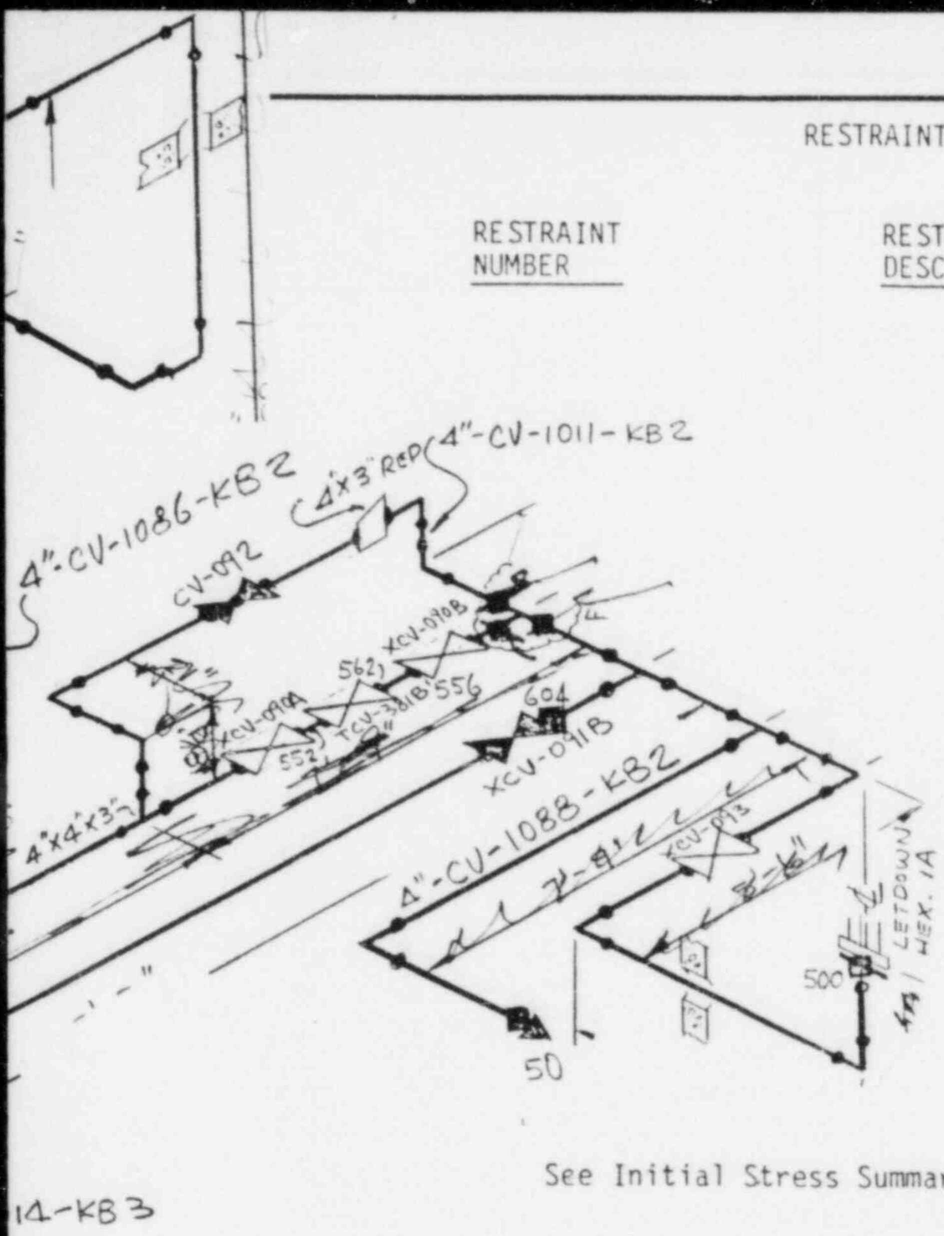


RESTRAINT LOAD SUMMARY

RESTRAINT NUMBER	RESTRAINT DESCRIPTION	DESIGN LOAD (KIPS) BREAK LOCATION

NONE



See Initial Stress Summary Results Table 3.6.2-1, SH 9B

LEGEND

■ POSTULATED BREAK POINT

→ ENERGY ABSORBING RESTRAINT

—▷ RIGID GUIDE

SOUTH TEXAS PROJECT UNITS 1 & 2

POSTULATED BREAK POINTS AND RESTRAINT LOCATIONS

Chemical Volume and Control System Letdown Outside Containment

Figure 3.6.1-1 Sheet 9B

8510180333-31

ATTACHMENT I
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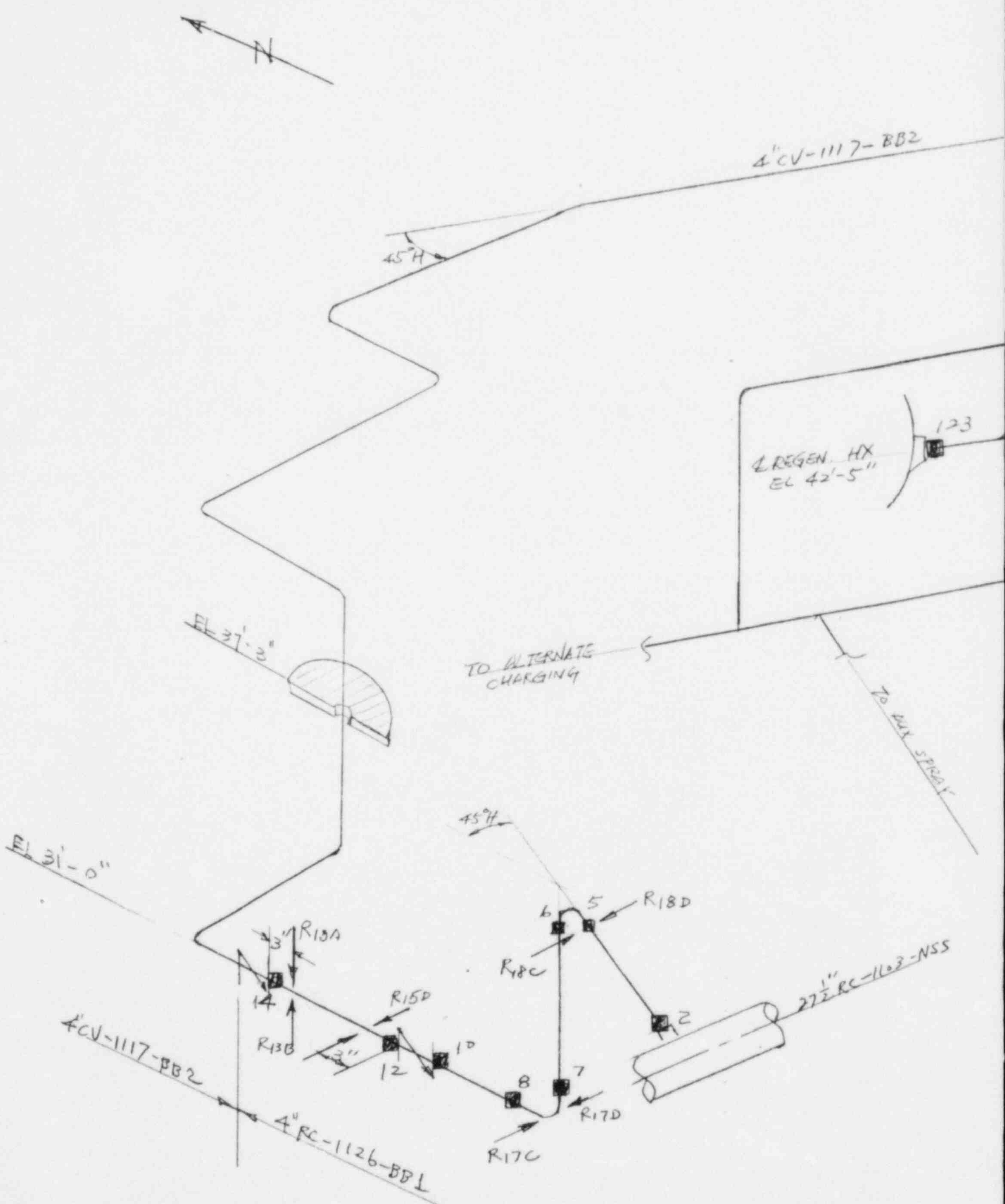

RESTRAINT LOAD SUMMARY

RESTRAINT NUMBER	RESTRAINT DESCRIPTION	DESIGN LOAD (KIPS) BREAK LOCATION 14	10,12	7,8	5,6
4.2c 44'-3" R13A	EAM ~~CRUSH PAD~~	40			
CV-1118- R13A	↓	40			
R15C	↓	40	40		
CV-1118- R15D	↓	50	50		
CV-1126 R17C	↓			45	
R17D	↓			45	
R18C	↓	45			45
R18D	↓	55			55

See initial Stress Summary Results Table 3.6.2-1, SH 9C

LEGEND

■ POSTULATED BREAK POINT

⟶ ENERGY ABSORBING RESTRAINT

—▷ RIGID GUIDE

SOUTH TEXAS PROJECT UNITS 1 & 2

POSTULATED BREAK POINTS AND RESTRAINT LOCATIONS

CVCS - NORMAL CHARGING

8510180333-32

Figure 3.6.1-1 Sheet ~~of~~ 9C

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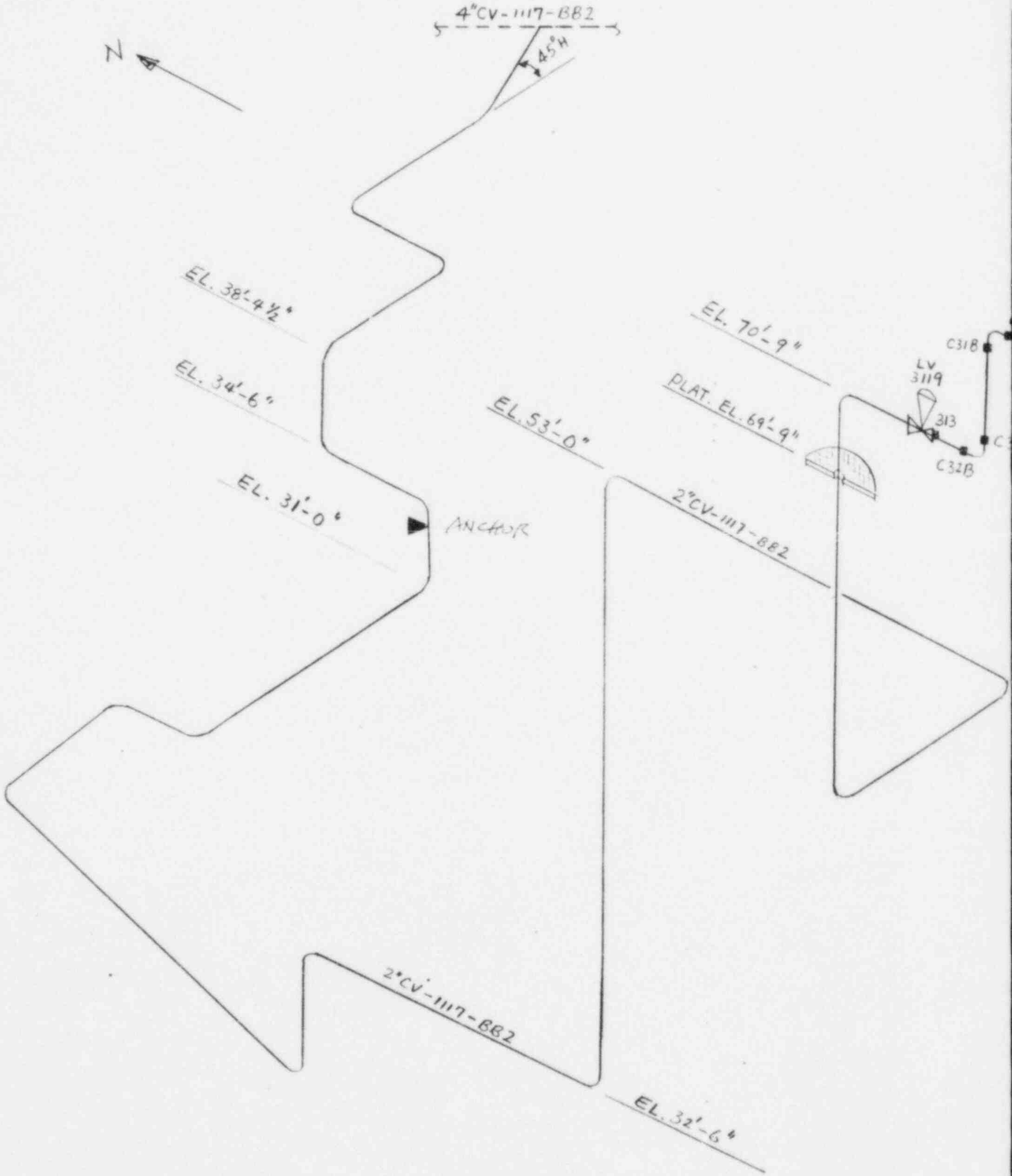
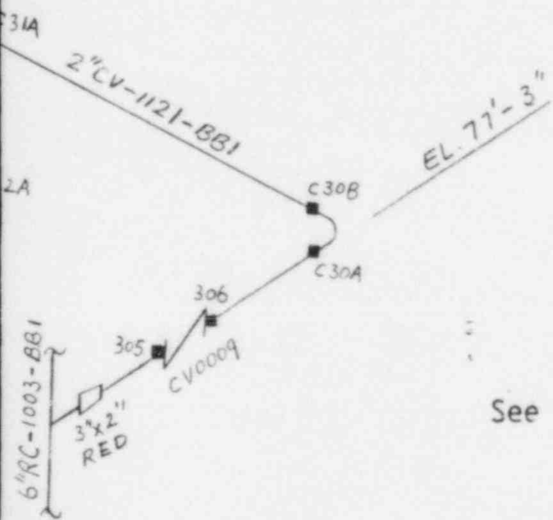


RESTRAINT LOAD SUMMARY

RESTRAINT NUMBER	RESTRAINT DESCRIPTION	DESIGN LOAD (KIPS) BREAK LOCATION
	None	



See Initial Stress Summary Results Table 3.6.2-1, SH 9 D

TI APERTURE CARD

Also Available On Aperture Card

LEGEND

■ POSTULATED BREAK POINT

➞ ENERGY ABSORBING RESTRAINT

—▷ RIGID GUIDE

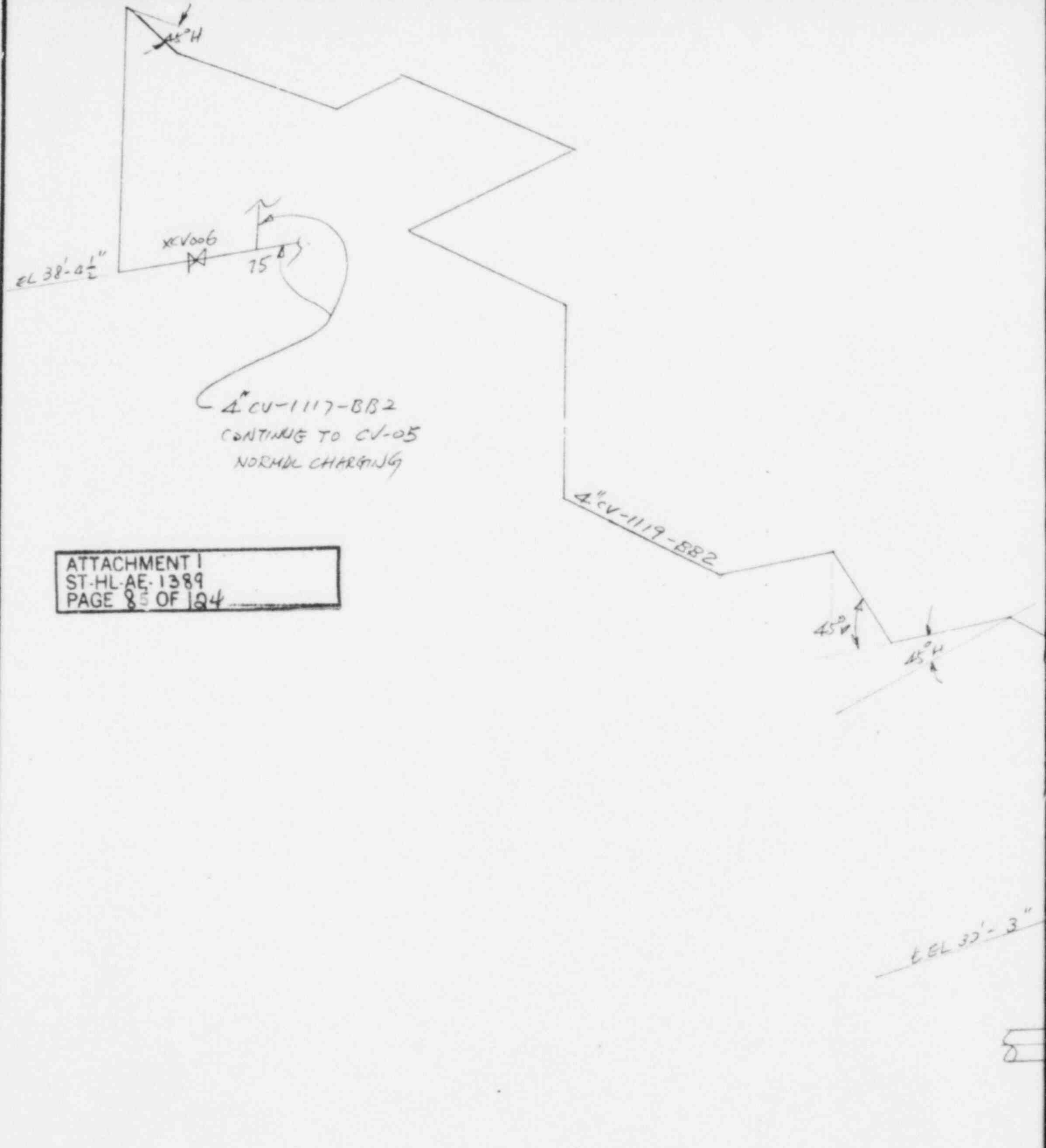
8510180333-33

SOUTH TEXAS PROJECT UNITS 1 & 2

POSTULATED BREAK POINTS AND RESTRAINT LOCATIONS

CVCS Auxiliary Pressurizer Spray

Figure 3.6.1-1 Sheet 9D



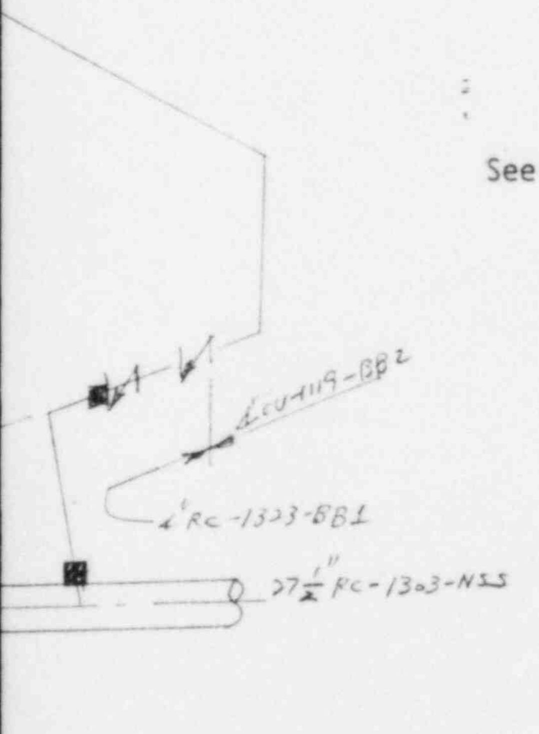
ATTACHMENT I
ST-HL-AE-1389
PAGE 85 OF 124

RESTRAINT LOAD SUMMARY

RESTRAINT NUMBER	RESTRAINT DESCRIPTION	DESIGN LOAD (KIPS) BREAK LOCATION
None		

TI APERTURE CARD

Also Available On Aperture Card



See Initial Stress Summary Results Table 3.6.2-1, SH 9E

LEGEND

- ■ POSTULATED BREAK POINT
- ➞ ENERGY ABSORBING RESTRAINT
- ⇾ RIGID GUIDE

SOUTH TEXAS PROJECT UNITS 1 & 2

POSTULATED BREAK POINTS AND RESTRAINT LOCATIONS

CVCS Alternate Charging

Figure 3.6.1-1 (sheet 9E)

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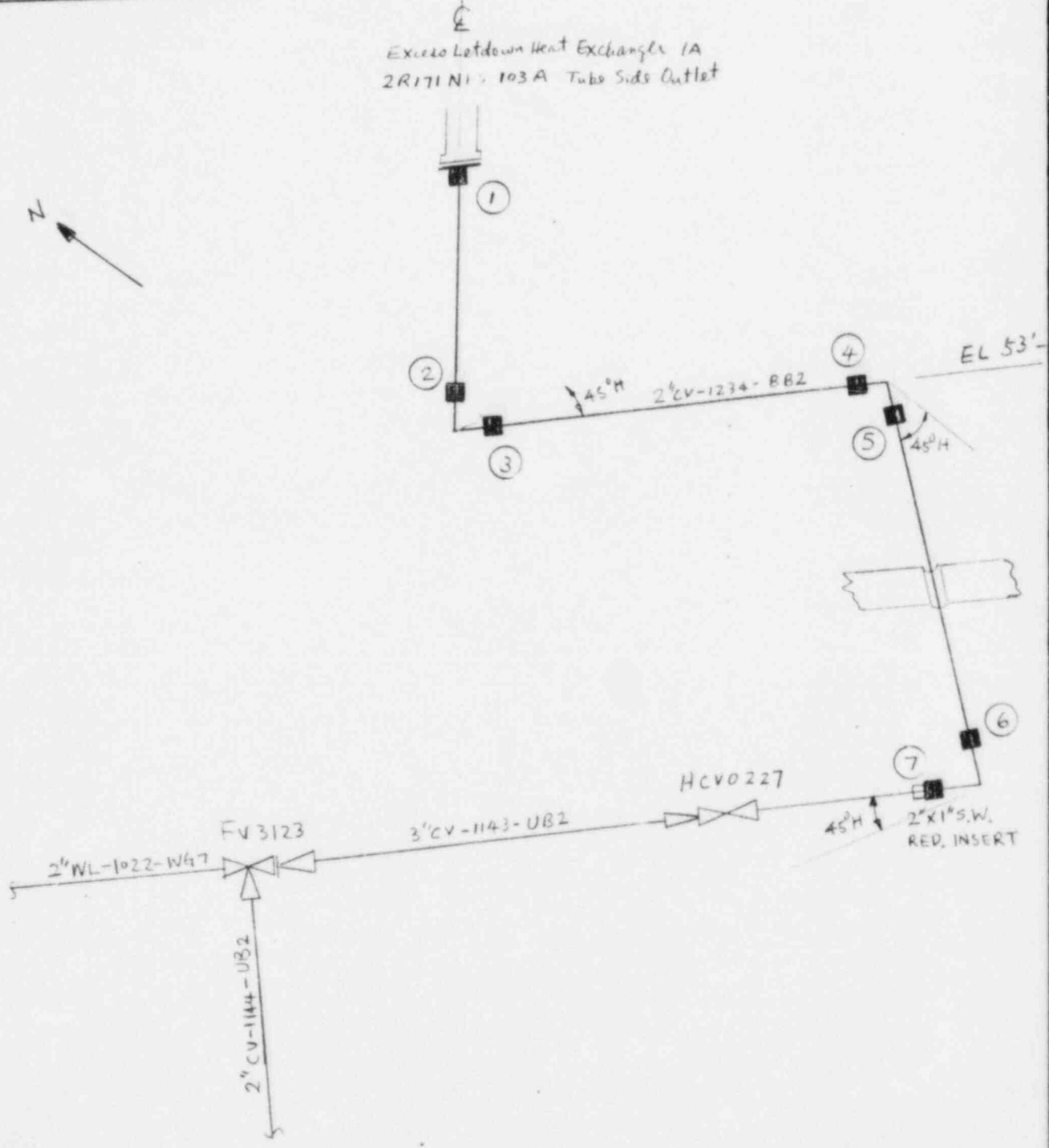

RESTRAINT LOAD SUMMARY

RESTRAINT NUMBER	RESTRAINT DESCRIPTION	DESIGN LOAD (KIPS) BREAK LOCATION
None		

6"

TI APERTURE CARD

Also Available On Aperture Card

See Initial Stress Summary Results Table 3.6.2-1, SH 9F

LEGEND

■ POSTULATED BREAK POINT

→ ENERGY ABSORBING RESTRAINT

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8510180333-35

SOUTH TEXAS PROJECT
UNITS 1 & 2

POSTULATED BREAK POINTS AND RESTRAINT LOCATIONS

Chemical Volume and Control Excess Letdown from letdown heat exchanger (Onside Containment)

Figure 3.6.1-1 Sh 9F

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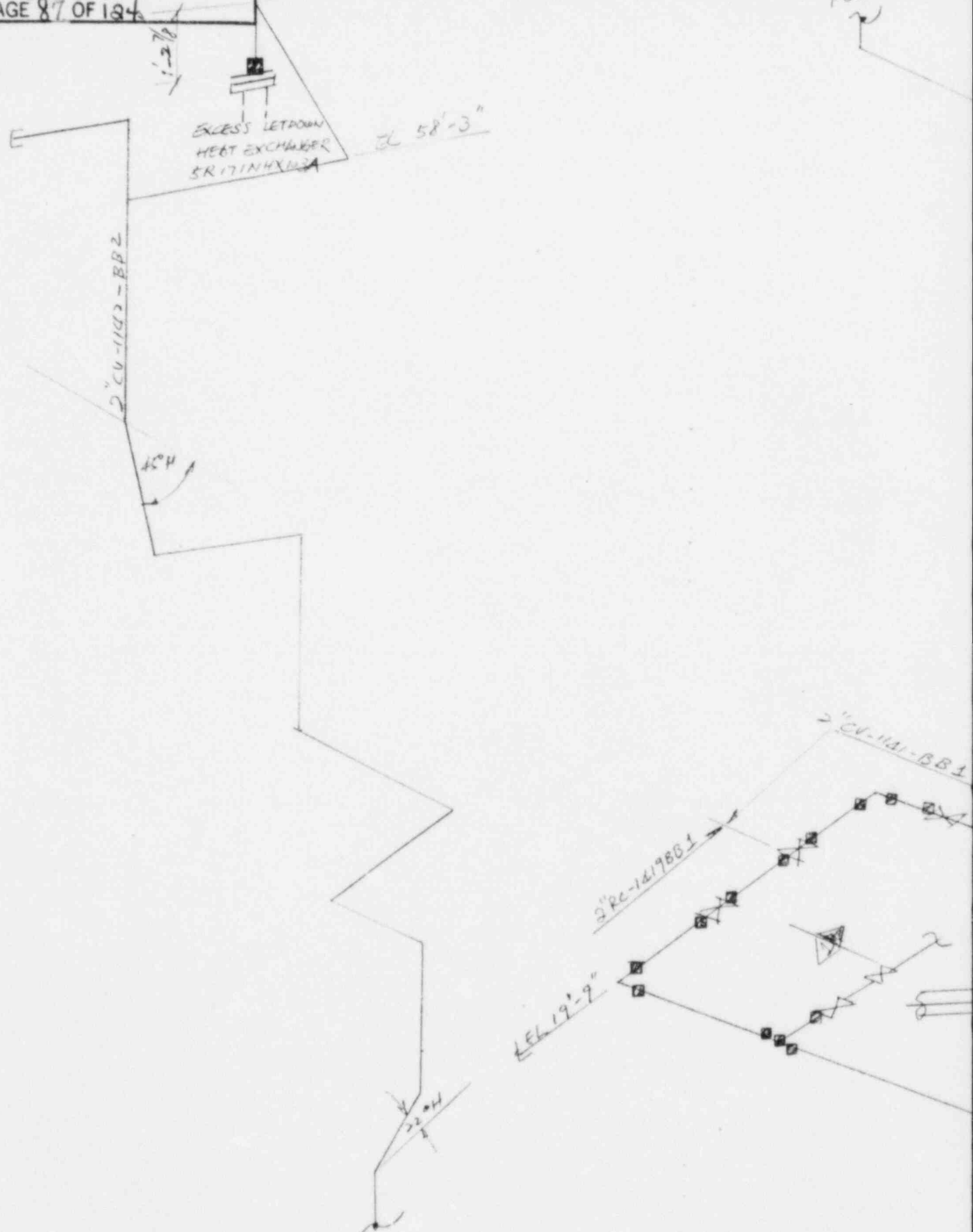

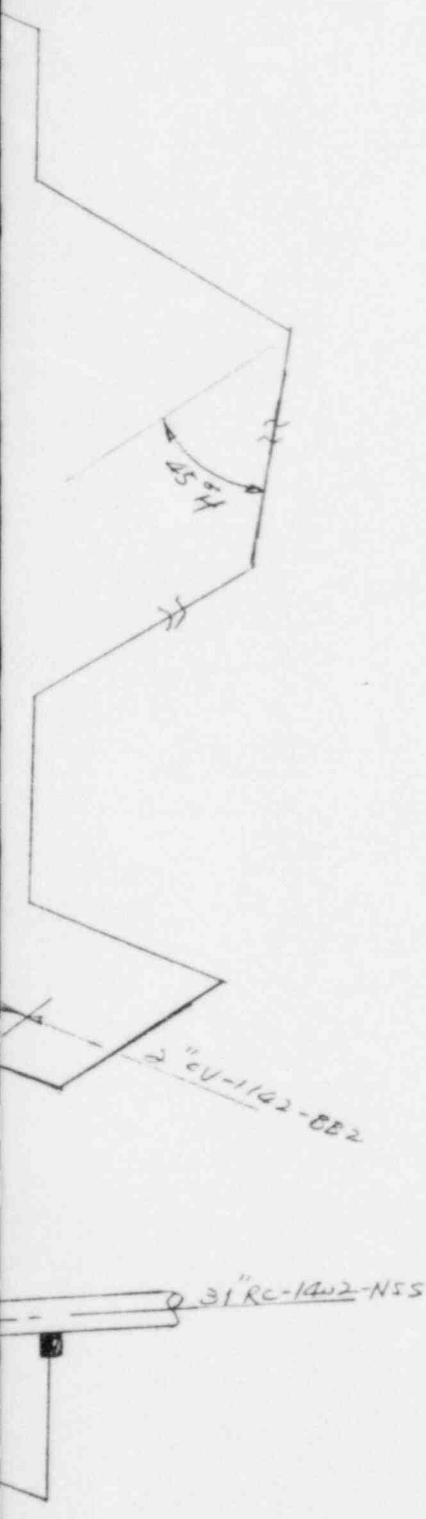

RESTRAINT LOAD SUMMARY

RESTRAINT NUMBER	RESTRAINT DESCRIPTION	DESIGN LOAD (KIPS) BREAK LOCATION
	None	

See Initial Stress Summary Results Table 3.6.2-1, SH 9F

LEGEND

■ POSTULATED BREAK POINT

→ ENERGY ABSORBING RESTRAINT

▷ RIGID GUIDE

SOUTH TEXAS PROJECT UNITS 1 & 2

POSTULATED BREAK POINTS AND RESTRAINT LOCATIONS

CVCS Excess Letdown from Loop 4 (Inside Containment)

Figure 3.6.1-1 (Sheet 9F)

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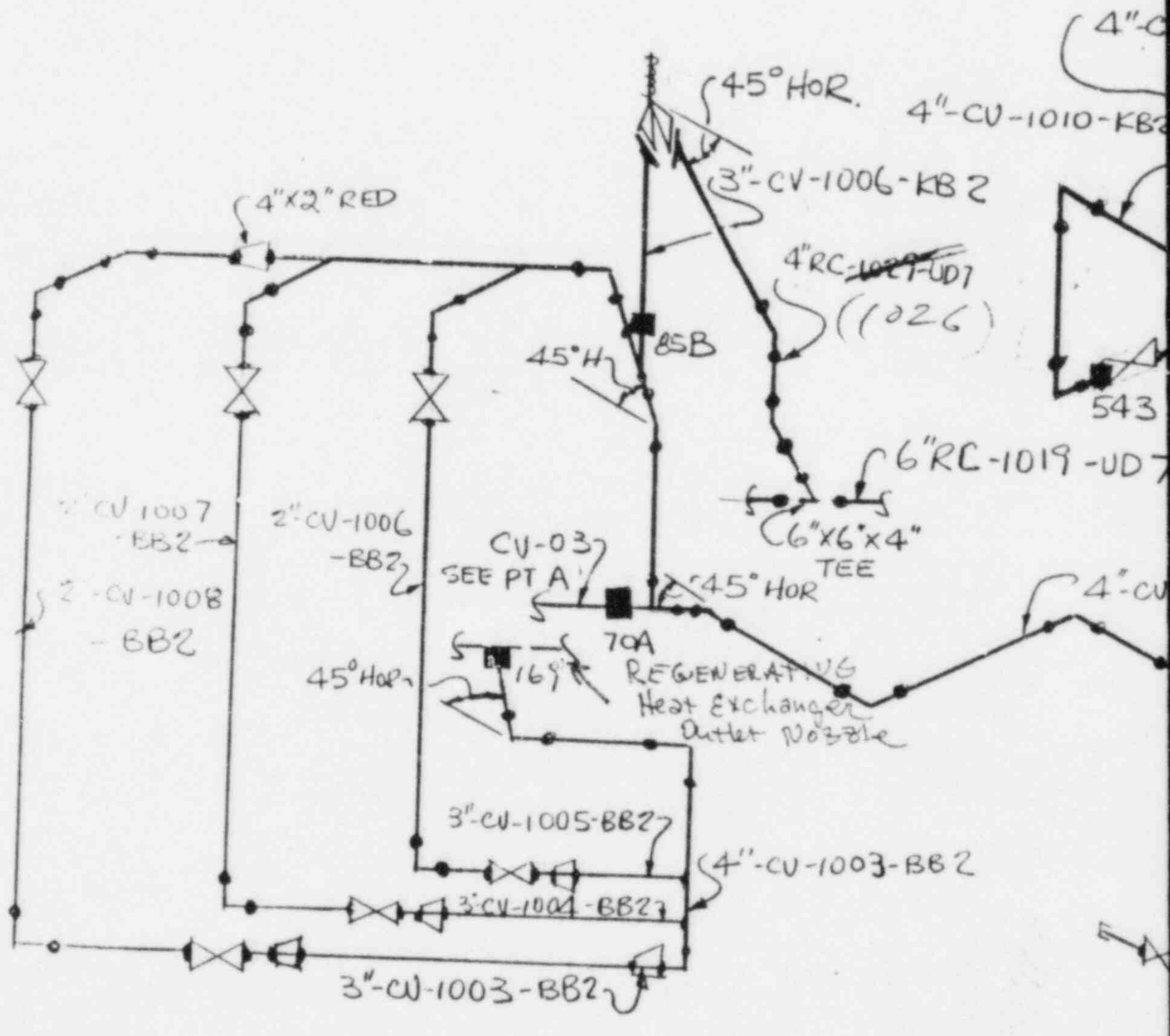
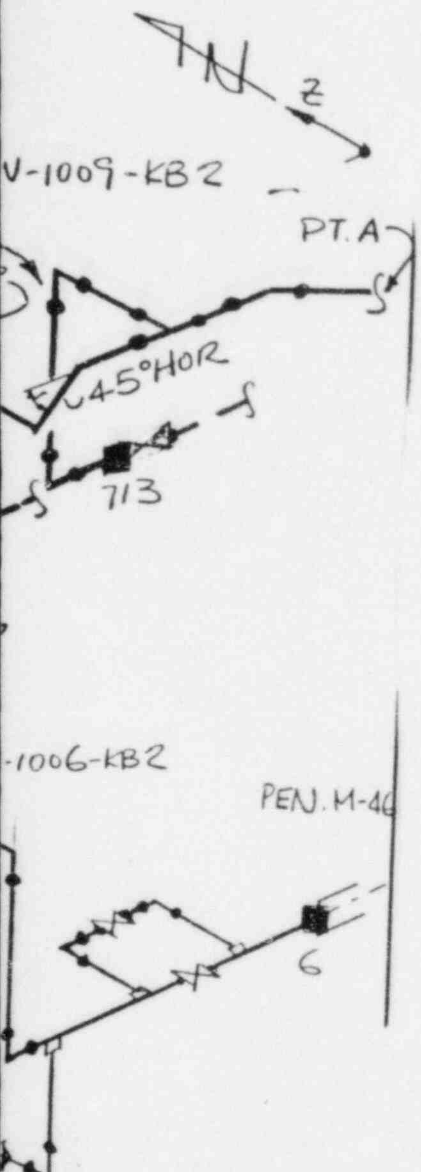


RESTRAINT LOAD SUMMARY

RESTRAINT NUMBER	RESTRAINT DESCRIPTION	DESIGN LOAD (KIPS) BREAK LOCATION



NONE

See Initial Stress Summary Results Table 3.6.2-1, SH 9H

LEGEND

■ POSTULATED BREAK POINT

→ ENERGY ABSORBING RESTRAINT

▷ RIGID GUIDE

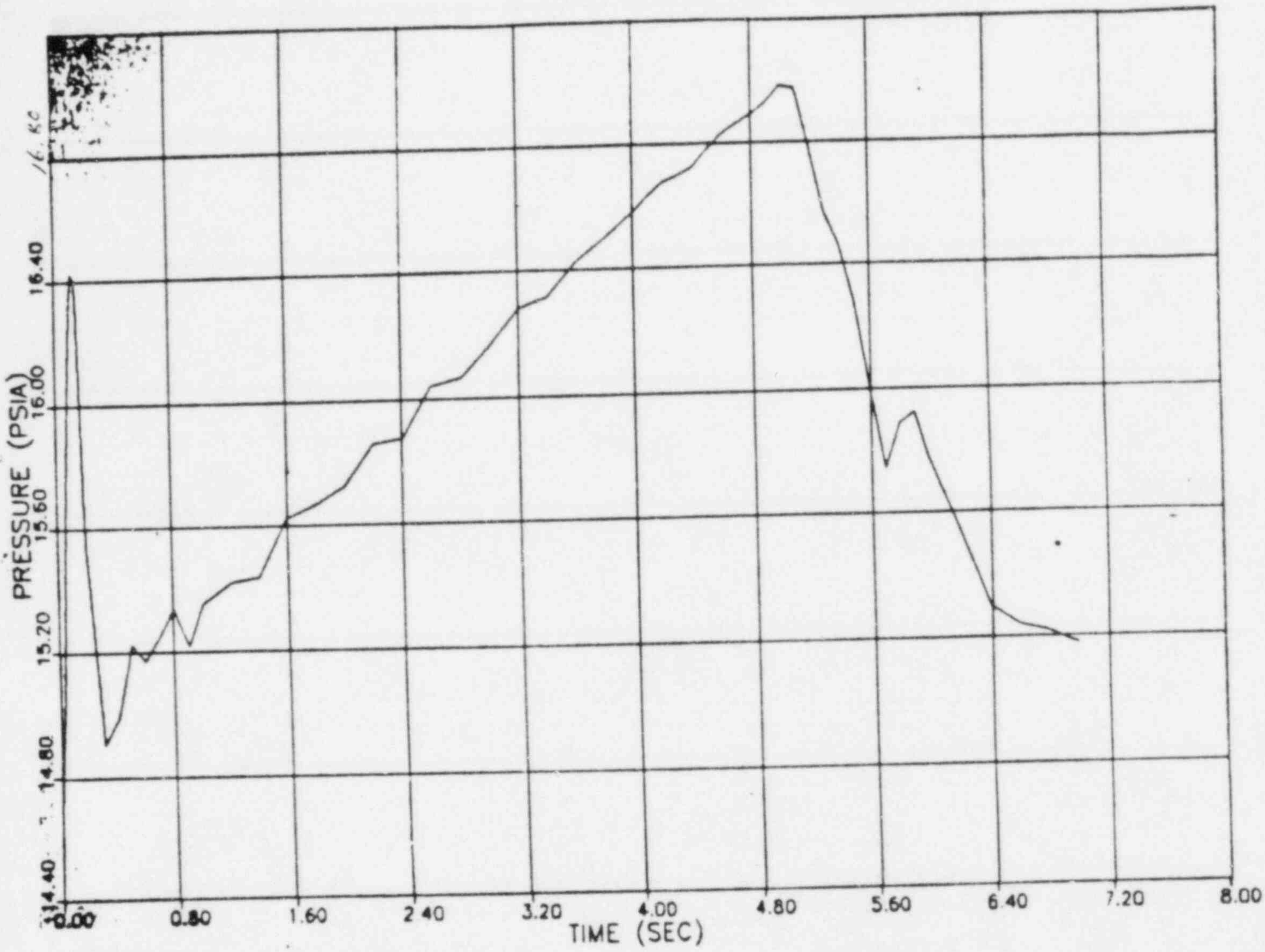
8510180333-37

SOUTH TEXAS PROJECT UNITS 1 & 2

POSTULATED BREAK POINTS AND RESTRAINT LOCATIONS

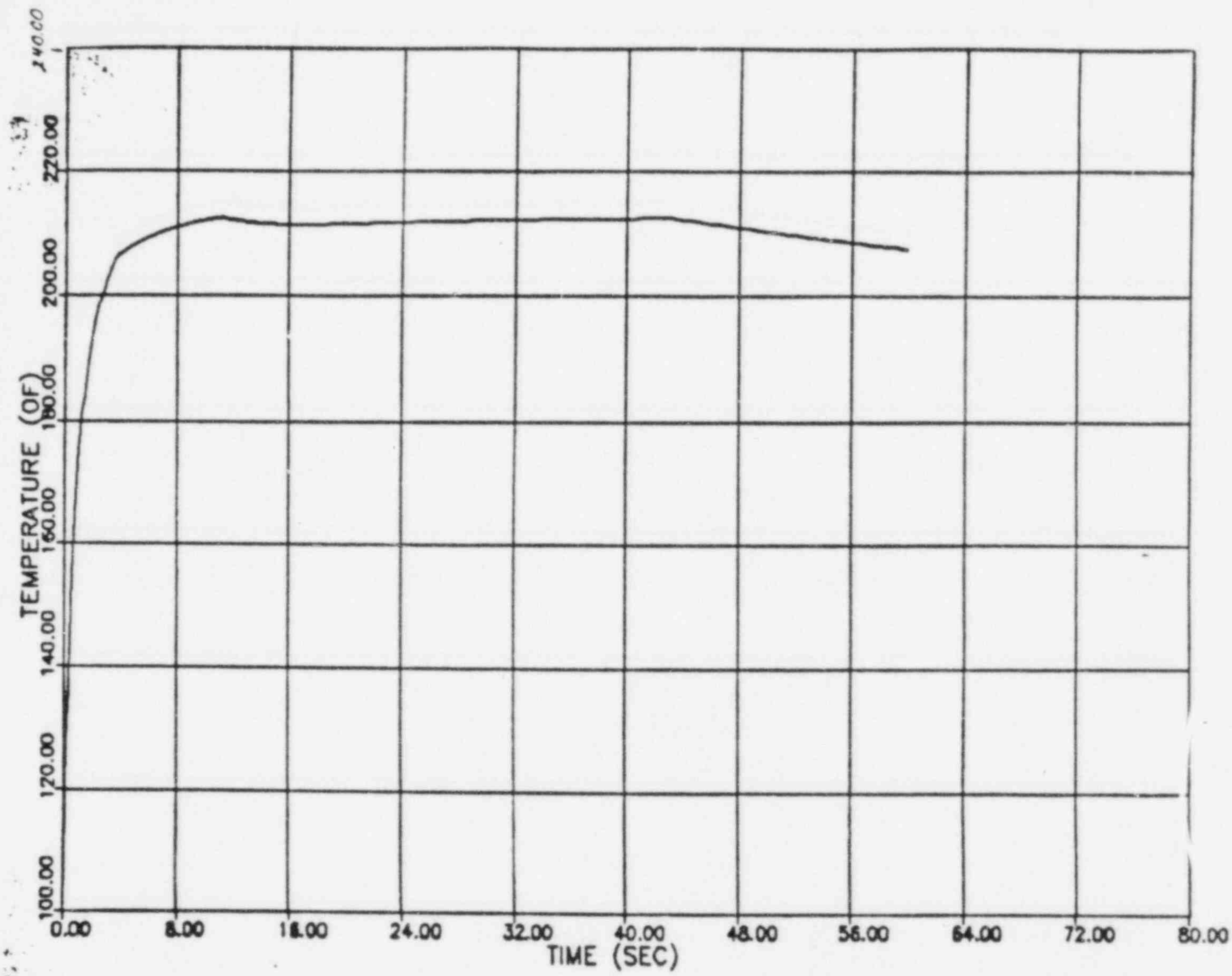
Chemical Volume and Control Letdown to Containment Penetration

Figure 3.6.1-1 Sheet 9H



Letdown Heat Exchanger Compartment Pressure Profile

Fig. 3.6.2-5



Letdown heat exchanger ~~room~~ compartment
Temperature Profile

Figure 3.6.2-6

APPENDIX 3.6.A

ISOLATION VALVE CUBICLE SUBCOMPARTMENT ANALYSIS

3.6.A.1 Design Features

The Isolation Valve Cubicle (IVC) is located between the Containment and Turbine Generator buildings on the north side of the containment. Figure 1.2-21 through 1.2-25 provides the plan and elevation views of this area. The IVC consists of four cubicles with each cubicle designed to accommodate equipment and piping pertaining to each of the four trains of the steam-feedwater system, thus meeting the train separation criteria.

At lower levels (between El. 10'0" and 34'0") each train has an AFW pump. Three of them are motor driven while the fourth is turbine-driven. Water-tight doors assures the separability of the auxiliary pump cubicles from one another in the event of flooding of any one of the cubicles due to a pipe break. Main Steam and Main Feedwater pipes run through the IVC above El. 34'0" extending from the containment penetrations to the five-way bending-torsional restraints mounted between two walls on the north end of the IVC. The MSIV, main steam safety valves, MFIV, etc. are located in this compartment. A sloped metal roof covers the top of the IVC. The roof will lift off the affected cubicle in the event of a pressure build-up due to a pipe break in one of the cubicles. The ~~auxiliary~~ AFW pump cubicles relieve their pressure build-up in the event of a AFW pipe break through the grated opening at Elevation 34'0" from whence it is eventually vented to the the atmosphere via the roof in the IVC.

3.6.A.2 Design Evaluation

The subcompartment pressure transients were determined using the COPDA computer code. Details of the code are given in Section 6.2.1.2.4. The piping in this compartment is designed to the break exclusion criteria stated in paragraph 3.6.2.1 for those portions of the piping passing through the primary containment and extending to the first pipe Whip restraint past the first outside isolation valve. Accordingly mechanistic pipe breaks are not postulated in te MSIV/MFIV piping. However, to provide an additional level of assurance of operability of safety related equipment in this compartment, the building structures and safety related equipment are designed to environmental conditions (pressure temperature and flooding) that would result from a break, equal to one cross-sectional area of the main steam and main feedwater main piping. Adequate venting is provided to limit the pressurization of the cubicles to below the design pressures of the wall.

The following cases were analyzed to determine the worst environmental conditions for the IVC.

1) Blowdown from a main steam line break (MSLB) equivalent to the area of a single area ripture.

2) Blowdown from a main feedwater line break due to a two-area (double-ended) break.*

3) Auxiliary feedwater line double-ended break in the auxiliary feedwater cubicle.

The MSLB results in maximum pressure conditions enveloping the results due to other cases and hence it is used for the design of IVC. Results of the MSLB analysis are presented below.

RELAP5 Code (Ref. 6.2.1.2-6) has been used to calculate the short term blowdown of the main steam line and is presented on Table 3.6.A-1.

The modalization scheme selected for the model is shown in Fig. 3.6.A-1. The nodal boundaries have been selected wherever there has been flow restrictions (such as grating platforms). As mentioned, the roof of the IVC is covered by built-up metal panels. The differential pressures at which these panels lift is 0.8 psig. The weight of these panels is 3 pounds/square foot. The panel is assumed to move parallel to its original position (note the panel has a small slope away from the containment building) till it clears the sidewalls of the IVC. Once the panels clear the walls, it is assumed to lift away from the path of the flow of the steam-air mixture to the atmosphere. Thus, this movement of the panels above its nominal position creates movable nodes 10 and 11 shown on the sectional diagrams. The node volume and junction parameters of the IVC are given on Table 3.6.A-2. Node 10 and 11 have variable properties as the panel moves above its nominal position. The vent area and the volume of these nodes are given in Table 3.6.A-3 and Table 3.6.A-4.

Out of the cases consider for the main steam line break in the IVC, results of two cases which yields maximum pressures in the various nodes are presented. In Case 1, the blowdown is distributed to node 6 while in Case 2, all the blowdown due to MSLB goes to node 7. The limiting pressure resulting from the two cases is presented in Fig. 3.6.A-3. The peak pressures for each of these nodes are listed in Table 3.6.A-2.

For generating the equipment qualification temperatures of the IVC a simpler 3-node model of the IVC has been used and the volume and junction properties were inputted into a modified COPDA code named FLUD (see 3.6.A.3 for discussion of FLUD). The simplified model consists of 3-nodes with node 1 being

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*Although a one area break, in accordance with FSAR Section 3.6.2.1, could have been justifiably used for the main feedwater line, a conservative double-ended break yields lower pressures and temperatures when compared to the one area break for the main steam line.

the auxiliary pump room between El. 10' and 32', node 2 is between El. 34' and 55.5' and lastly node 3 occupying space above 55.5". ~~Out of the various cases~~ *STET considered, MSLB produced the limiting temperatures in the IVC. The longterm blowdown used in the analysis is presented in Table 3.6.A-5 and the temperature profiles are given in Fig. 3.6.A-4. Blowdown has been obtained using Westinghouse LOFTRRAN code (Ref. 3.6.A.4.5).

3.6.A.3 FLUD, A Compartment Differential Pressure Analysis Code

This describes the computational procedure and the analytical techniques used in FLUD. The analytical basis for COPDA is described in Reference 6.2.1.2-2. The set-up of initial conditions, the determination of the thermodynamic state point at subsequent time increments, and computation of energy and mass transport between one time step is discussed in Sections 3.6.A.3.1, 3.6.A.3.2 and 3.6.A.3.3 for FLUD. Selection was made of the control volume and flow path configuration that resulted in the best representation of the pressure transients in the compartments along the flow paths from the break. The major differences between FLUD and COPDA (Ref. 3.6.A.6) are the use of steam table curve fits (Section 3.6.A.3) instead of table look-ups, ~~and~~ the equation of state which is a first-order virial expansion (discussed in 3.6.A.3.1) and the capability of wall heat transfer calculation. The fluid flow equations (compressible equations, HEM model and integrated momentum equation) used in COPDA have been reproduced in the FLUD code. It may be observed from the FLUD flowchart in Fig. 3.6.A.2 that the calculational procedures for FLUD and COPDA are very similar.

3.6.A.3.1 Equation of State

~~In~~ This section ~~we~~ describes how FLUD determines the thermodynamic state for each compartments in a system of interconnected compartments.

~~Our~~ the thermodynamic system (compartment) is assumed to be in equilibrium. The states assumed by the air-steam-water mixture can be described in terms of thermodynamic coordinates P, V, and T referring to the mixture as a whole. The equation of state is derived from a first order virial expansion as presented in Ref. 3.6.A.4.1. Using the molecular theory of gases, the following equation of state for an air-steam mixture is obtained assuming negligible air-steam molecular interaction:

$$P = \left(M_a R_a + M_s R_s\right) \frac{T}{V} + \frac{(M_s)^2}{V} R_s\, T\, B_s(T), \ (\text{lbf/ft}^2) \quad \text{(EQ. 3.6.A.1)}$$

where the temperature dependence of the second virial coefficient for steam $R_s(T)$ is given by (Reference 3.6.A.4.2)

$$B_s(T) = 0.0330 - \frac{75.3137}{T}\, 10^{\,3.2659/(T^2 \times 10^{-5} + 1.1308)}$$

(EQ. 3.6.A.2)

EQ. 3.6.A.1 can be rewritten as the sum of the partial pressure of air P_a and the partial pressure of steam P_s where

$$P_a = \frac{M_a}{V} P_a T, \ (lbf/ft^2) = 0.37043 \frac{T}{V_a}, \ (psia) \qquad (EQ. 3.6.A.3)$$

and

$$P_s = \frac{M_s}{V} R_s T \left[1 + \frac{M_s}{V} B_s (T)\right], \ (lbf/ft^2) \qquad (3.6.A.4)$$

EQ. 3.6.A.4 compares well with the steam tables (Ref. 3.6.A.4.2). For example, the relative error in EQ. 3.6.A.4 is less than 1% for saturated steam at temperatures less than 570°F.

3.6.A.3.2 Compartment Thermodynamic State

At any time, the total internal energy E, the air mass M_a, and the vapor mass M_v have known values for each compartment. Vapor is defined as a homogeneous mixture of steam and water in unknown proportions.

The internal energy is a function of as many thermodynamic coordinates as are necessary to specify the state of the system. Therefore, for known air and vapor masses and because the compartment volume is originally specified, the compartment internal energy can be expressed as a function of temperature only:

$$P = P(T) \qquad (EQ. 3.6.A.5)$$

At the saturation temperature T_0, there is a discontinuous change in the slope of B(T) due to a phase change in the compartment atmosphere. Associated with T_0 is the compartment saturation energy $E_0 = E(T_0)$. Equation 3.6.A.5 has two branches: (1) a two-phase branch were $E < E_0$ and $T < T_0$ and (2) a superheat branch where $E > E_0$ and $T > T_0$. Along the two-phase branch the vapor portion of the atmosphere has a non-zero water mass component, while along the superheat branch the vapor contains no water.

Having examined the behavior of E(T), ~~we now proceed to solve~~ EQ. 3.6.A.5 IS SOLVED for the compartment temperature, E being known. v_{sat}, e_{sat} and v_m, e_w represent the specific volumes and specific internal energies of saturated steam and water respectigely. The dependence of these quantities on temperature is determined empirically from steam table curve fits described in Section 3.6.A.8. E_0 is calculated to determine on which branch of E(T) the compartment temperature lies. At compartment saturation, the steam mass M_s is identical to M_v and the specific volume of the steam is just v_{sat} (T_0). Thus,

$$V = M_v V_{sat} (T_o) \qquad (EQ. 3.6.A.6)$$

The above equation is easily solved to T_o by utilizing the inverse of the function $V_{sat}(T_o)$, which is also a steam table curve fit where $T_o = T_{sat}(V/M_v)$. The saturation internal energy for the compartment is then given by

$$E_o = M_a c_{va} T_o + M_v e_{sat}(T_o) \quad \text{(EQ. 3.6.A.7)}$$

where c_{va} = 0.1725 Vtu/lbm°R is the specific heat at constant volume for air averaged over the temperature range -109.7 to 440.3°F. For the case $E > E_o$ (the two-phase branch), the explicit dependence of E on M_a, M_s, M_w and T is

$$E = M_a c_{va} T + M_s(T)\, e_{sat}(T) + M_w(T)\, e_w(T) \quad \text{(EQ. 3.6.A.8)}$$

The functions $e_s(P_s, T)$ and $e_w(T)$ are the specific internal energies of steam and water respectively and are also discussed in Section 3.6.A.5. The steam and water masses are functions of temperature only and are given by

$$M_s(T) = x(T) M_v = \frac{V - M_v v_w(T)}{v_{sat}(T) - v_w(T)} \quad \text{(EQ.3.6.A.9)}$$

and

$$M_w(T) = M_v - M_s(T) \quad \text{(EQ.3.6.A.9)}$$

where the steam quality x(T) is defined by the following:

$$x(T) = \frac{M_s(T)}{M_v} = \frac{V/M_v - v_w(T)}{v_{sat}(T) - v_w(T)} \quad \text{(EQ. 3.6.A.10)}$$

LC

For the case $E > E_o$ (the superheat branch), the explicit dependence of E is given by

$$E = M_a c_{va} T + M_s e_s(P_s, T) \quad \text{(EQ. 3.6.A.11)}$$

The steam mass M_s is not a function of temperature since it is equal to the vapor mass M_v, and of course the water mass is zero.

Because E is a complex function of T as seen by the above, EQ. 3.6.A.5 does not readily lend itself to a strictly analytical solution. Instead, FLUD employs a one-pass iterative technique to solve for the temperature.

3.6.A.3.3 Compartment Initial Conditions

The initial thermodynamic state is specified for each compartment by the total compartment pressure P, the compartment volume V, temperature T, relative humidity Ø, and vapor quality x.

If Ø < 1.0, the compartment is superheated, the vapor consists entirely of steam, and the steam mass is given by definition as

$$M_s = Ø \frac{V}{v_{sat}(T)} \qquad \text{(EQ. 3.6.A.12)}$$

The steam partial pressure is obtained from EQ. 3.6.A.4, and thus the air mass is given by EQ. 3.6.A.3. The internal energy is calculated using EQ. 3.6.A.11. If Ø = 1.0 and x = 1.0, the compartment is saturated. The steam partial pressure is given by the saturation pressure $P_s = P_{sat}(T)$. The saturation pressure of steam P_{sat} is obtained empirically from a curve fit to the steam tables. The steam mass is given by EQ. 3.6.A.12 with Ø = 1.0. The vapor mass is identically equal to the steam mass, and the internal energy is computed from EQ. 3.6.A.7. For Ø = 1.0 and x = 1.0, the compartment is two-phase. The vapor and steam masses are given by EQ. 3.6.A.9 and the water mass by EQ. 3.6.A.9. The steam ~~potential~~ partial pressure is equal to the saturation pressure $P = P_{sat}(T)$. Therefore, the air mass can be calculated from EQ. 3.6.A.3. However, because the compartment now contains water, the volume accessible to the air and steam V_g is just

$$V_g = V - M_w v_{sat}(T) \qquad \text{(EQ. 3.6.A.13)}$$

This gas volume V_g must be used in place of V in EQ.3.6.A.3 determining the air mass. The internal energy is obtained from EQ. 3.6.A.8.

3.6.A.3.4 Air and Vapor Component Flow Rates

The time-dependent partial pressure of steam is given by EQ. 3.6.A.4 where v_s replaces V/M_s. The time-dependent air specific volume v_a is then obtained from EQ. 3.6.A.3. Time-dependent air and steam mass fractions are then calculated as follows:

$$f_a = v_s/(v_s + v_a) \qquad \text{(EQ. 3.6.A.14)}$$

$$f_v = v_a/(v_s + v_a) \qquad \text{(EQ. 3.6.A.14)}$$

The flow rates of the air and vapor components that comprise the gas are calculated from the total flow rate M by using the mass fractions of air and vapor in the upstream compartment:

$$\dot{M}_{aij} = f_a M_{ij} \qquad \text{(EQ. 3.6.A.15)}$$

$$\dot{M}_{vij} = f_v M_{ij} \qquad \text{(EQ. 3.6.A.16)}$$

3.6.A.4 Energy Transfer Mechanisms

There are several mechanisms by which FLUD transfers energy to and from the various compartments and the atmosphere. These mechanisms are:

1) Blowdown energy
2) Flow of energy between compartments
3) Compartment heat loads
3) Compartment unit coolers

All of these mechanisms add or subtract energy from the system. A continuous accounting of all energy contributors is kept by FLUD in the form of an overall energy balance to ensure energy conservation. The various energy transfer mechanisms are discussed and the energy balance are discussed below.

3.6.A.4.1 Blowdown Energy

Blowdown energy is added to the system of compartments when FLUD is used to analyze a high-energy pipe break problem. The blowdown flow rate M_B, specific enthalpy h_B, and the split among compartments are assumed to be given at input data. The rate of energy addition to the system by blowdown H_B is usually a time-varying quantity given by

$$\dot{H}_B = \dot{M}_B \, h_B \qquad \text{(EQ. 3.6.A.17)}$$

This variable energy rate is used to calculate the amount of energy that is placed in one or in the various break compartments during each time step. The total amount of blowdown energy added to the system is the integral of H_B

$$H_B\,(t) = \int_0^t \dot{H}_B \, dt \qquad \text{(EQ. 3.6.A.18)}$$

The blowdown energy rate added to the ith compartment is calculated by multiplying the user-supplied split fraction for the ith compartment times the total blowdown energy rate in EQ. 3.6.A.17.

3.6.A.4.2 Enthalpy Flow

Whenever mass is transferred between compartments or between a compartment and the atmosphere, there is an associated transfer of energy based upon the enthalpy of the upstream compartment. The general relation used to calculate enthalpy flow between compartments is

$$\dot{H}_i = \sum_j \dot{M}_{ij} h^*_{ij} \qquad \text{(EQ. 3.6.A.19)}$$

where h^*_{ij} represents the total specific enthalpy of the gas in the upstream compartment and $\dot{M}_{ij}$ is the flow rate between compartments i and j as discussed in ~~26B.1.2~~ 3.6.A.4. The total enthalpy flow rate for the system is

$$\dot{H} = \sum \dot{H}_i \qquad \text{(EQ. 3.6.A.20)}$$

When energy transfer occurs between a compartment and the atmosphere, the relation used to calculate this flow is

$$\dot{H}_{atm,i} = \dot{M}_{ii} h^*_{ii} \qquad \text{(EQ. 3.6.A.21)}$$

Here $\dot{M}ii$ represents the total flow from or to the atmosphere from compartment i and h^*_{ii} is the specific enthalpy of the upstream compartment (which may be either compartment i or the atmosphere depending upon the sign $\dot{M}ii$). The total enthalpy flow rate to the atmosphere is

$$\dot{H}_{atm} = \sum_i \dot{H}_{atm,i} \qquad \text{(EQ. 3.6.A.22)}$$

and the total amount of energy transferred to the atmosphere is

$$H_{atm}(t) = \int_0^t \dot{H}_{atm}\, dt \qquad \text{(EQ. 3.6.A.23)}$$

3.6.A.4.3 Compartment Heat Loads

Heat is generated within a compartment in the case where pumps or equipment are operating in that compartment. These heat loads are given with the input data as a constant heat rate (Btu/sec) for each compartment Q_{load}. These heat loads are assumed to be applicable throughout the problem under consideration.

3.6.A.4.4 Unit Coolers

Unit coolers or room coolers are present in many situations, especially in compartments that have equipment capable of generating large heat loads. Room coolers can have a variable start temperature which is specified in the input data. The coolers are usually set to begin operating when the compartment temperature exceeds some prescribed limit.

The cooling heat transfer rate is given by

$$\dot{Q}_{cool} = \alpha (T - T_{cool}) \qquad \text{(EQ. 3.6.A.24)}$$

Where T_{cool} is the cooler cold water inlet temperature, T is the temperature of the compartment, and α is the cooler constant (Btu/sec-°R). The cooler constant can be calculated from room cooler specifications and is assumed to be constant throughout the temperature ranges of the room atmosphere and the cooling water temperature.

3.6.A.4.5 Energy Balance

The energy balance given by the following equations is used to ensure that energy conservation is achieved.

$$E_{bal} = E_i + \dot{Q}\, dt + \dot{H}_{atm}\, dt + \dot{H}_B dt - E_i\,(0) \qquad \text{(EQ. 3.6.A.25)}$$

where E_i is the total energy in the ith compartment, E_i (0) is the initial compartment energy, and

$$\dot{Q} = \dot{Q}_c + \dot{Q}_{load} + \dot{Q}_{cool} \qquad \text{(EQ. 3.6.A.26)}$$

If an energy balance is achieved, then E_{bal} should be zero.

3.6.A.4.6 Blowout Panel Activation

Blowout panels are treated as instantaneous one-way switches. Once a blowout panel set pressure is exceeded, the flowpath is open for the duration of the calculation. The actual activation of a blowout panel is made by setting the forward and reverse set pressures equal to zero once the forward set pressure has been exceeded.

3.6.A.4.7 Energy and Mass Conservation

Energy and mass conservation is then checked by calculating the following quantities:

$$E_{bal} = \sum E_i + \int \dot{Q}\, dt + \int \dot{H}_{atm} dt - \int \dot{H}_B dt - E_{init} \qquad \text{(EQ. 3.6.A.27)}$$

$$M_{bal} = \sum M_i + \int \dot{M}_Q dt + \int \dot{M}_{atm} dt - \int \dot{M}_B dt - M_{init} \qquad \text{(EQ. 3.6.A.28)}$$

If all mass and energy transfer has been accounted for, then E_{bal} and M_{bal} should be zero (or a very small percentage of the total energy and mass due to computer round-off error).

3.6.A.4.8 Eulerian Integration

The time-dependent quantities listed below are integrated according to the following general scheme:

$$X(T + \Delta t) = X(t) + \dot{X}(t)\Delta t \qquad \text{(EQ. 3.6.A.29)}$$

where X is any time dependent variable and $\dot{X}$ is its time rate of change. The variables integrated by FLUD are:

$\dot{H}_B$ - blowdown enthalpy flow rate

$\dot{M}_B$ - blowdown mass flow rate

$\dot{E}$ - energy rate of change

$\dot{H}_{atm}$ - atmospheric enthalpy flow rate

$\dot{M}_a$ - air mass flow rate

$\dot{Q}$ - Heat transfer rate

$\dot{M}_v$ - vapor mass flow rate

$\dot{M}_{atm}$ - atmospheric mass flow rate

$\dot{m}_a$ - mass condensation rate

3.6.A.5 Thermodynamic Properties of Steam, Water, and Air

FLUD uses steam, air, and water properties for various thermodynamic calculations which are performed during each time step. The thermodynamic variables needed in FLUD calculations are:

$e_a(T)$	Specific internal energy of air
$P_{sat}(T)$	saturation pressure of steam
$v_{sat}(T)$	saturation specific volume of steam
$e_s(T,P)$	specific internal energy of steam
$v_w(T)$	specific volume of water
$e_w(T)$	specific internal energy of water
$T_{sat}(P)$	saturation temperature of steam
$T_{sat}(v)$	saturation temperature of steam
$e_{sat}(T)$	saturation specific internal energy of steam
$h_{sat}(T)$	saturation specific enthalpy of steam
$h_{fg}(P)$	enthalpy of vaporization of steam

The "unknown" quantities that can be used to calculate the above nine variables are the macroscopic compartment thermodynamic variables pressure, specific volume, and temperature, P, v, and T respectively.

The air and water properties $e_a(T)$, $v_w(T)$, and $e_w(T)$ are calculated by ~~spline~~ fitting polynomials to data in the steam and gas tables (References 3.6.A.4.2 and 3.6.A.4.3). The air property $e_a(T)$ was found to be adequately represented by a linear fit. This is no doubt due to the good "ideal gas" behavior of air. Thus,

$$e_a(T) = a_1 T \qquad \text{(EQ. 3.6.A.30)}$$

The water properties $v_w(T)$ and $e_w(T)$ and the steam properties $h_{sat}(T)$, $e_0(T)$, and
$e_{sat}(T)$ are very nearly straight line functions, but small variations were acco
modated by using third order spline polynomial fits of the general form:

$$\text{property } (T) = a_0 + a_1 T + a_2 T^2 = a_3 T^3 \qquad \text{(EQ. 6.3.A.31)}$$

For example, for $h_{fg}(P)$;

$$h_{fg}(P) = a_0 + a_1 P + a_2 p^2 + a_3 P_3^3 \qquad \text{(EQ. 3.6.A.33)}$$

The accuracy of the curve fits range between 0.01% and 4% for the various properties.

3.6.A.6 References

3.6.A.4.1 Reif, F. J. Fundamentals of Statistical and Thermal Physics, McGraw-Hill Book Co., p. 183.

3.6.A.4.2 Kennan, J. H. et al, Steam Tables, John Wiley & Sons, Inc., New York, 1969.

3.5.A.4.3 Keepan, J. H., and J. Kaye, Gas Tables, John Wiley & Sons, Inc., New York, 1948.

3.6.A.4.4 Bechtel Topical Report BN-TOP-4 Rev. 1, October 1977, "Subconmartment Pressure and Temperature Transient Analysis". This report was approved by the NRC in February, 1979.

3.6.A.4.5 LOFTRAN, "later"

Table 3.6.A-1

MAIN STEAM LINE BREAK BLOWDOWN

(an enthalpy of 1200 Btu/lbm is conservatively assumed throughout)

Time (Secs.)	Steam Generator A or B (lb/sec.)
0.0	0.0
0.0066	8700.0
0.01	6090.89
0.013	5763.63
0.025	5531.81
0.05	5227.25
0.10	4890.86
0.125	4972.72
0.15	5190.87
0.20	5036.35
0.25	4899.95
0.30	4809.05
0.35	4763.60
0.40	4718.15
0.45	4718.15
0.50	4672.70

Table 3.6.A-2

IVC Subcompartment Nodal Description

Volume Number	Volume Cu ft.	Initial Conditions			Flow Path	Flow Area Ft^2	Flow Coefficient	L/A ft^{-1}	Calculatred Peak Press. psia
		Temp. °F	Pressure psia	Humidity %					
1.	3588.5	105.0	14.7	90					21.35
2.	1977.5	105.0	14.7	90	2 → 1	75.45	0.78	0.05	21.08
3.	5530.95	105.0	14.7	90	3 → 2	54.16	0.82	0.18	20.33
4.	2558.5	105.0	14.7	90	4 → 3	210.37	0.80	0.024	20.435
					4 → 5	64.60	0.92	0.26	
					4 → 6	256.84	0.82	0.02	
5.	1453.0	105.0	14.7	90	5 → 3	115.72	0.80	0.035	23.25
					5 → 7	131.90	0.817	0.04	
6.	2221.7	105.0	14.7	90	6 → 7	56.52	0.91	0.27	22.93
					6 → 8	195.42	0.80	0.05	
7.	1262.26	105.0	14.7	90	7 → 9	90.29	0.79	0.09	28.79
8.	7957.44	105.0	14.7	90	8 → 9	80.53	0.85	0.07	19.73
					8 → 10	257.94	0.92	0.038	
9.	5448.47	105.0	14.7	90	9 → 11	227.24	0.94	0.04	19.15
10.	Please	see	table	3.6.A-3	for details for this node				
11.	Please	see	table	3.6.A-4	for details for this node				
12.	1.0E22	105.0	14.7	90					

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Table 3.6.A-3

Node 10, Variable Node Parameters

Variable height of the panel ft	Variable Vent Area ft^2	Variable Volume ft^3
0.0	0.0	173.92
0.4	5.2	298.71
0.8	10.4	423.50
1.05	14.32	501.50
1.30	19.59	579.50
1.55	26.88	657.49
1.92	42.61	1084.90
2.92	100.98	772.92
3.92	161.97	1396.88
5.00	227.84	1733.82

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Table 3.6.A-4

Node 11, Variable Node Parameters

Variable height of the panel ft	Variable Vent Area ft^2	Variable Volume ft^3
0.0	18.0	158.38
0.4	23.2	275.37
0.8	28.4	392.37
1.5	37.5	597.11
1.92	42.96	719.95
2.32	51.48	836.95
2.72	66.66	953.94
3.00	81.25	1035.84
4.00	139.24	1328.32
5.00	197.24	1620.87

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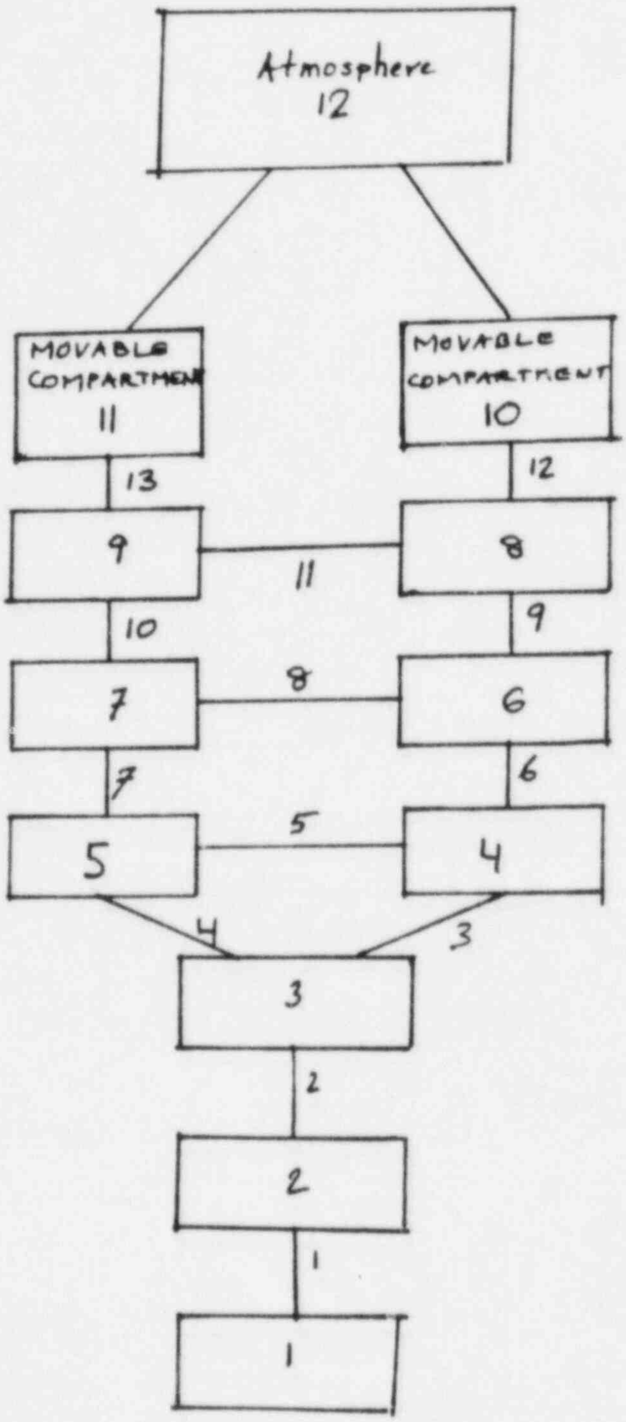
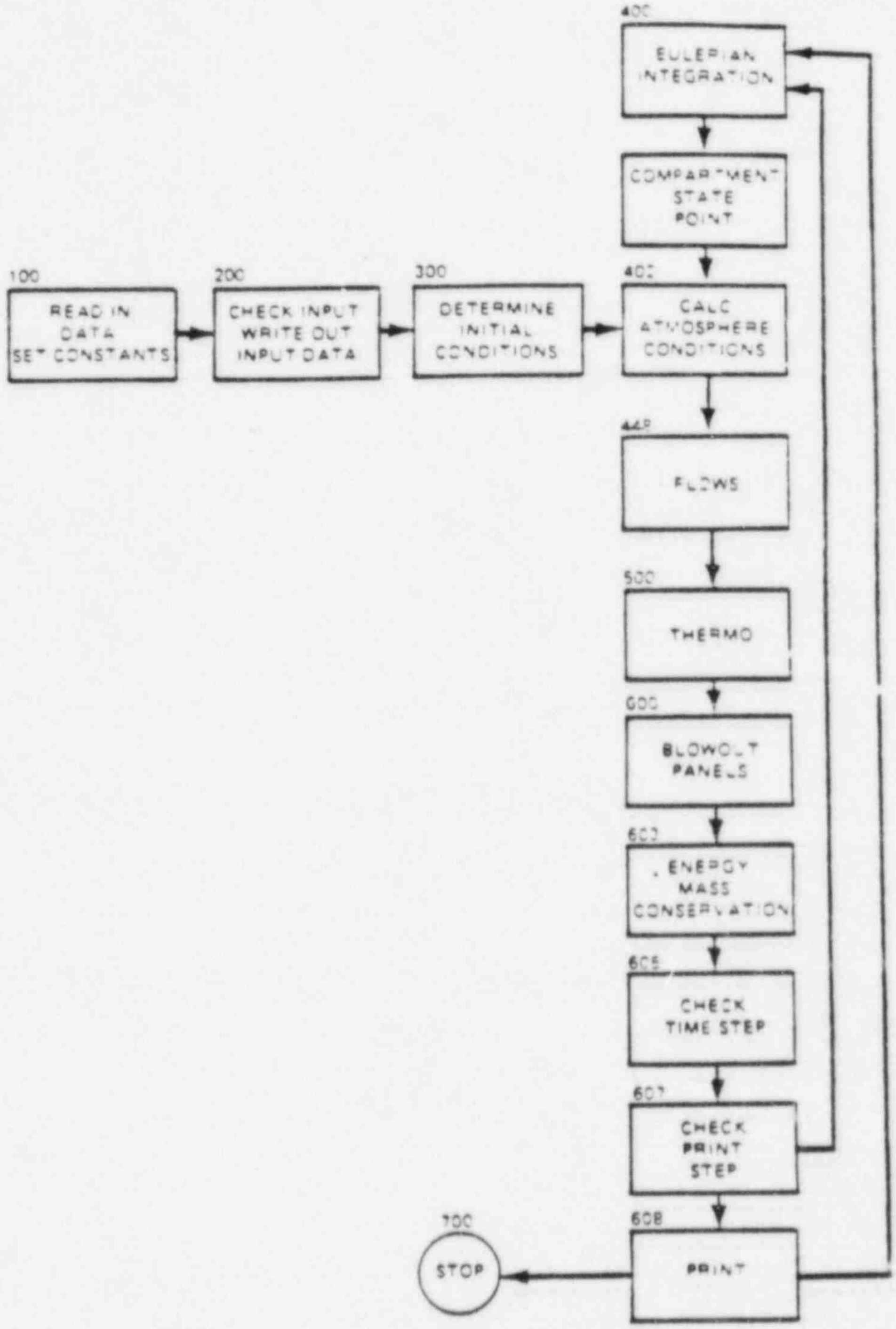
Table 3.6.A-5

Mass/Energy Release Results For a 4.05 ft^2
Split Steam Line Break at 0% Power

Time	Mass flow Rate (lbm/sec)	Enthalpy Btu/lbm
0.0	10143.6	1184.98
2.5	9336.6	1189.68
5.0	8550.8	1192.87
7.5	7906.5	1195.46
10.0	2506.3	1197.98
15.0	2084.8	1201.55
20.0	1780.7	1203.46
25.0	1561.5	1204.42
30.0	1397.9	1204.74
35.0	1270.5	1204.80
40.0	1170.3	1204.73
45.0	1091.7	1204.36
50.0	1030.3	1204.16
60.0	942.5	1203.60
80.0	855.7	1202.88
100.0	821.5	1202.43
150.0	786.8	1202.08
200.0	743.6	1201.45
250.0	696.9	1200.88
300.0	628.2	1199.62
310.0	595.1	1198.62
350.0	595.1	1198.62
351.0	141.3	1198.86
1800.0	141.3	1198.86
2802.0	0.0	0.0

FIGURE 3.6.A-1. NODE AND JUNCTION DIAGRAM OF THE IVC.





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UNITS 1 AND 2
ENVIRONMENTAL REPORT

BASIC FLUD CALCULATION FLOWCHART

FIGURE ~~~~ 3.6.A.2

FIG 3.6A-3
(Sheet 1 of 9)

PRESSURES IN IVC DUE TO MSLB

NODE 1 (BREAK NODE 1: Case 2)

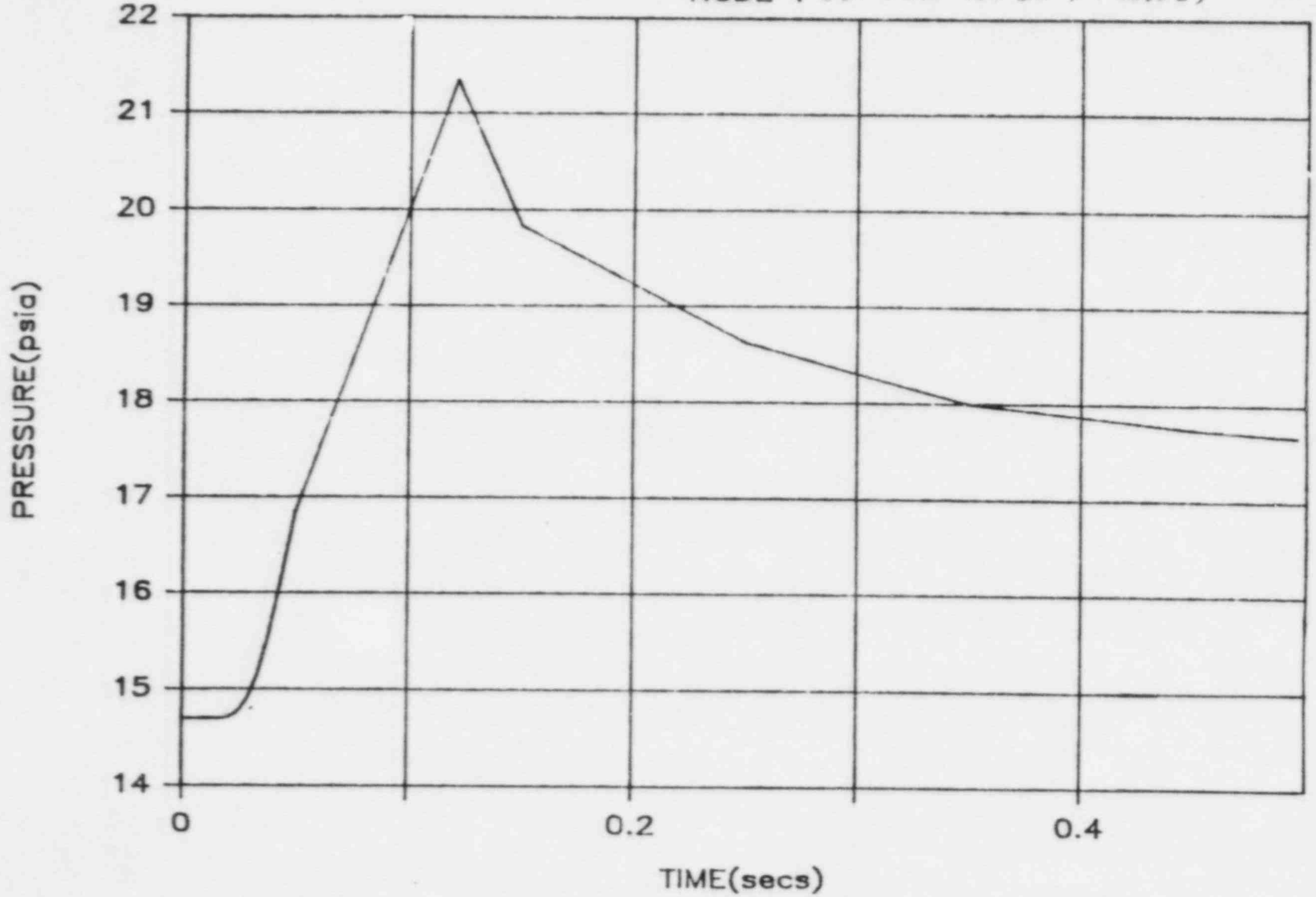

FIG 3.6A-3
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PRESSURES IN IVC DUE TO MSLB

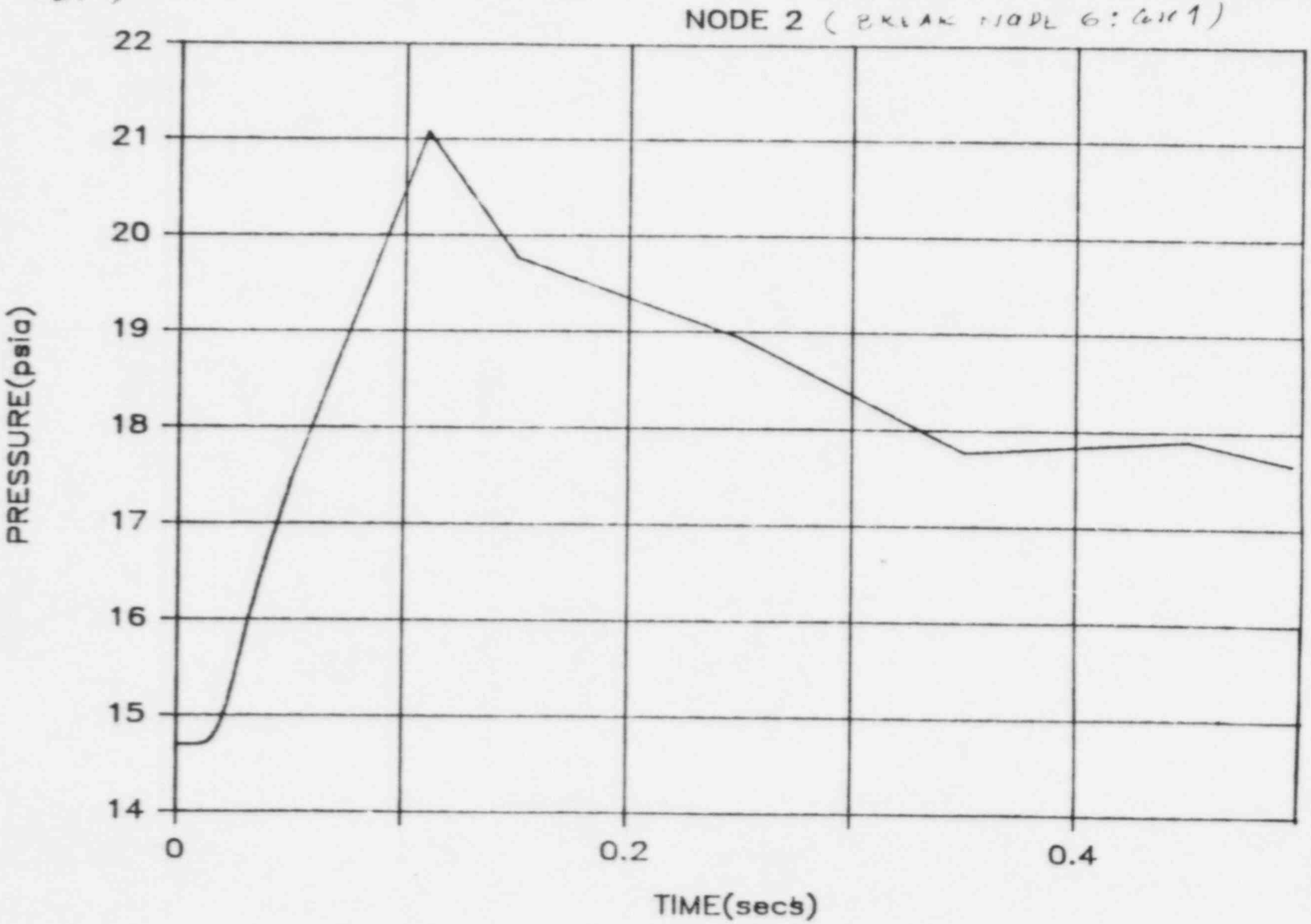

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Fig 36A-3
(sheet 3 of 9)

PRESSURES IN IVC DUE TO MSLB

NODE 3 (BREAK NODE 7: Case 2)

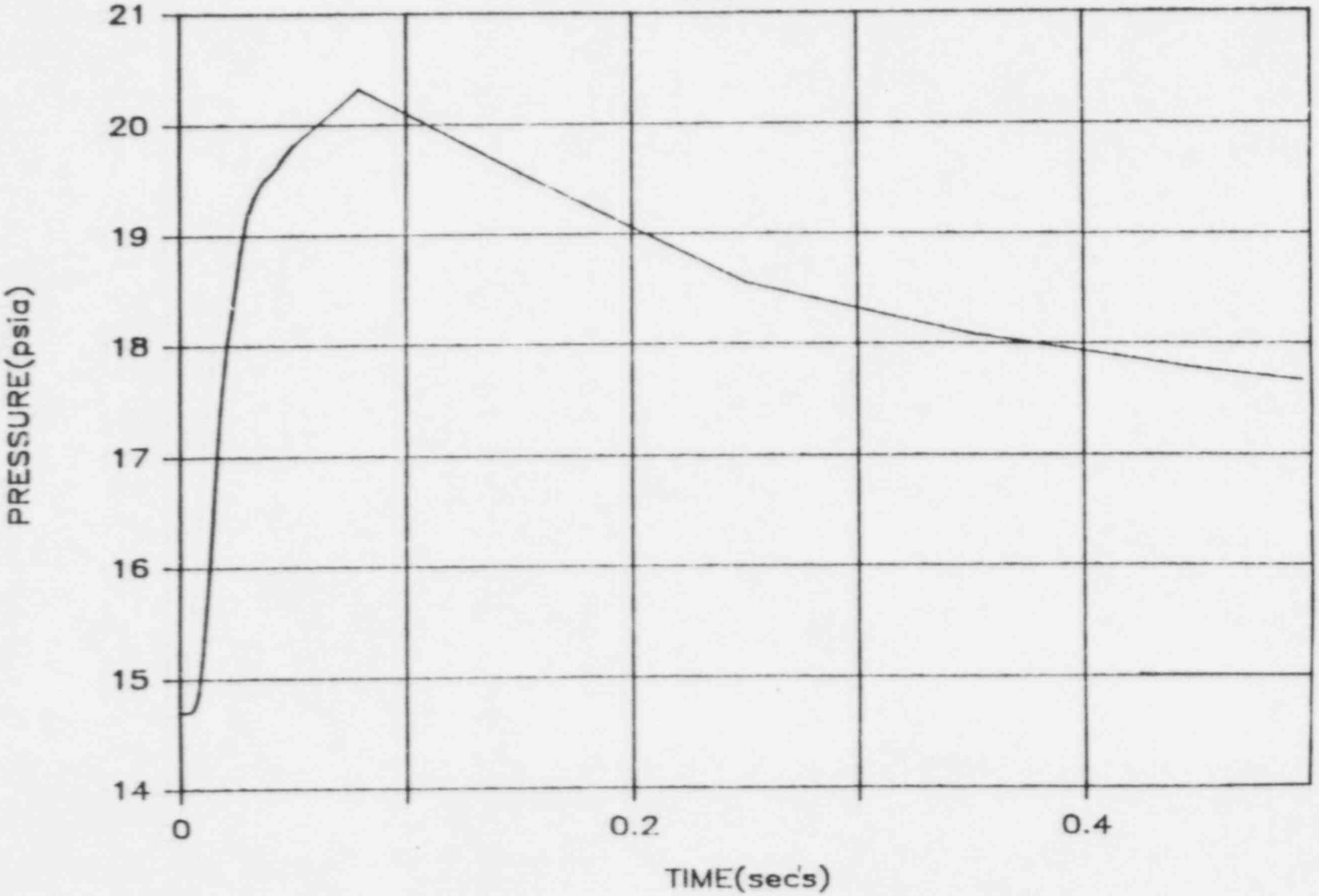

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FIG. 3C.A-3 (sheet 4 of 9)

PRESSURES IN IVC DUE TO MSLB

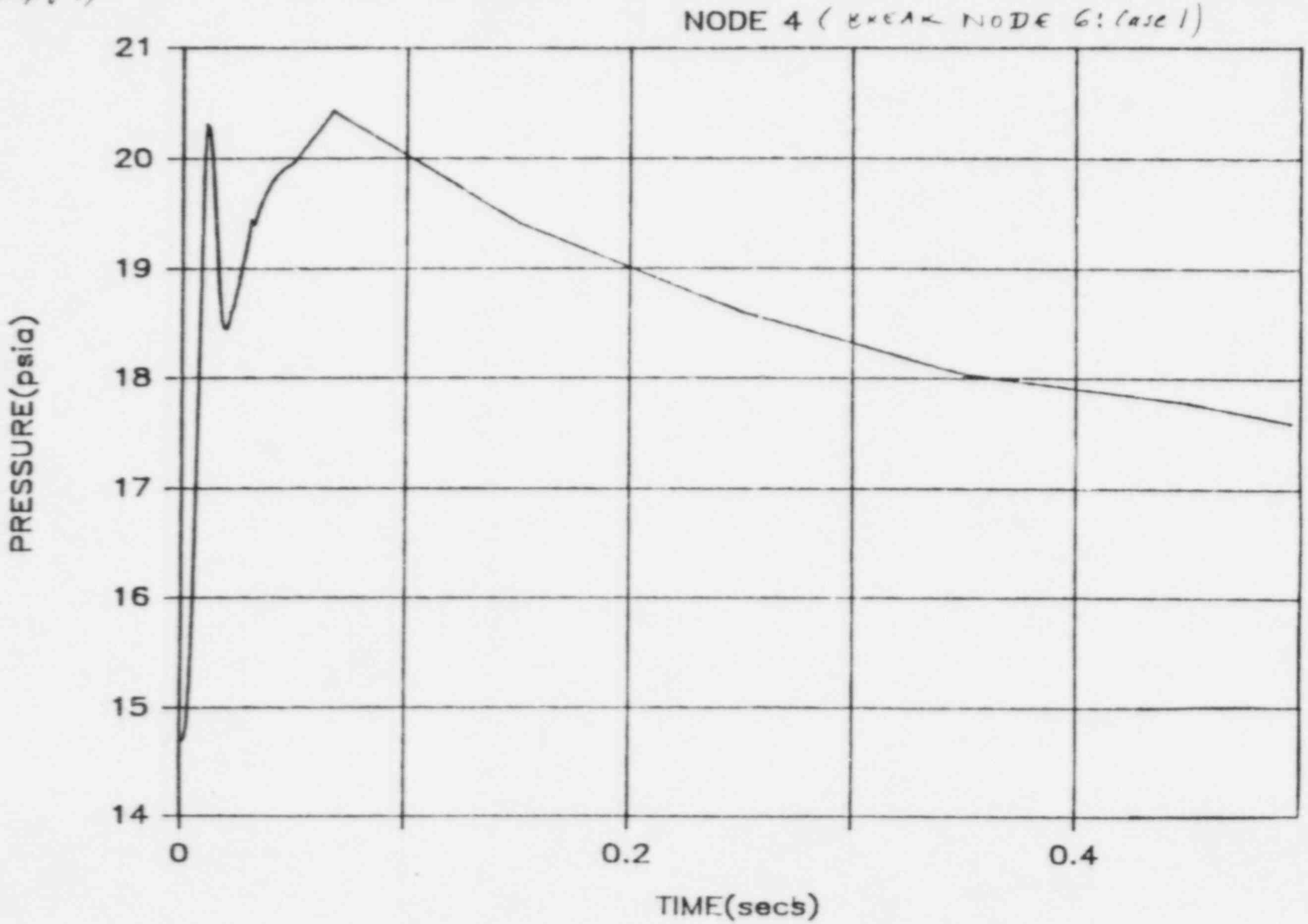

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Fig 3.6.A-3
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PRESSURES IN IVC DUE TO MSLB

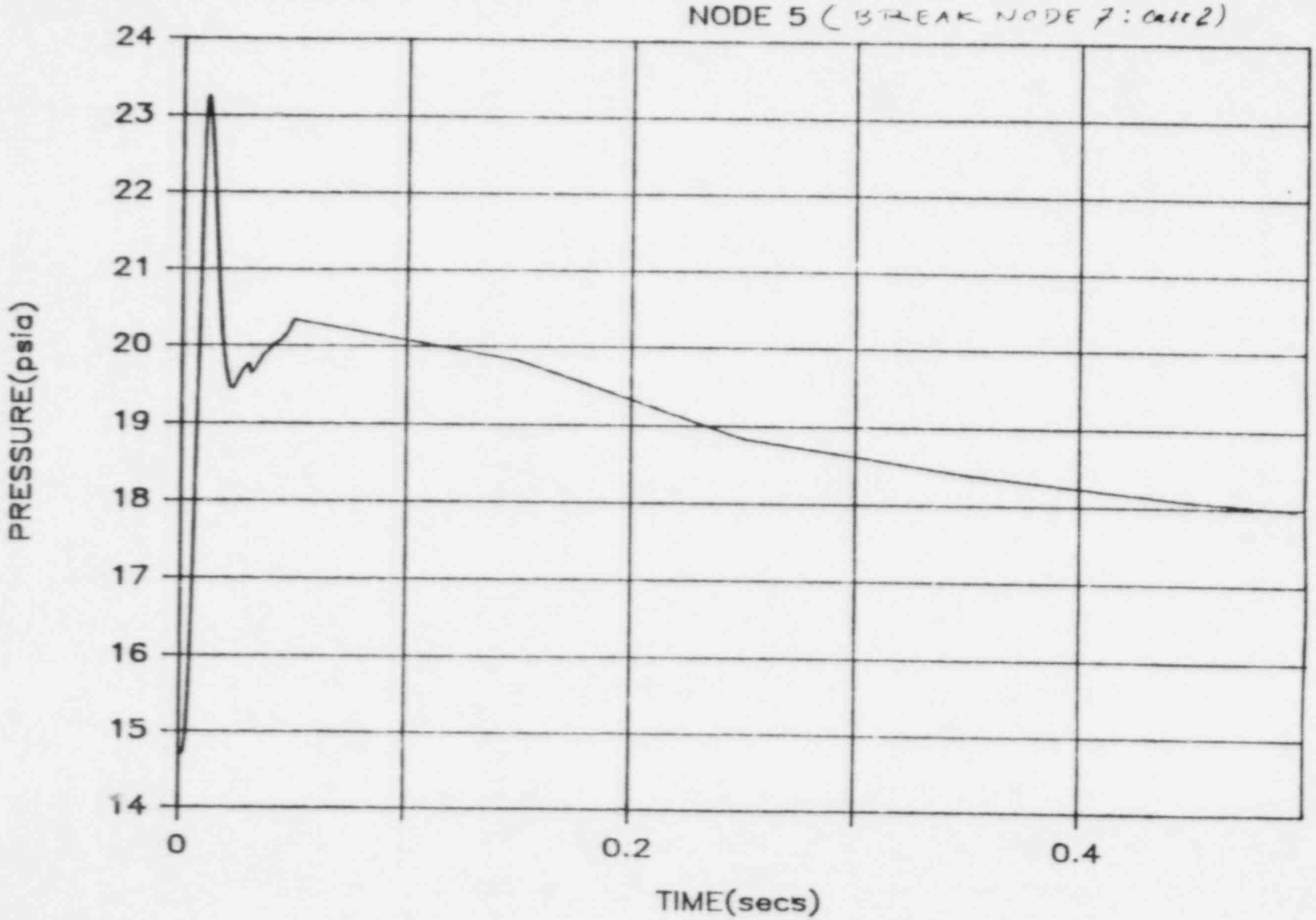

FIG 3.6.A-3
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PRESSURES IN IVC DUE TO MSLB

NODE 6 (BREAK NODE 6: case 1)

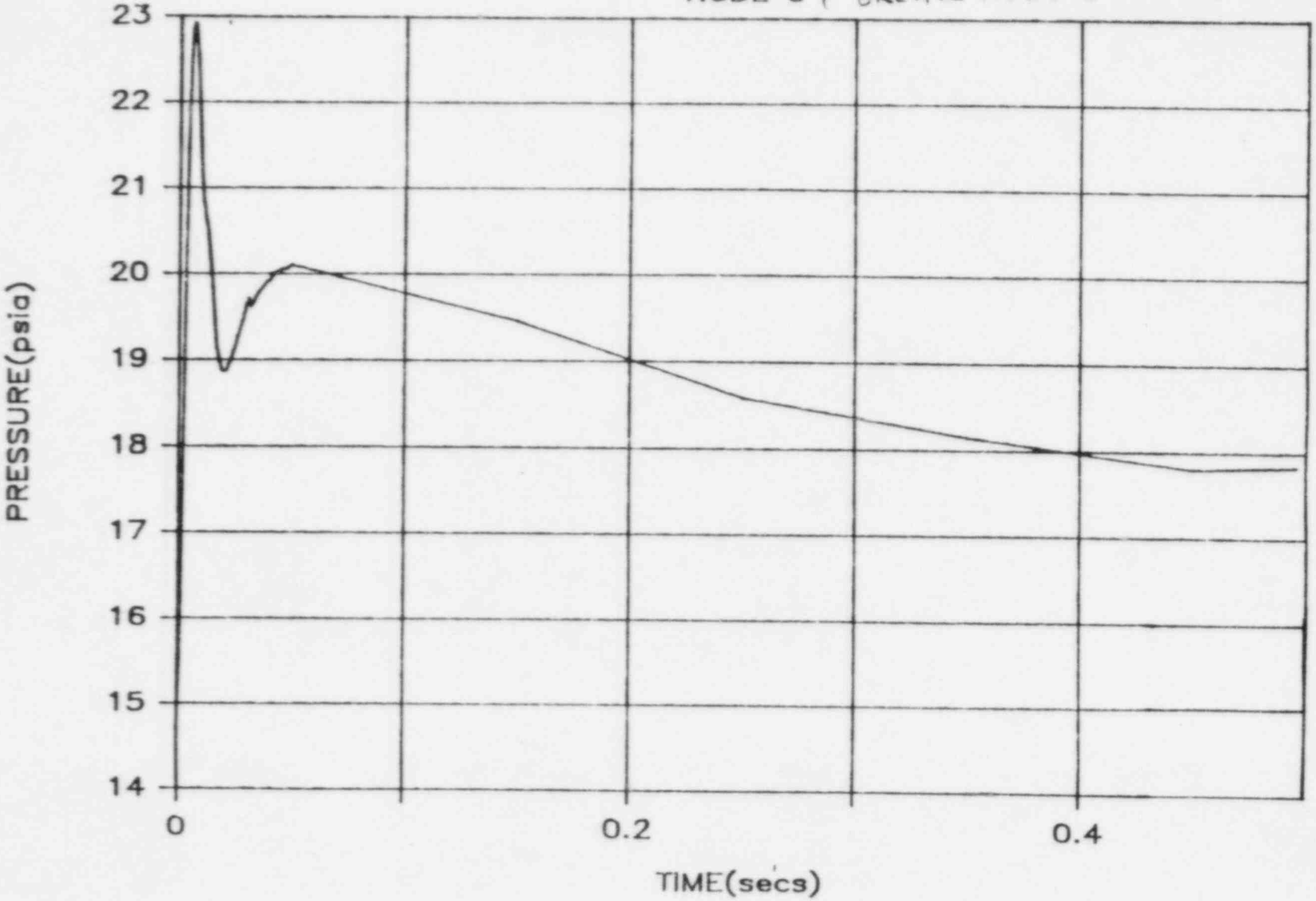

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FIG 3 6 A-3
(sheet 7 of 9)

PRESSURES IN IVC DUE TO MSLB

NODE 7 (BREAK NODE 7: Case 2)

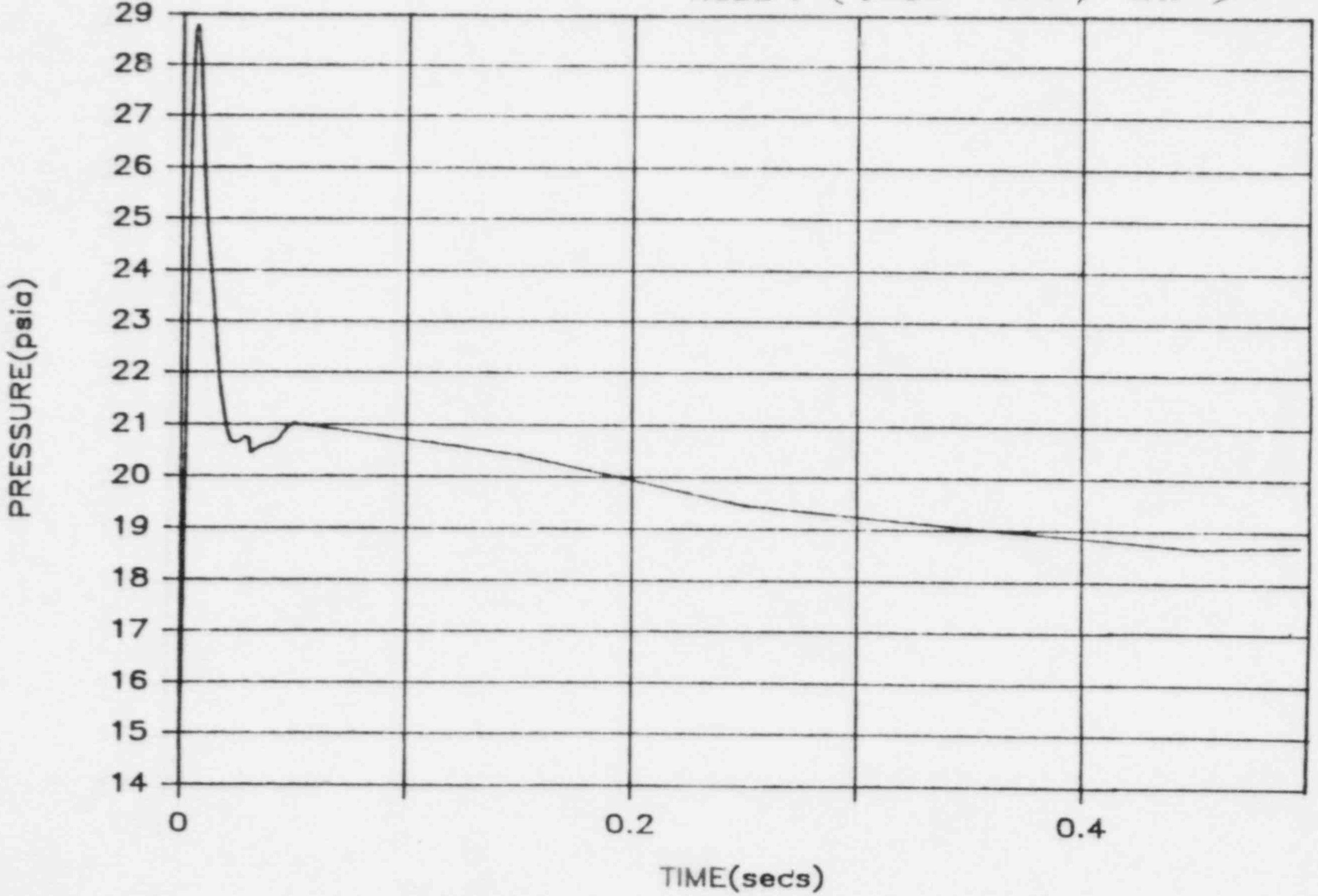

FIG. 3.6A-3
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PRESSURES IN IVC DUE TO MSLB

NODE 8 (BREAK NODE 7: Case 2)

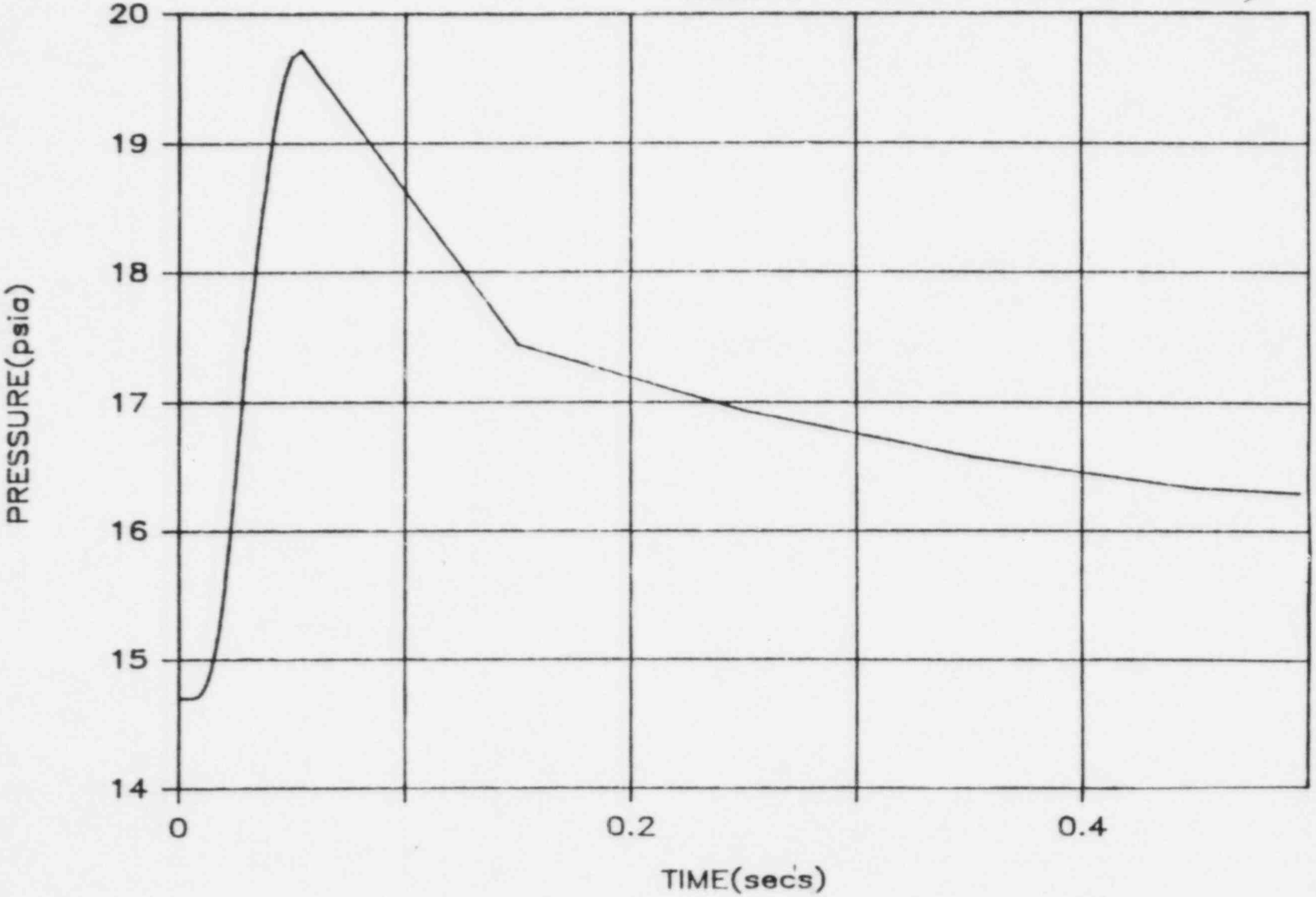

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FIG 3CA-3
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PRESSURES IN IVC DUE TO MSLB

NODE 9 (BREAK NODE 6 : Can 1)

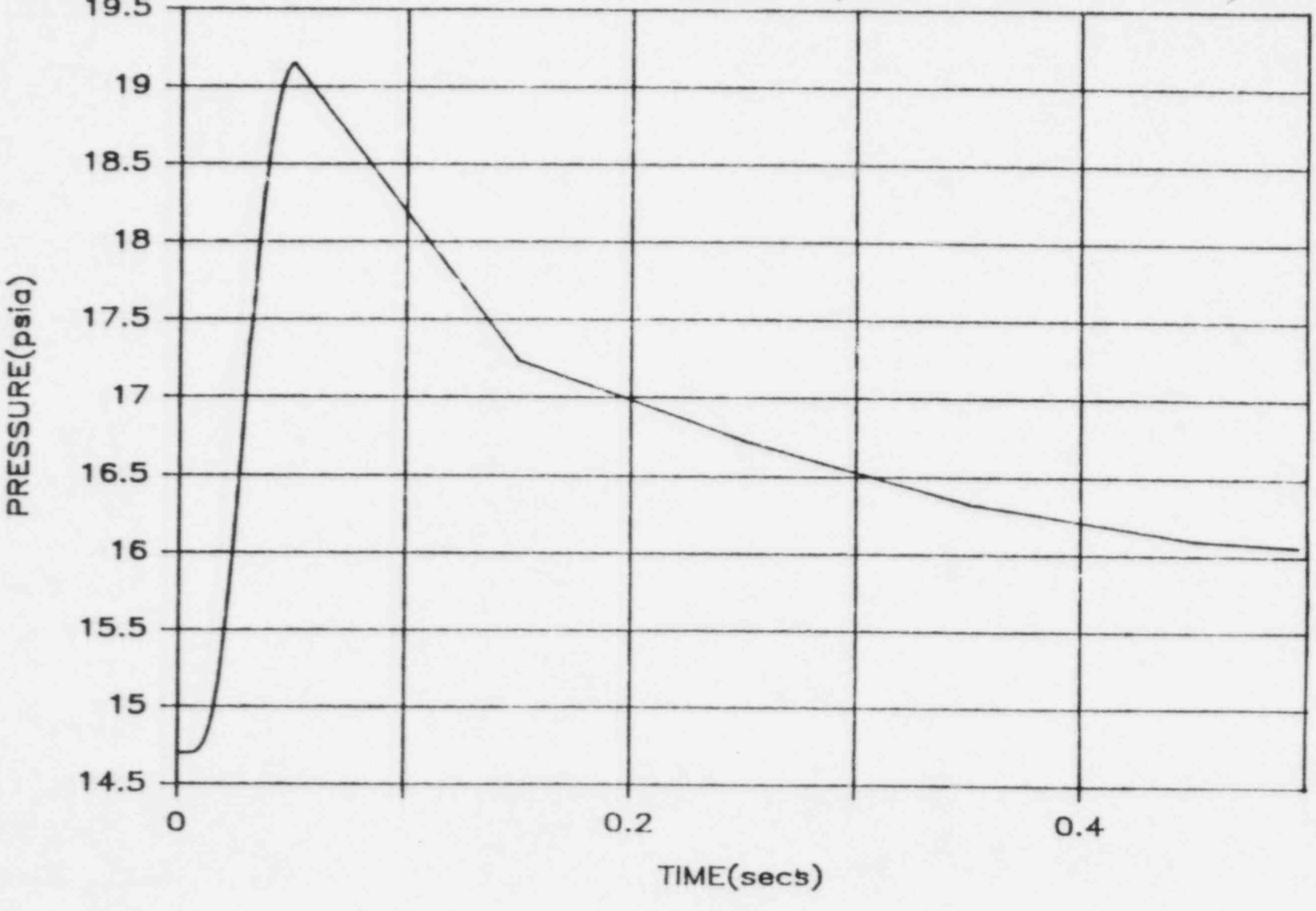

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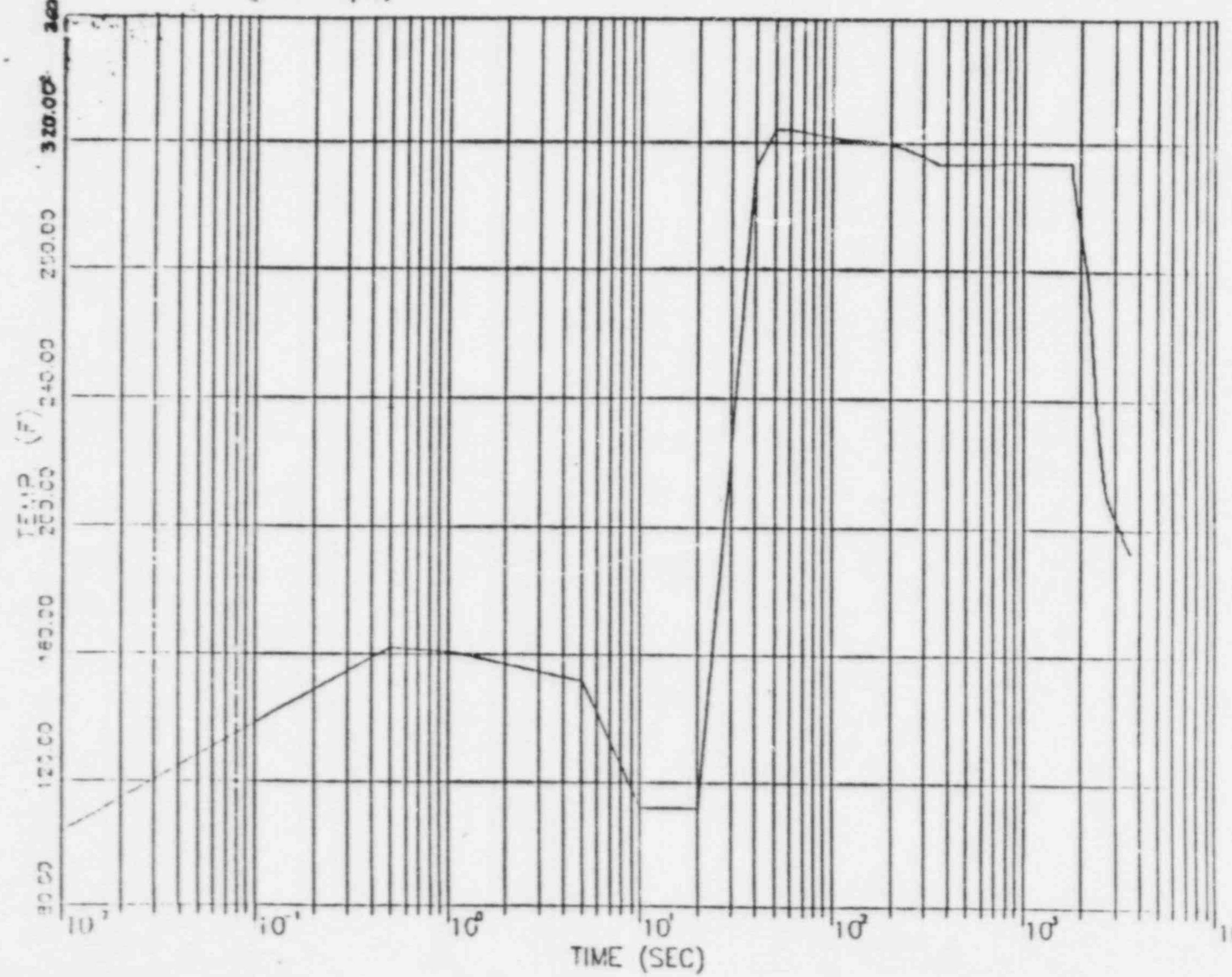
FIG. 3.6.A-4 IVC EQ TEMP. NODE 1 M SLB
(sheet 1 of 3)



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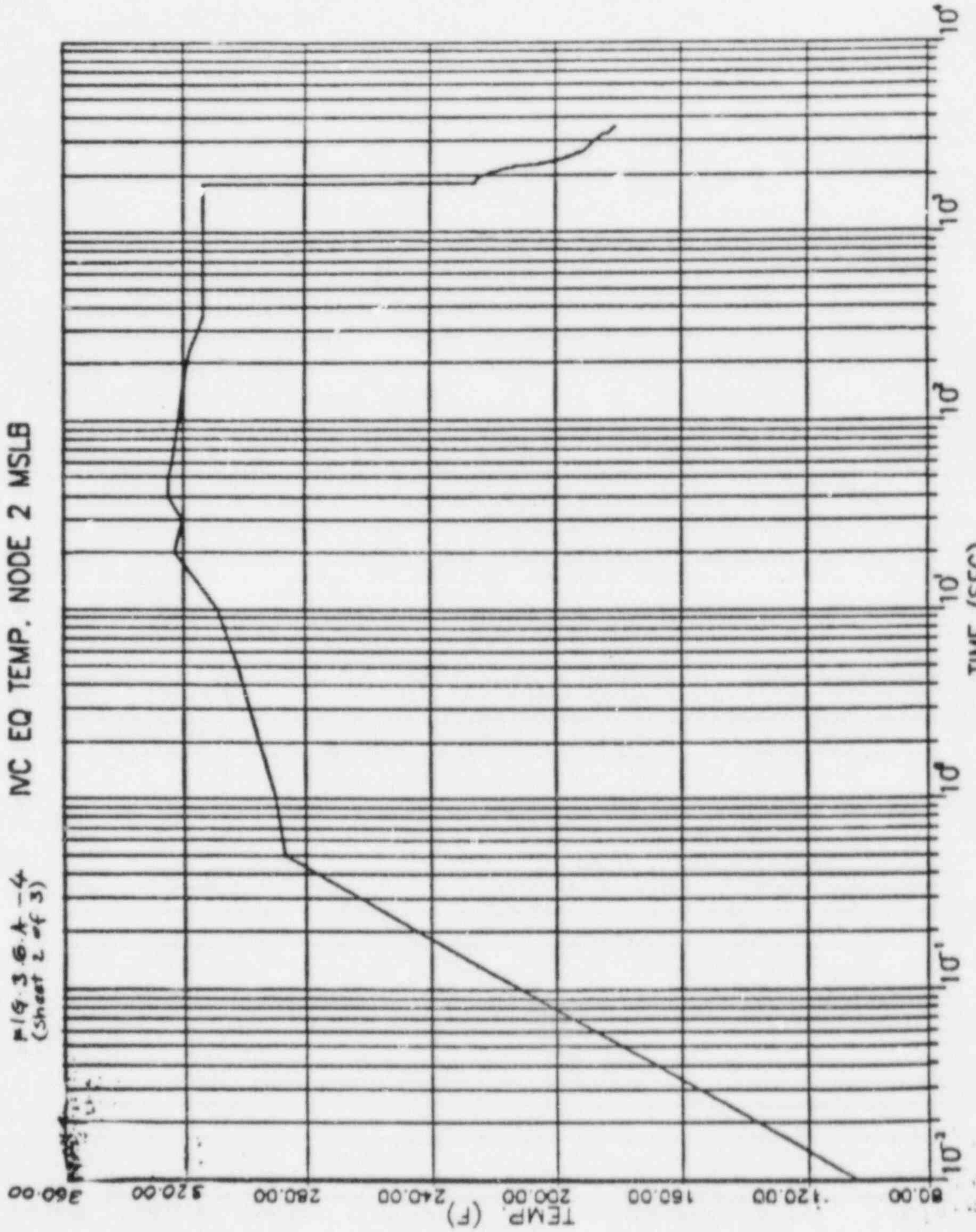

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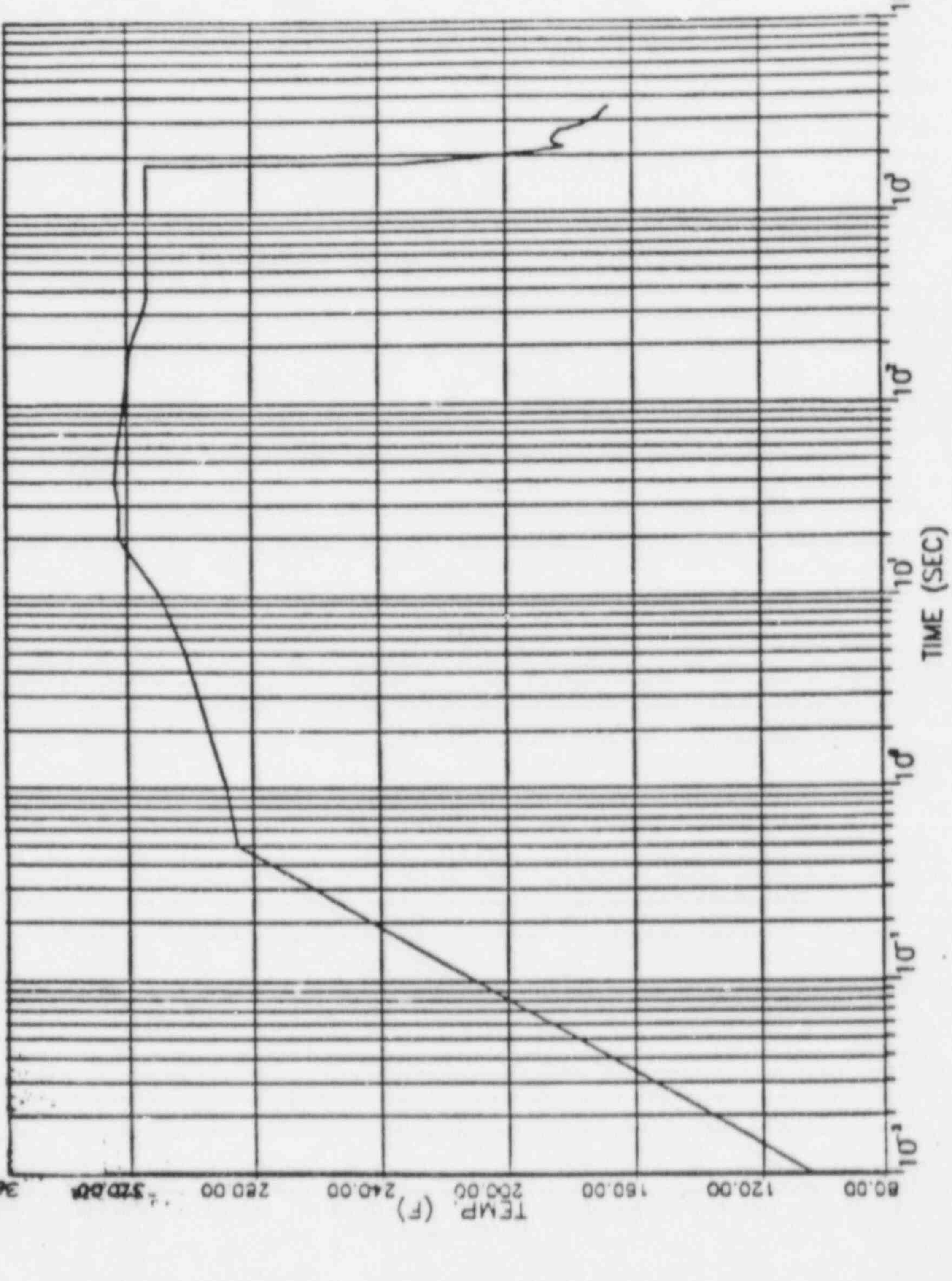
FIG. 3.6.4-4 (Sheet 3 of 8) IVC EQ TEMP. NODE 3 MSLB



Question 010.18

During our review of your Report No. L010RR064A, "Report on Dynamic Effects of Postulated Piping Failures Outside the Containment," you proposed to redesign your main steam and feedwater valve compartment to consider the environmental effects (pressure, temperature, humidity) and potential flooding consequences from an assumed crack, equivalent to the flow are of a single ended pipe rupture in these lines inside the valve compartment. Provide your design modification and the related safety analysis, including the following:

1. Describe the location and size of the vent areas in the main steam and feedwater valve compartment.

2. We require that essential equipment located within the compartment including the main steam isolation and feedwater valves and their operators be qualified to operate in the environment resulting from the above assumed single ended pipe rupture. State your intent with regard to this position.

3. Provide a subcompartment pressure analysis to confirm that the design of the main steam and feedwater valve compartment can withstand the effects of the above assumed single ended pipe rupture. When you submit the subcompartment pressure analysis, identify the computer code used, the assumptions used for mass and energy release rates, the length of time blowdown exists, and sufficient design data so that we may perform independent calculations.

Response

piping

As discussed in revised Section 3.6, ~~an Appendix~~ will be provided that describes the ~~evaluations~~ made of the effects ~~of postulated pipe failures~~ within the plant. A discussion of the effects of postulated failures within the Isolation Valv Cubicle ~~will be included~~ ~~are~~ is provided in FSAR Table 3.6.2-2 and Appendix 3.6A. 40

Question 210.20N

In order to assure that the pipe break criteria have been properly implemented, the Standard Review Plan requires the review of sketches showing the postulated rupture locations and of summaries of the data developed to select postulated break locations including, for each point, the calculated stress intensity, the calculated cumulative usage factor, and the calculated primary plus secondary stress range. The required sketches and tables for some high energy piping systems have not been provided at this time in the FSAR. Provide a schedule for submission of these data.

Response

Initial stress summaries regarding pipe break locations, stress levels, cumulative usage factors ~~will be provided during the fourth quarter of 1985.~~ are shown in FSAR Table 3.6.2-1. Sketches showing pipe break locations are provided in FSAR Figure 3.6.1-1. Final design information, including as-built reconciliation, will be provided prior to fuel load.

The South Texas Project (STP) has submitted a request to the NRC for exemption to General Design Criterion 4 in order to delete postulation of Reactor Coolant Loop (RCL) pipe breaks based upon the "Leak Before Break" analyses. This has been justified in WCAP-10560. (Refer to HL&P to NRC letters ST-HL-AE-1010 dated September 28, 1983, ST-HL-AE-1096, dated July 17, 1984, ~~and~~ ST-HL-AE-1200 dated March 1, 1985, and ST-HL-AE-1326, August 19, 1985.) Although the NRC has not yet responded to the request, the project is sufficiently confident such that the current design is proceeding on the assumption that the exemption will be granted. Thus, RCL pipe breaks are not postulated and the information requested is not pertinent to STP for that scope. However, it should be noted that primary component supports have been designed to withstand the structural loads associated with non-mechanistic Reactor Coolant pipe breaks at the locations described in WCAP-8082. ~~Upon NRC approval of the elimination of RCL pipe breaks, the STP FSAR will be revised to reflect this revised design basis.~~

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Question 231.04

In addition to the seismic and hydraulic loads on fuel assemblies, Westinghouse has determined that an asymmetric horizontal load will be imposed on the reactor core in the event of a rupture in the primary system piping. Provide the results of an analysis which shows that the South Texas fuel assemblies can withstand this additional horizontal load. Similar analyses have been submitted on the North Anna, Sequoyah, Farley and Diablo Canyon dockets and these can be referenced for information. This analysis should be performed with the best available methodology and criteria for the South Texas design.

We are currently reviewing a generic analysis method to account for the horizontal asymmetric load (see Task A-2, NUREG-0371, dated November 1978). If the methodology or criteria developed from this task were to result in a need for a reevaluation on South Texas, at that time we would require that you perform such a reevaluation.

Response

Westinghouse has demonstrated on a generic basis that Reactor Coolant System (RCS) primary loop pipe breaks are highly unlikely. By Generic Letter 84-04 the NRC Staff documented their approach of Westinghouse topical reports dealing with the elimination of postulated breaks in PWR primary main coolant loop piping. Generic Letter 84-04 authorizes applicants for operating licenses to request exemptions from the requirements of General Design Criteria 4 with respect to asymmetric blowdown loads requesting from breaks in the primary main coolant loop. STP intends to apply for such an exemption. Should an need for these analyses of our exemption requests still exist after the NRC review, a timely response will be provided. 37

Refer to the response to NRC Question 210.20N.

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QUESTION 410.05 (3.6.1)

Provide the results of a high energy pipe break analysis that addresses the consequences of pipe whip, jet impingement, flooding and environmental effects on safety-related systems and components as indicated on the FSAR Table 3.6.2-2.

RESPONSE:

~~Results of the high energy pipe break analysis indicated in FSAR Table 3.6.2-2 will be provided during Fourth Quarter of 1985.~~

FSAR Table 3.6.2-2 has been revised in response to this question.

5660N:0242N (4)