TENNESSEE VALLEY AUTHORITY

DIVISION OF ENGINEERING DESIGN

THERMAL POWER ENGINEERING BRANCHES

CIVIL ENGINEERING BRANCH

BREAK EXCLUSION POSITION

FOR COMPLYING WITH

APCSB 3-1 AND MEB 3-1

BELLEFONTE NUCLEAR PLANT UNITS 1 AND 2

JUNE 8, 1976

CEB-76-13

Revision 2
9/28/77

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Revision 1
2/1/77

Revision 2
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Sponsor Engineer B B Neely

Reviewed by [signature]

Recommended W B English

Approved [signature]

BELLEFONTE NUCLEAR PLANT UNITS 1 AND 2
BREAK EXCLUSION POSITION FOR COMPLYING WITH

Title: APCSB 3-1 AND MEB 3-1

REVISION LOG

CEB-76-13 R2

Revision No.	DESCRIPTION OF REVISION	Date Approved
1	Add paragraphs 5.0 and 6.0. Change Table of Contents, List of Figures, and page numbers to reflect addition of new paragraphs 5.0 and 6.0	2/1/77
2	Change the statement in paragraph 11.0, b, Table of Contents, List of Figures, and add List of Tables and Appendix A.	9/28/77

TVA 10567 (DED-6-74)

COORDINATION LOG

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Design Criteria For BREAK EXCLUSION POSITION FOR COMPLYING WITH APCSB 3-1 AND MEB 3-1

Revision:

R – Denotes review A – Denotes approval

Thermal Power Engineering Branches						Thermal Power Design Project						Architectural, Hydro, & Special Projects Engineering & Design Branches							
MEB		EEB		CEB		Project Manager (R)				R	A: RMA	AD		ME&D		CE&D		EE&D	
						MD		ED		CD									
R	A	R	A	R	A	R	A	R	A	R	A	R	A	R	A	R	A	R	A
RFC	RJC			OCP	OCP														
LWL	Lau			BBN	BBN														
GEG	GEG			PAE	PAE	RCS	RCS			EEC	EEC								
JOV	JOV			WAE	WAE	JSB	JSB			[illegible]	[illegible]								
TCP	TCP				RGD						CWH								
	HGO																		
	[illegible]																		
—	EDB																		
—	[illegible]																		

TVA 10567 (DED-6-74)

COORDINATION LOG

Plant: BELLEFONTE NUCLEAR PLANT UNITS 1 AND 2

CEB-76-13 R1

Design Criteria For BREAK EXCLUSION POSITION FOR COMPLYING WITH APCSB 3-1 AND MEB 3-1

Thermal Power Engineering Branches						Thermal Power Design Project						Architectural, Hydro, & Special Projects Engineering & Design Branches							
MEB		EEB		CEB		Project Manager				R	A	AD		ME&D		CE&D		EE&D	
R	A	R	A	R	A						Rmh	R	A	R	A	R	A	R	A
TCP	TCP			DMW	DMW	MD		ED		CD									
HGO	HGO			BBN	BBN	R	A	R	A	R	A								
	GM			FAE	FAE	BCS	BCS			EEC	EEC								
LWL	Lau			WAE	WAE	JSB	JSB			[illegible]	RDH								
	[illegible]			RGD	RGD					CDD	CDD								

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COORDINATION LOG

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CEB-76-13

Thermal Power Engineering Branches						Thermal Power Design Project								Architectural, Hydro, & Special Projects Engineering & Design Branches							
MEB		EEB		CEB		Project Manager								AD		ME&D		CE&D		EE&D	
R	A	R	A	R	A					R	A			R	A	R	A	R	A	R	A
											[illegible]										
						MD		ED		CD											
						R	A	R	A	R	A										
GWC	[illegible]			[illegible]	[illegible]																
TCP	TCP			DCP	DCP																
HGO	HGO			KLM	KLM	BCS	BCS			[illegible]	[illegible]										
	CM (for HGO)			[illegible]	[illegible]	JSB	JSB			RDM	[illegible]										
EGB	JCB for EGB			[illegible]	[illegible]					CDD	CDD										
[illegible]	[illegible]																				

R – Denotes review

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FOREWORD

On March 3, 1976, TVA representatives met with the Nuclear Regulatory Commission's Mechanical and Containment Systems Branches and presented the TVA plan for implementing the portion of Branch Technical Positions APCSB 3-1 and MEB 3-1 which deals with postulated pipe break exclusions. NRC generally agreed with the TVA approach and asked that the position be submitted for formal consideration. This submittal is in response to that request.

1.0 PURPOSE

The purpose of this submittal is to present for formal review the TVA plan for implementing APCSB 3-1, paragraph B.2.c, and MEB 3-1, paragraphs B.1.b(1)(e) and (f).

2.0 INTRODUCTION

Companion Branch Technical Positions APCSB 3-1 and MEB 3-1 acknowledge the practical necessity for allowing relief in the postulation of pipe breaks in certain main steam and feedwater piping. These positions also establish controls in the form of stress limits and other protective measures to assure an increased confidence level in this particular piping and in the operational integrity of the associated isolation valves.

3.0 SCOPE

The piping addressed by this submittal is the main steam and feedwater piping for the Bellefonte Nuclear Plant beginning at the flued head anchors in the primary containment wall and extending through the annulus to the main steam valve rooms (protected by guard pipe in this region), continuing through the valve rooms and isolation valves, to the flued head anchors in the outer valve room walls (figures 1 through 4).

4.0 PIPING LAYOUT INSIDE MAIN STEAM VALVE ROOMS

Figures 1 through 4 show the main steam and feedwater piping layouts including approximate locations of isolation valves. Figures 5 through 8 are isometrics of the main steam and feedwater lines showing the anchors, supports, and other prominent elements of the piping models. Also shown in figures 5 through 8 are the locations at which breaks would normally be postulated in the main runs and the corresponding stresses associated with the upset plant condition. Stresses at all other points are less than those shown.

5.0 EQUIPMENT LOCATED IN MAIN STEAM VALVE ROOMS

a. Safety Related Equipment

(1) Main steam isolation valves.
(2) Main feedwater isolation valves.
(3) Main feedwater control valves.
(4) Main steam safety valves.
(5) Steam supply to auxiliary feedwater turbine.
(6) Modulating atmospheric dump valve.
(7) Associated instrumentation and control for above valves.
(8) Essential air.

b. Non-Safety Related Equipment

Startup and recirculation system.

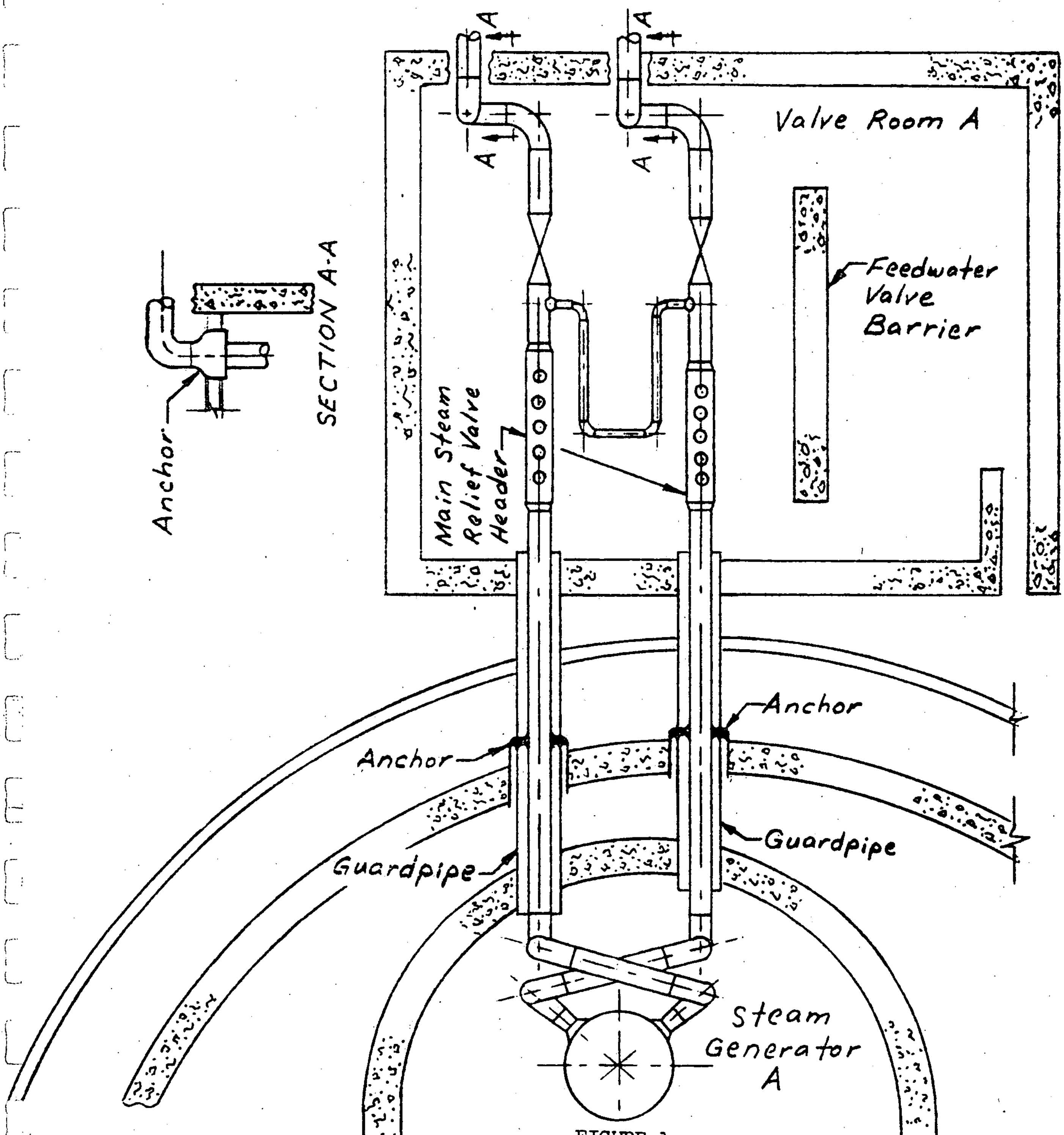


FIGURE 1
MAIN STEAM PIPING
STEAM GENERATOR A

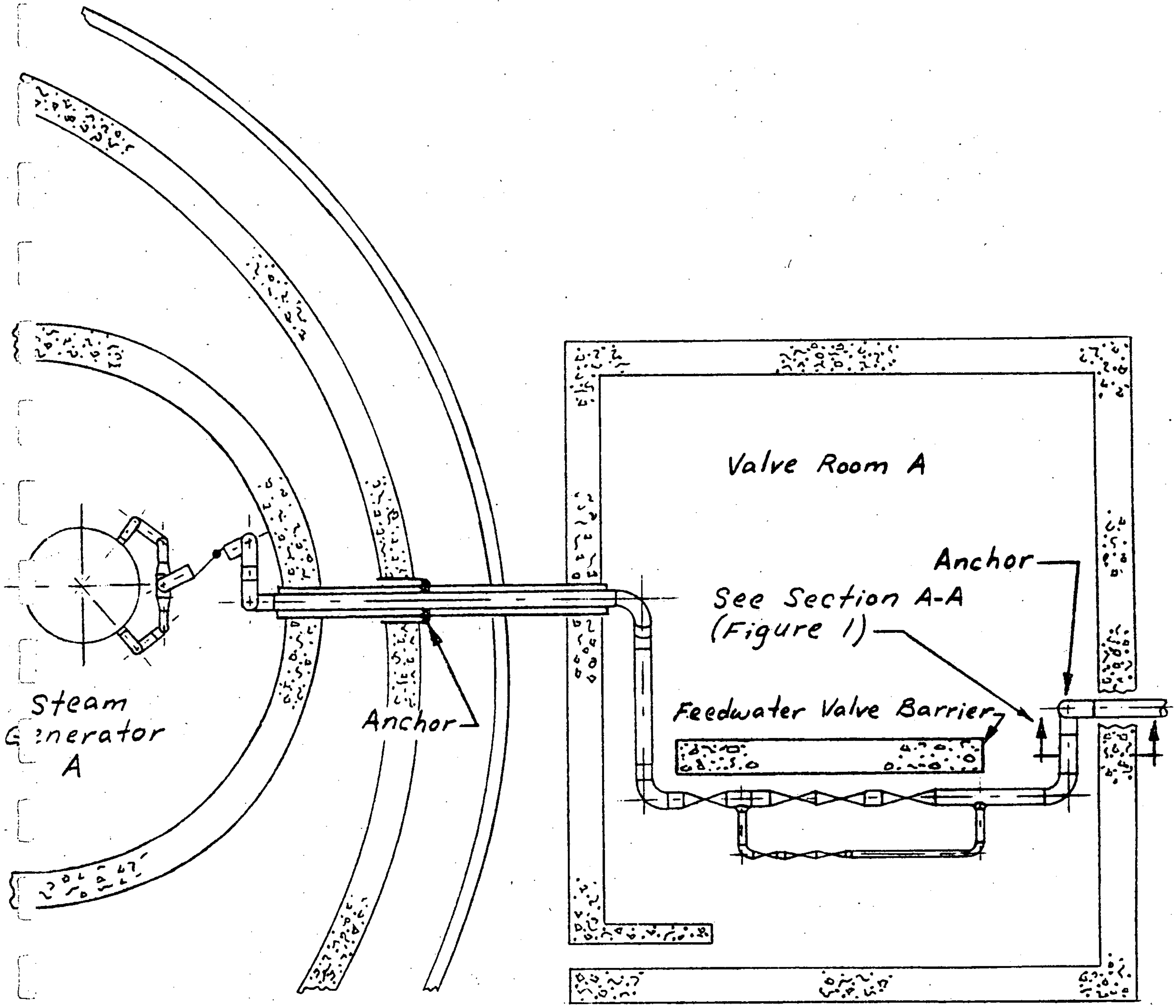


FIGURE 2
FEEDWATER PIPING
STEAM GENERATOR A

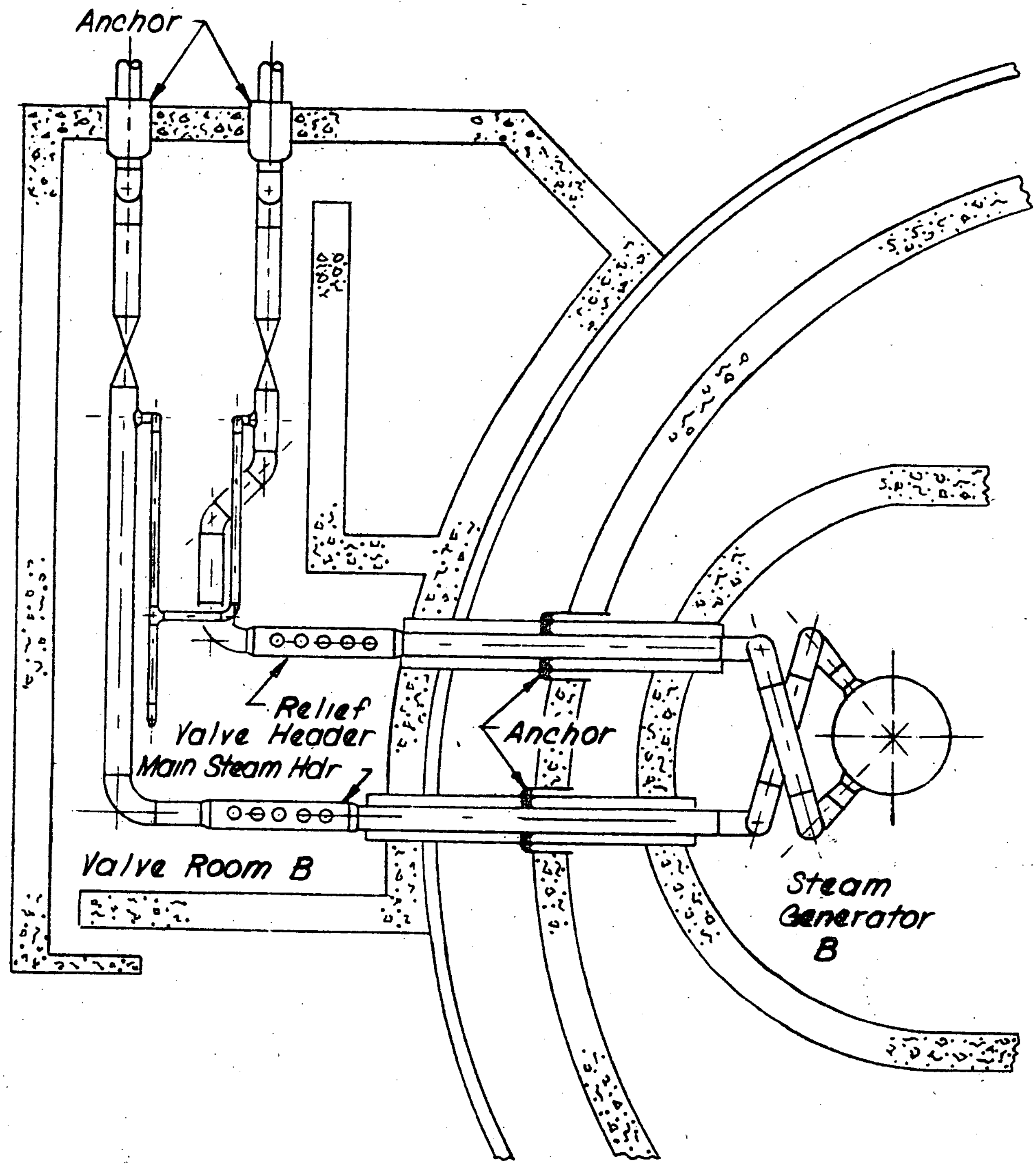


FIGURE 3

MAIN STEAM PIPING
STEAM GENERATOR B

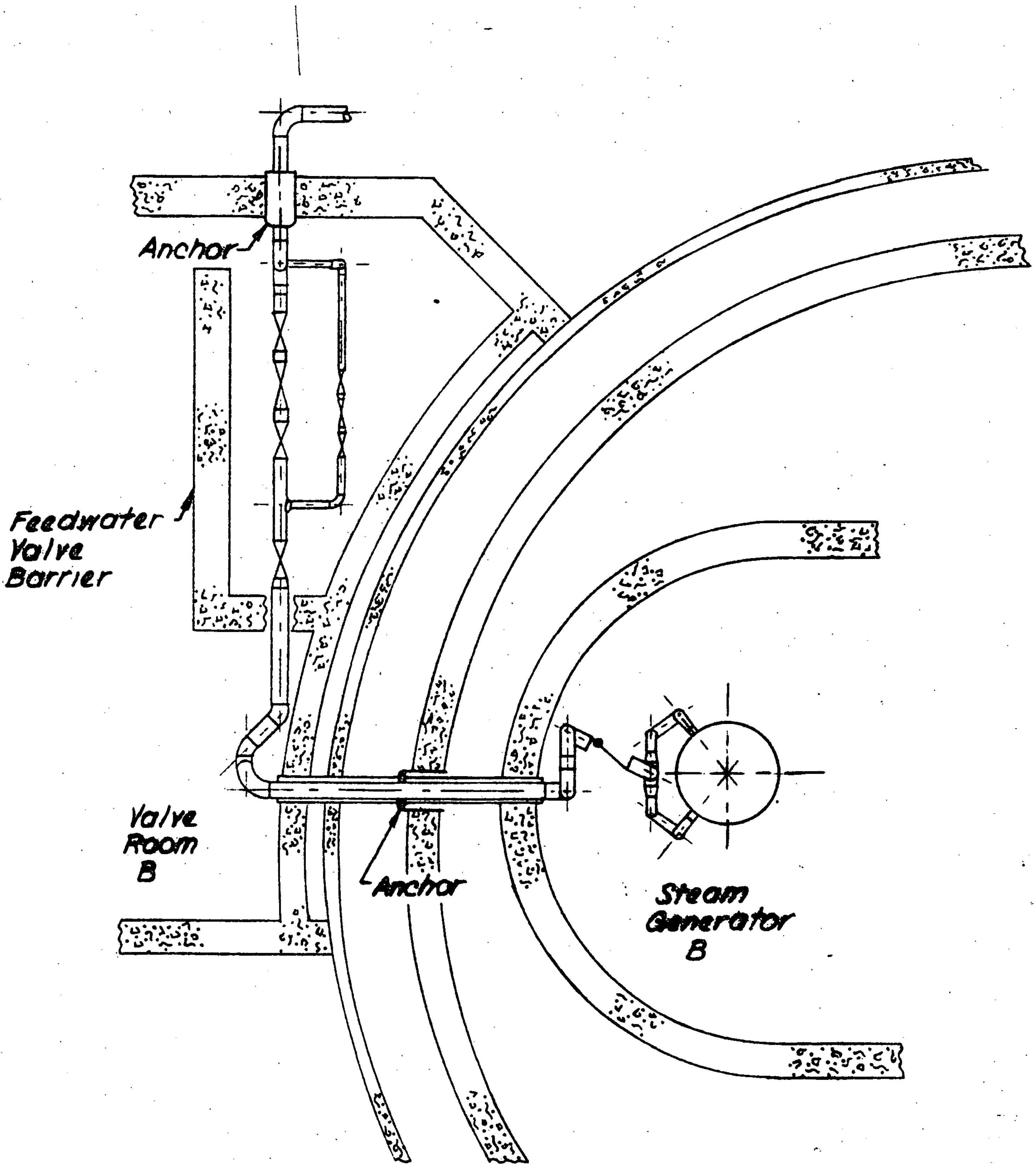


FIGURE 4

FEEDWATER PIPING
STEAM GENERATOR B

NODE POINT	STRESS (KSI) (PLANT UPSET)
1.	26.6
2.	26.0
3.	26.9
4.	19.2
5.	27.3
6.	26.1
7.	26.5
8.	20.4

$$0.8\left(1.2\,S_h + S_A\right) = 37.8 \text{ KSI}$$

For Legend See Figure 7.

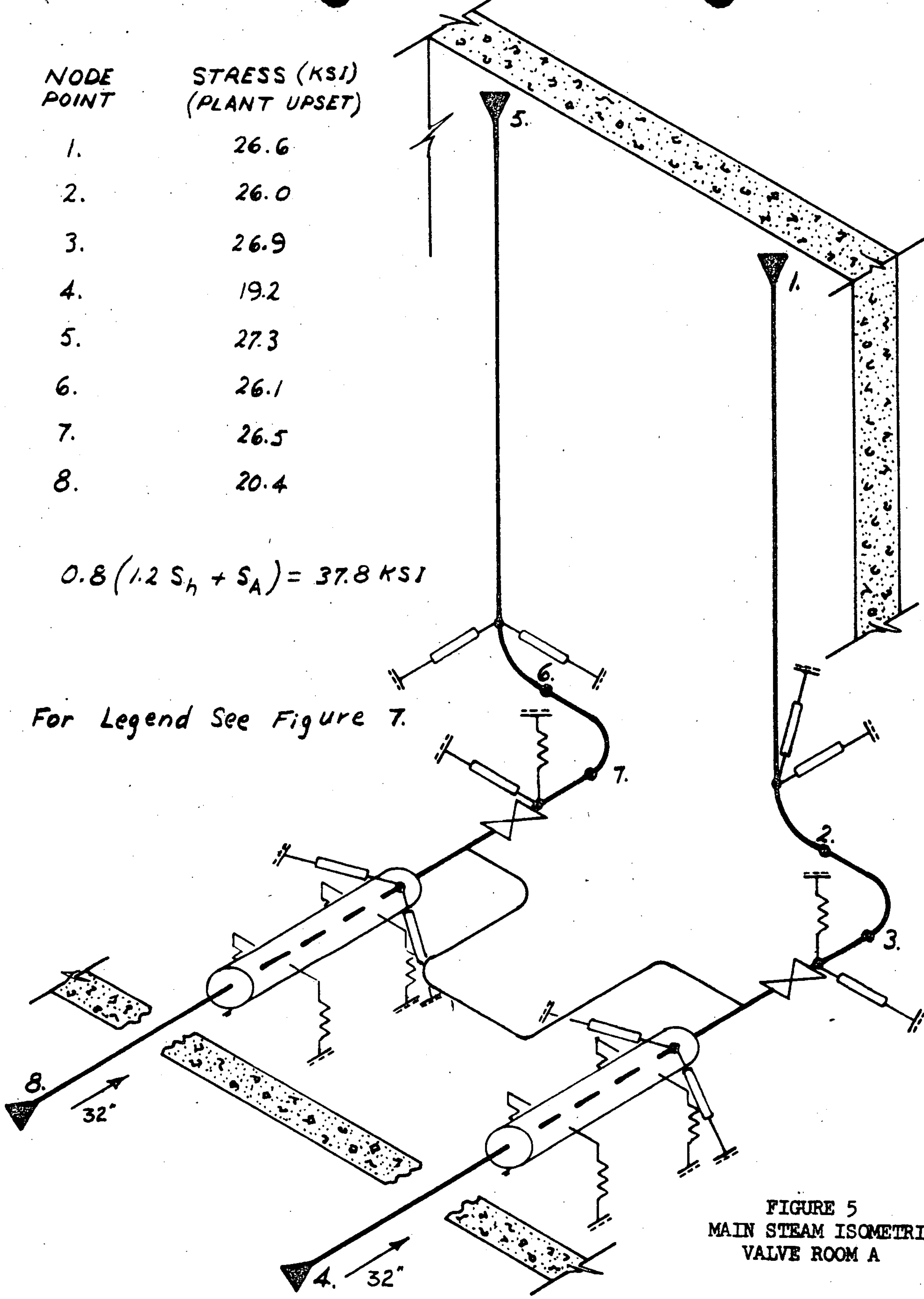


FIGURE 5
MAIN STEAM ISOMETRIC
VALVE ROOM A

NODE POINT	STRESS (KSI) (PLANT UPSET)
1.	17.3
2.	18.4
3.	16.8
4.	18.6

$0.8(1.2S_h + S_A) = 32.4$ KSI

For Legend See Figure 7.

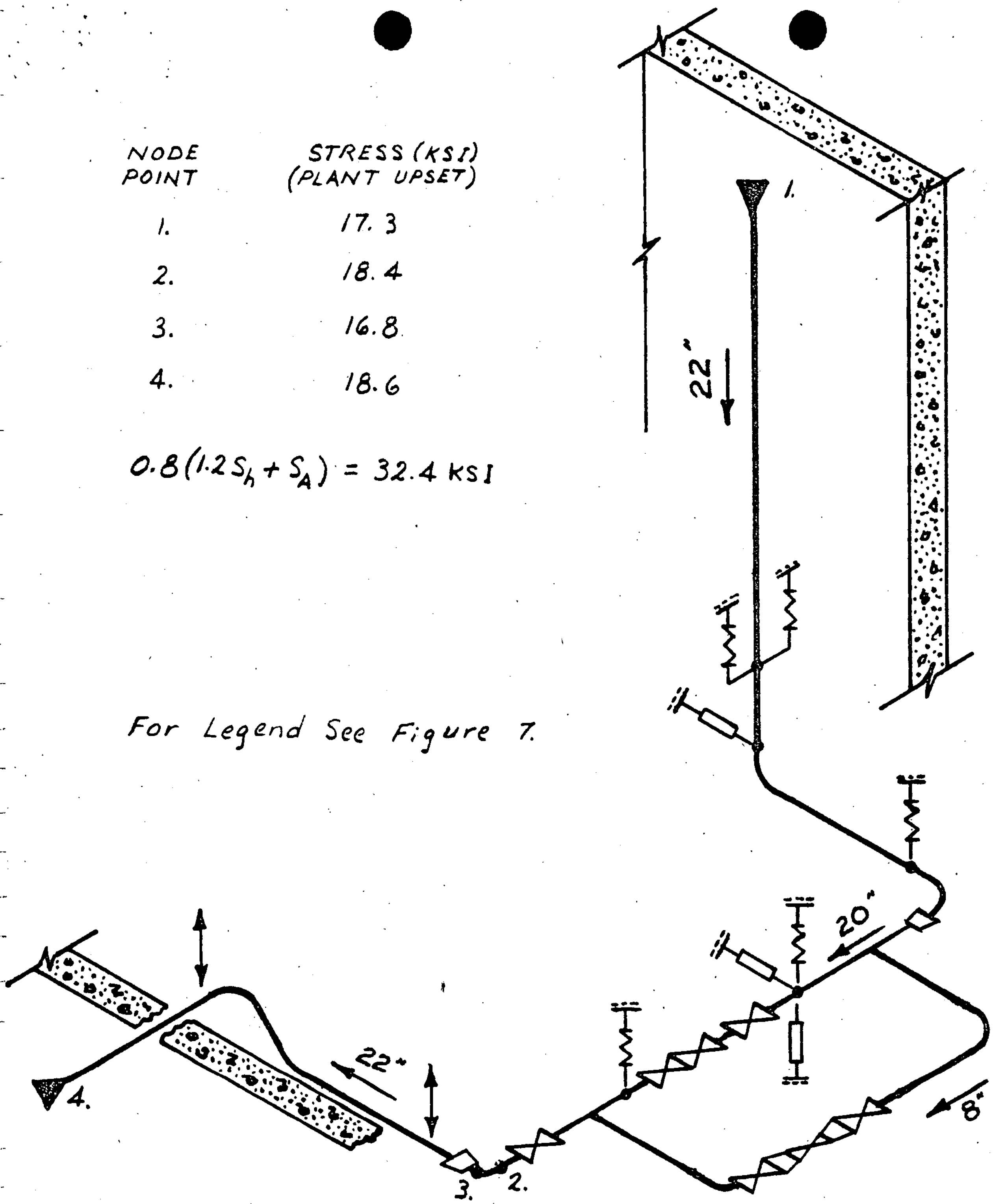
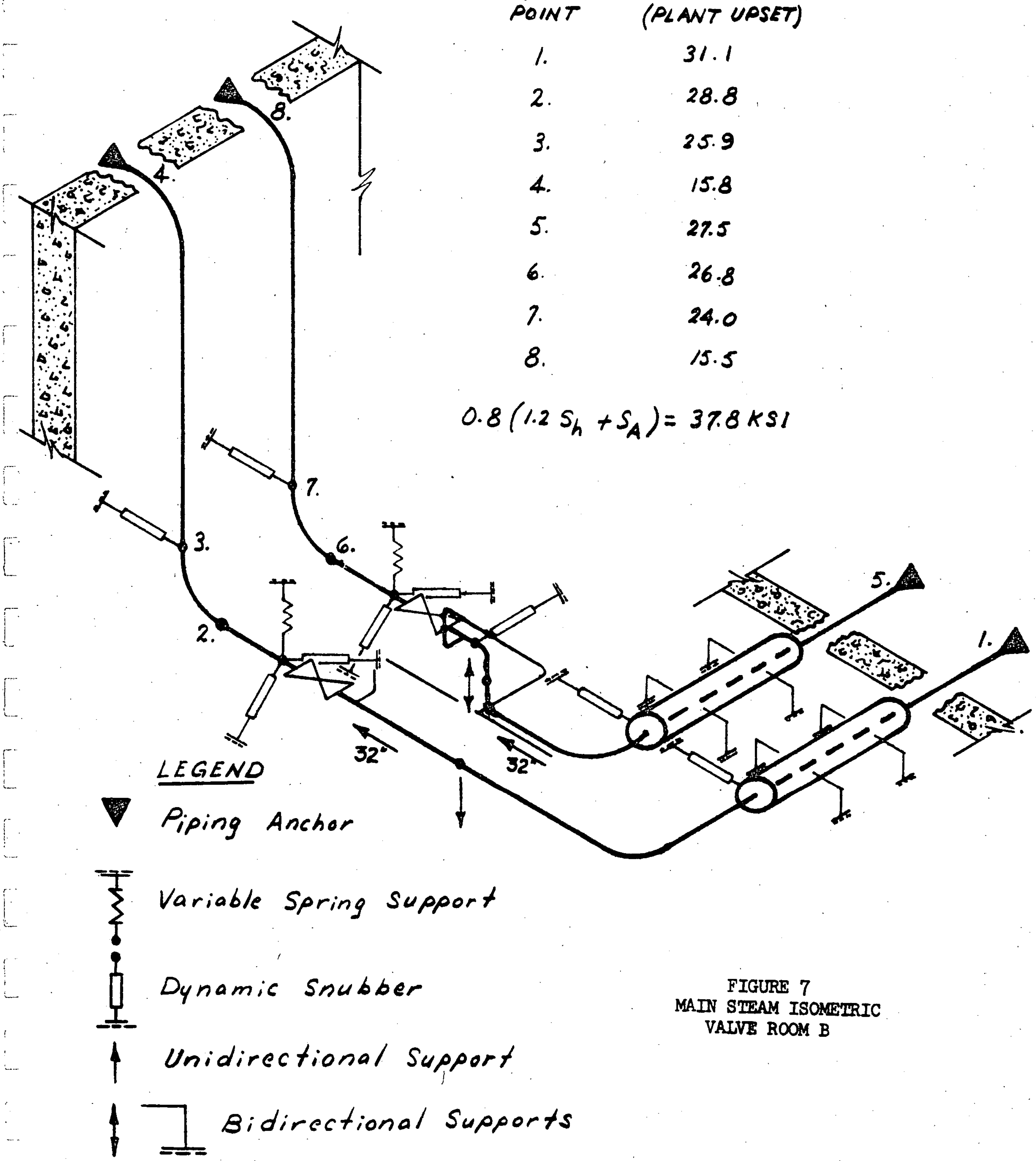


FIGURE 6
FEEDWATER ISOMETRIC
VALVE ROOM A



NODE POINT	STRESS (KSI) (PLANT UPSET)
1.	31.1
2.	28.8
3.	25.9
4.	15.8
5.	27.5
6.	26.8
7.	24.0
8.	15.5

$$0.8\,(1.2\,S_h + S_A) = 37.8\ \text{KSI}$$

FIGURE 7
MAIN STEAM ISOMETRIC
VALVE ROOM B

NODE POINT	STRESS (KSI) (PLANT UPSET)
1.	25.7
2.	19.7
3.	19.7
4.	14.5

$0.8(1.2\,S_h + S_A) = 32.4\ KSI$

For Legend See Figure 7.

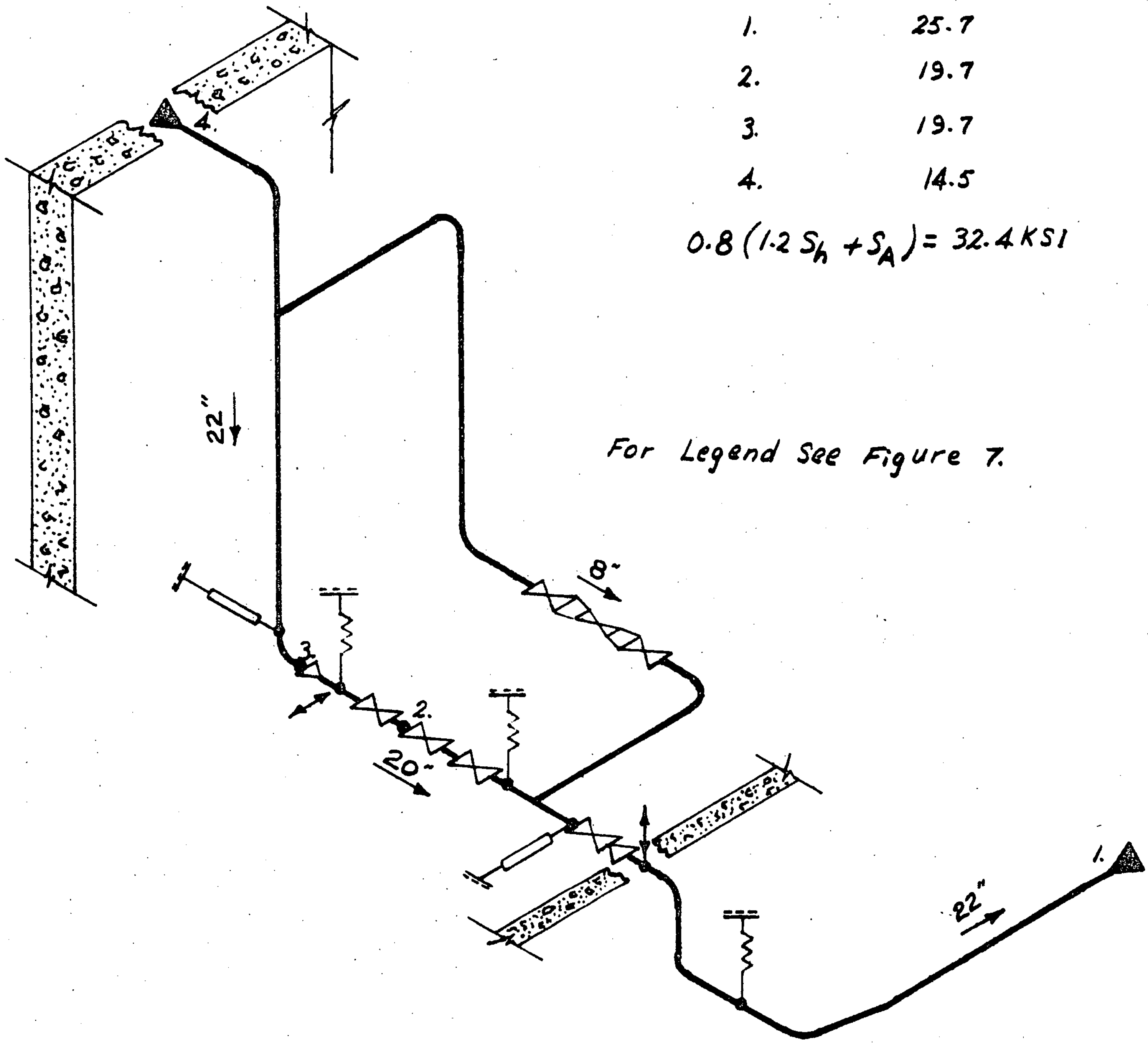


FIGURE 8
FEEDWATER ISOMETRIC
VALVE ROOM B

The only requirement for protection of safety related equipment inside the valve rooms is for the main feedwater isolation valves and the main feedwater control valves from the effects of any arbitrarily selected main steam line break. The loss of any or all other safety related equipment in the valve room will not prevent safe shutdown of the reactor.

6.0 CONSTRUCTION OF MAIN STEAM VALVE ROOM ENCLOSURES

a. Valve Room A

The main steam valve room A is surrounded by 3'-0" reinforced concrete walls, a 3'-6" reinforced concrete slab at elevation 649.0 and a 3'-0" reinforced concrete slab at elevation 669.0 The walls and slabs of the main steam valve room A are designed to take the forces of pipe whip and jet impingement resulting from any arbitrarily selected pipe rupture. A 4'-0" thick reinforced concrete barrier wall is located in the main steam valve room A between the feedwater valves and the main steam lines. This barrier wall is designed for pipe whip and jet impingement. The roof of the valve room A consists of structural steel blowout panels. These blowout panels are designed to relieve at 0.5 psig. In addition to the jet force and pipe whip loads, the walls and slabs of the valve room A have been designed for an internal pressure of 18 psig.

b. Valve Room B

The main steam valve room B is a reinforced concrete building which is separated from the reactor building and the auxiliary building by expansion joints. Valve room B is constructed of a 4'-0" floor slab, 4'-0" thick walls on the north and south sides, a 3'-0" thick wall on the west side near the reactor building and a 2'-0" thick wall on the east side. The roof of the valve room B is a 3'-0" thick reinforced concrete slab. A 4'-0" thick reinforced concrete barrier wall is located in the main steam valve room B between the feedwater valves and the main steam lines. This barrier wall is designed for pipe whip and jet impingement from any arbitarily selected pipe rupture. There is an interior roof over the feedwater valves which, along with the barrier wall, almost completely encloses the feedwater valves in a separate interior room. This interior room around the feedwater valves is designed for 50 psig plus jet forces and pipe whip. The outer walls and roof of the valve rooms are designed for 30 psig. There are blowout panels in the south wall of the unit 1 valve room B and in the north wall of the unit 2 valve room B. If the internal pressure builds to over 30 psig, the east wall will fail before the other three walls, which will retain their structural integrity.

7.0 BACKGROUND

Prior to the break exclusions offered by NRC Branch Technical Positions APCSB 3-1 and MEB 3-1, breaks inside valve rooms were postulated on a highest stress, minimum number basis. Mitigation measures normally consist of additions of large amounts of structural restraints, sleeves, barriers, etc. Many tons of pipe rupture mitigative steel are usually required inside valve rooms to meet the pipe rupture requirements. In addition to the costs and schedule constraints, these mitigative devices complicate other necessary activities such as inservice and maintenance inspections or component servicing, removal, and repair. Other alternatives (such as completely sleeving these lines) have been considered. Many of the same disadvantages exist, however, for sleeving as do for restraining with the additional problems of protecting the valves which cannot readily be sleeved.

It is TVA's position that Branch Technical Positions APCSB 3-1 offer a very rational and meaningful approach to the PWR main steam and feedwater valve room pipe rupture problem. MEB 3-1 acknowledges the decreased probability of breaks occurring in piping systems where the stresses are kept within specified limits and requires physical isolation of the no-break region through use of structural restraining devices. Through use of these restraints, events outside this region are prevented from stressing this piping and interfering with valve operability.

8.0 DESIGN BASES

In the design of the main steam valve rooms and the contained main steam and feedwater piping, several controlling criteria have been set to assure safe shutdown capability is preserved for all postulated pipe ruptures.

a. No arbitrarily located pipe rupture within the valve rooms shall result in a class 9 accident.

b. No pipe rupture in a steam line shall be allowed to jeopardize the isolation capability of the feedwater valves.

c. No pipe rupture event outside the valve rooms shall prevent closure of either the main steam or feedwater valves.

d. No arbitrarily located postulated pipe rupture shall pressurize the annulus region of the reactor building.

e. One complete train of steam supply to the turbine-driven auxiliary feedwater pump shall be protected and located within seismic Category I enclosures.

f. Piping in the no-break region shall be rigorously analyzed to ASME Section III, Class 2 requirements.

g. Stresses for the lines in the no-break region shall not exceed 0.8 ($1.2\ S_h + S_A$) where the terms are as defined in MEB 3-1 for class 2 piping for loading associated with the upset plant condition including the effects of the 1/2 SSE.

9.0 ALTERNATIVE APPROACHES CONSIDERED

Three alternative approaches to the valve room problem were considered in arriving at the selected scheme as presented herein. The alternatives considered and principal considerations are the following:

a. Design without the relief intended by APCSB 3-1/MEB 3-1 break exclusion allowances. The disadvantages of this approach are discussed in 5.0.

b. Design through literal interpretation of APCSB 3-1 and MEB 3-1.

   The major problem of this approach may be attributable to a definition of terms. MEB 3-1 allows the use of "restraints" to confine consequences of an unlikely pipe break to the no-break region and to prevent external loading effects from affecting the no-break piping and valves. By the usual connotation of "restraints," these devices are inactive and out of contact with the process piping during all normal (and perhaps upset and emergency) plant conditions. For restraints to provide this protection would require a series of devices placed such as to remove all six components of loading. These would have to be spaced along the piping in such a manner as to resist all shears, moments, and torsion. For this series of restraints to work effectively, the no-break region would have to include the piping throughout the system of restraints. Otherwise, a postulated break within the system of restraints could invalidate the intent of restraints.

c. TVA recognizes that APCSB 3-1 and MEB 3-1 were developed for the general case which could not contain sufficient specifics for all possible cases. The approach taken for the Bellefonte Nuclear Plant differs from that given in b. above in that "anchors" instead of "restraints" are used to perform the function of a series of "restraints" indicated by a literal interpretation of MEB 3-1. Anchors, one at each end of the no-break piping runs, are designed to resist all six degrees of motion.

10.0 IMPLEMENTATION OF APCSB 3-1 AND MEB 3-1 FOR THE BELLEFONTE NUCLEAR PLANT

TVA is using the provisions offered in MEB 3-1 for each main steam and feedwater valve room at the Bellefonte Nuclear Plant. Even though MEB 3-1 was issued late in the design phase of this plant, sufficient advantages were recognized that considerable redesign was performed to allow its implementation. Some of the changes that were made are the following:

a. Flued head type anchors were added at the valve room piping penetrations to the yard and roof areas.

b. Piping was upgraded from B31.1S (from the isolation valves to the anchors in the exterior valve room walls) to ASME Section III, Class 2.

c. The feedwater flow control valves located upstream of the isolation valves were upgraded from ASME Section III, Class 3, to Class 2.

d. Feedwater maintenance valves were upgraded from B31.1S to ASME Section III, Class 2. (All 32-inch main steam and 20-inch feedwater piping and valves are now ASME Section III, Class 2, throughout the no-break region.

e. Inservice inspection requirements were invoked for the upgraded piping.

f. Valve room walls were extended to provide the required flexibility between the terminals (anchors) of each no-break piping run.

g. Piping was completely reanalyzed and requalified both inside the no-break region and outside the valve rooms.

h. As an additional precaution, separation of the main steam and feedwater systems has been maintained through the use of reinforced concrete barrier walls.

i. Guard pipes have been maintained through the containment annulus region for additional protection.

j. The flued head anchor at the primary containment wall was redesigned to relocate the process pipe circumferential weld on valve room side of the anchor. This provides a greater confidence level for this terminal for which inservice inspection would have otherwise been very difficult to perform. The new design is shown in figure 9.

The break exclusion criteria have only been applied to the 32-inch main steam and the 20- and 22-inch feedwater piping. The next largest lines inside the valve rooms are the 12-inch cross-connectors to the main steam lines. Provisions have been made to accept postulated breaks in these 12-inch and any lesser lines inside the valve rooms.

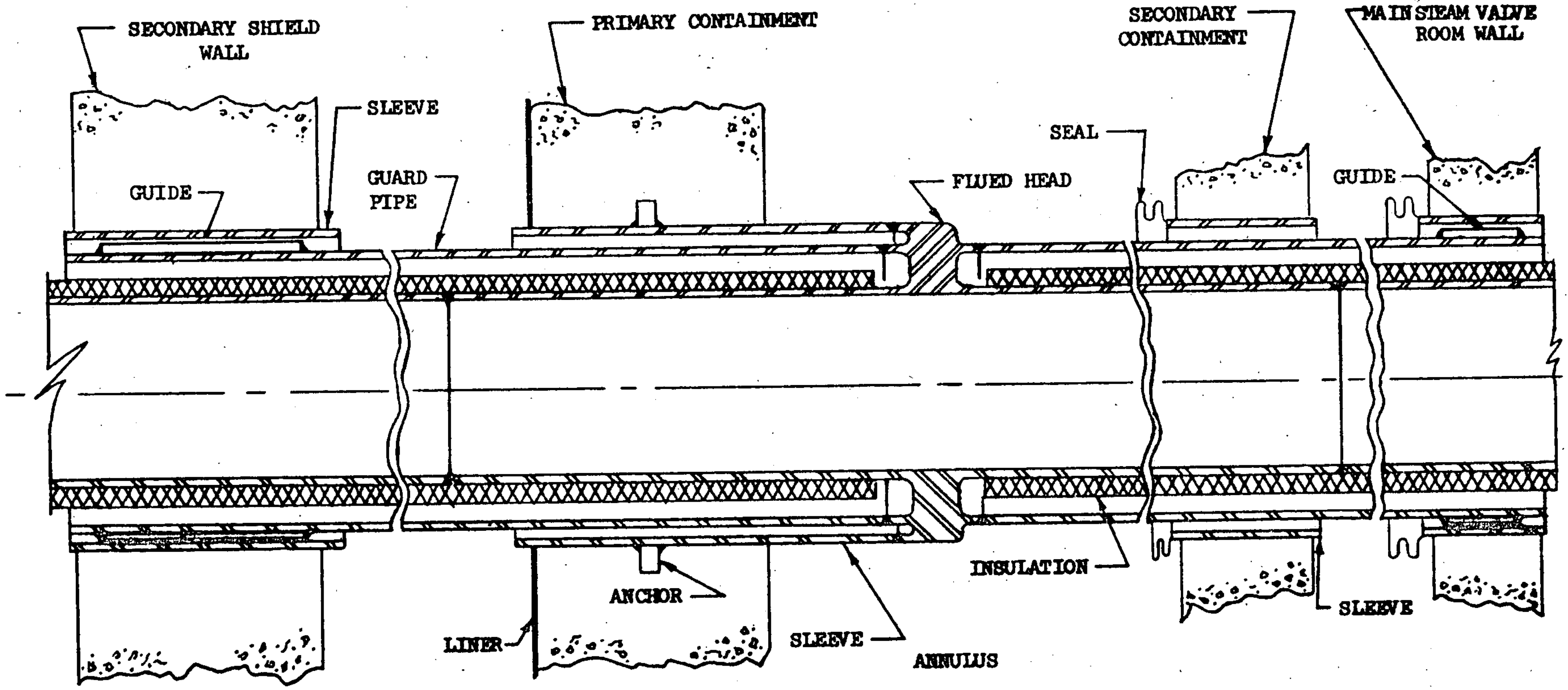


FIGURE 9

TYPICAL PENETRATION WITH GUARD PIPE, BELLEFONTE NUCLEAR PLANT

11.0 SUMMARY

TVA believes that the Branch Technical Position MEB 3-1 and its companion APCSB 3-1 offer a technically sound and safe approach to the problems involving postulated pipe breaks inside the main steam and feedwater valve rooms of pressurized water reactors. As the result of this confidence in the MEB 3-1, TVA has expended considerable effort in its implementation. The following is a summary of the implementing actions taken.

a. Anchors are provided at each end of each run of no-break piping. Isolation valve operability is protected from all events outside of the valve rooms whether in the yard or inside containment.

b. Venting relief paths are provided for all possible postulated breaks inside the valve rooms. Measures required by MEB 3-1 and described herein have been taken to preclude the postulation of breaks in the main steam and feedwater main runs. However, for structural integrity evaluation, venting relief paths are provided for pipe breaks up to and including a break in a main steam line with a break area equivalent to its cross-sectional area (see appendix A). The design pressures of the rooms are described in section 6.0.

c. All piping and valves included under the no-break criteria have been upgraded to ASME Section III, Class 2, including the inherent inservice inspection requirements.

d. One complete train of steam supply to the turbine-driven auxiliary feedwater pump shall be protected and located within seismic Category I enclosures.

e. All no-break piping has been rigorously analyzed to ASME Section III, Class 2 requirements and the stresses are less than $0.8\ (1.2\ S_h + S_A)$ in accordance with MEB 3-1.

As a result of this implementation, the piping and piping components inside the valve rooms are essentially free from obstruction. There should be no pipe rupture restraints, sleeves, or local barriers to complicate inservice and maintenance inspections or component servicing, removal, and repair. TVA believes that this approach results in not only a cleaner and more economical arrangement but also a more functional, maintainable, and safer plant.

APPENDIX A

The design of the valve rooms is based on consideration of the consequences of ruptures of main steam and feedwater piping. Structural walls and slabs are designed to maintain their integrity while pressure differentials arising from hypothetical pipe ruptures are imposed on them. Hypothetical pipe breaks up to and including a break in a main steam line (MSL) with a break area equivalent to its cross-sectional area (4.7 feet^2) have been considered.

The mass and energy releases following a break of a main steam line with a break area equivalent to its cross-sectional area are provided in table A1. The mass and energy releases following a break of a main feedwater line (MFWL) with a break area equivalent to its cross-sectional area (3.464 feet^2) are provided in table A2. This cross-sectional area (3.464 feet^2) does not exist in the valve room but rather just outside the valve room. The piping in the valve room has a cross-sectional area of 1.993 feet^2. The mass and energy releases used were based on the larger value in order to provide a conservative calculation.

The computer model used for the subcompartment pressure analysis of the valve room A is described in tables A3, A4, and A5 and figures A1, A2, A3, and A4. The computer model used for the subcompartment pressure analysis of the valve room B is described in tables A6, A7, and A8 and figures A5 and A6.

The calculated pressure following a one area main steam line break (MSLB) in the valve room A is shown in figure A7. As seen from this figure, the calculated peak differential pressure is 2.01 psig. The calculated pressure following a one area main feedwater line break (MFWLB) in the valve room A is shown in figure A8. As seen from the figure, the calculated peak differential pressure is 9.62 psig. The design pressure of the valve room A is 18 psi.

The calculated pressure following a one area MSLB in the valve room B is shown in figure A9. As seen from this figure, the calculated peak differential pressure is 14.8 psig. The design pressure for this subcompartment is 30 psig. The calculated pressure following a one area MFWLB in the valve room B is shown in figure A10. As seen from this figure, the calculated peak differential pressure is 22.83 psig. The design pressure for this subcompartment is 50 psig.

TABLE A1

MASS AND ENERGY RELEASES
FOR ONE AREA MSLB (4.7 FT^2)

BELLEFONTE VALVE ROOMS

Time (sec)	Flow (lbm/sec)	Enthalpy (Btu/lbm)
0.00	0.0	1243.0
0.01	8227.4	1226.6
0.02	6586.0	1205.6
0.03	5776.1	1195.0
0.04	5418.1	1193.2
0.05	5290.4	1197.1
0.06	5311.3	1204.9
0.07	5518.2	1212.7
0.08	5839.5	1223.5
0.09	6229.6	1232.8
0.10	6644.4	1239.4
0.11	7006.6	1242.7
0.12	7248.1	1242.7
0.13	7332.5	1239.2
0.14	7301.4	1236.1
0.15	7180.5	1231.7
0.16	7008.8	1227.0
0.17	6815.7	1222.6
0.18	6616.9	1218.7
0.19	6420.3	1215.4
0.20	6243.2	1212.8
0.25	5930.1	1212.7
0.30	6041.1	1218.5
0.35	6016.4	1219.5
0.40	5919.5	1219.2
0.45	5877.0	1220.2
0.50	5869.3	1221.4
1.00	5305.1	1228.4
1.50	5098.5	1248.8
2.00	5127.7	1262.4

TABLE A2

MASS AND ENERGY RELEASES
FOR ONE AREA MFWLB (3.464 FT^2)

BELLEFONTE VALVE ROOMS

Time (sec)	Flow (lbm/sec)	Enthalpy (Btu/lbm)
0.00	0.0	447.3
0.01	1756.6	447.3
0.02	3372.6	446.8
0.03	4750.3	446.2
0.04	5840.0	445.6
0.05	6665.9	445.1
0.06	7432.1	445.1
0.08	8964.2	445.1
0.10	10496.0	445.1
0.12	12024.0	445.1
0.14	13546.0	445.1
0.16	15054.0	445.1
0.18	16544.0	445.1
0.20	18014.0	445.0
0.22	19025.0	445.0
0.24	19009.0	445.0
0.26	18994.0	445.0
0.28	18979.0	445.0
0.30	18963.0	445.0
0.35	18921.0	445.0
0.40	18880.0	445.0
0.45	18844.0	445.1
0.50	18811.0	445.1
1.00	18456.0	445.1
1.50	17940.0	445.0
2.00	17242.0	445.0

TABLE A3

NODAL VOLUMES

BELLEFONTE VALVE ROOM A

Node	Volume (ft^3)
1	$5.123(10)^3$
2	$4.094(10)^3$
3	$4.129(10)^3$
4	$4.169(10)^3$
5	$4.065(10)^3$
6	$4.477(10)^3$
7	$4.662(10)^3$
8	$3.82(10)^3$
9	$3.851(10)^3$
10	$3.899(10)^3$
11	$3.898(10)^3$
12	$4.547(10)^3$
13	$9.55(10)^3$
14	$9.627(10)^3$
15	$9.748(10)^3$
16	$9.745(10)^3$
17	$9.55(10)^3$
18	$9.627(10)^3$
19	$9.748(10)^3$
20	$9.745(10)^3$
21	$1.0(10)^{11}$

TABLE A4

FLOW AREAS

BELLEFONTE VALVE ROOM A

Path	Node To: From:	Area (ft^2)
0102	1 to 2	93.0
0106	1 to 6	174.0
0107	1 to 7	478.0
0203	2 to 3	221.0
0205	2 to 5	154.0
0208	2 to 8	392.0
0304	3 to 4	154.0
0309	3 to 9	396.0
0405	4 to 5	219.0
0410	4 to 10	400.0
0511	5 to 11	400.0
0612	6 to 12	466.0
0708	7 to 8	91.0
0712	7 to 12	167.0
0809	8 to 9	207.0
0811	8 to 11	151.0
0813	8 to 13	478.0
0910	9 to 10	151.0
0914	9 to 14	481.0
1011	10 to 11	207.0
1015	10 to 15	487.0
1112	11 to 12	61.0
1116	11 to 16	487.0
1314	13 to 14	518.0
1316	13 to 16	378.0
1317	13 to 17	478.0
1415	14 to 15	378.0
1418	14 to 18	481.0
1516	15 to 16	518.0
1519	15 to 19	487.0
1620	16 to 20	487.0
1718	17 to 18	518.0
1720	17 to 20	378.0
1819	18 to 19	378.0
1920	19 to 20	518.0

TABLE A5

PRESSURE RELIEF AREAS

BELLEFONTE VALVE ROOM A

Path	Node To: From:	Area (ft^2)	Pressure Differential For Blowout Panel
1721*	17 to 21	380.0	0.5 psid
1821*	18 to 21	380.0	0.5 psid
1921*	19 to 21	380.0	0.5 psid
2021*	20 to 21	380.0	0.5 psid

*Flow areas between nodes are pressure dependent and will open at specified differential pressure.

TABLE A6

NODAL VOLUMES

BELLEFONTE VALVE ROOM B

Node	Volume (ft^3)
1	$1.5749(10)^4$
2	$1.8109(10)^4$
3	$1.0803(10)^4$
4	$1.7587(10)^4$
5	$1.9092(10)^4$
6	$1.1497(10)^4$
7	$2.13(10)^2$
8	$1.0(10)^{11}$

TABLE A7

FLOW AREAS

BELLEFONTE VALVE ROOM B

Path	Node To: From:	Area (ft^2)
0102	1 to 2	361.0
0104	1 to 4	790.0
0203	2 to 3	20.0
0205	2 to 5	1100.0
0306	3 to 6	645.0
0405	4 to 5	338.0
0708	7 to 8	33.7

TABLE A8

PRESSURE RELIEF AREAS

BELLEFONTE VALVE ROOM B

Path	Node To: From:	Area (ft^2)	Pressure Differential For Blowout Panels
0107*	1 to 7	24.8	0.5 psid
0208*	2 to 8	100.0	0.5 psid
0308*	3 to 8	150.0	0.5 psid

*Flow areas between nodes are pressure dependent and will open at specified differential pressure.

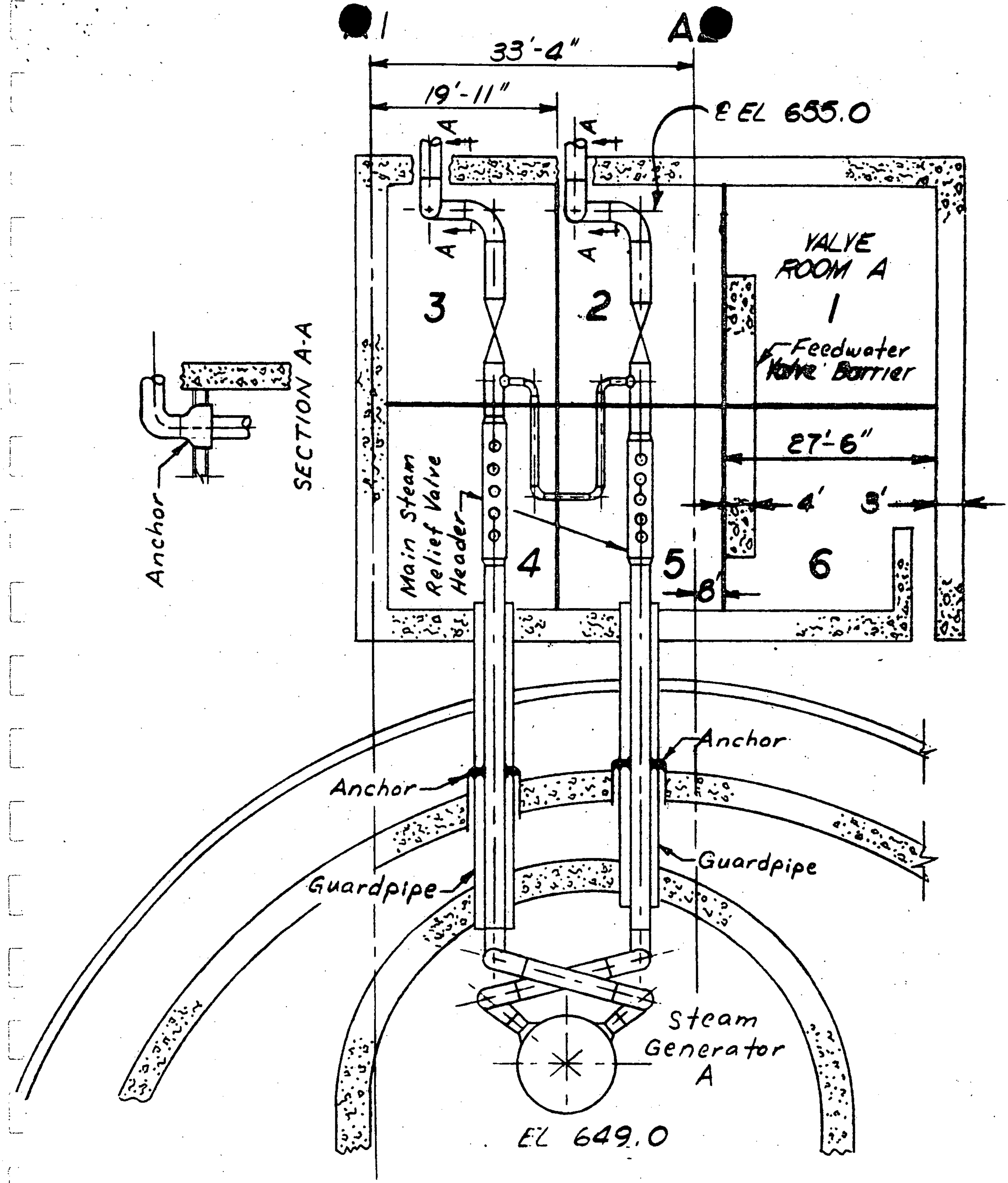


FIGURE A1

BELLEFONTE VALVE ROOM A
SUBCOMPARTMENT NODE SCHEME

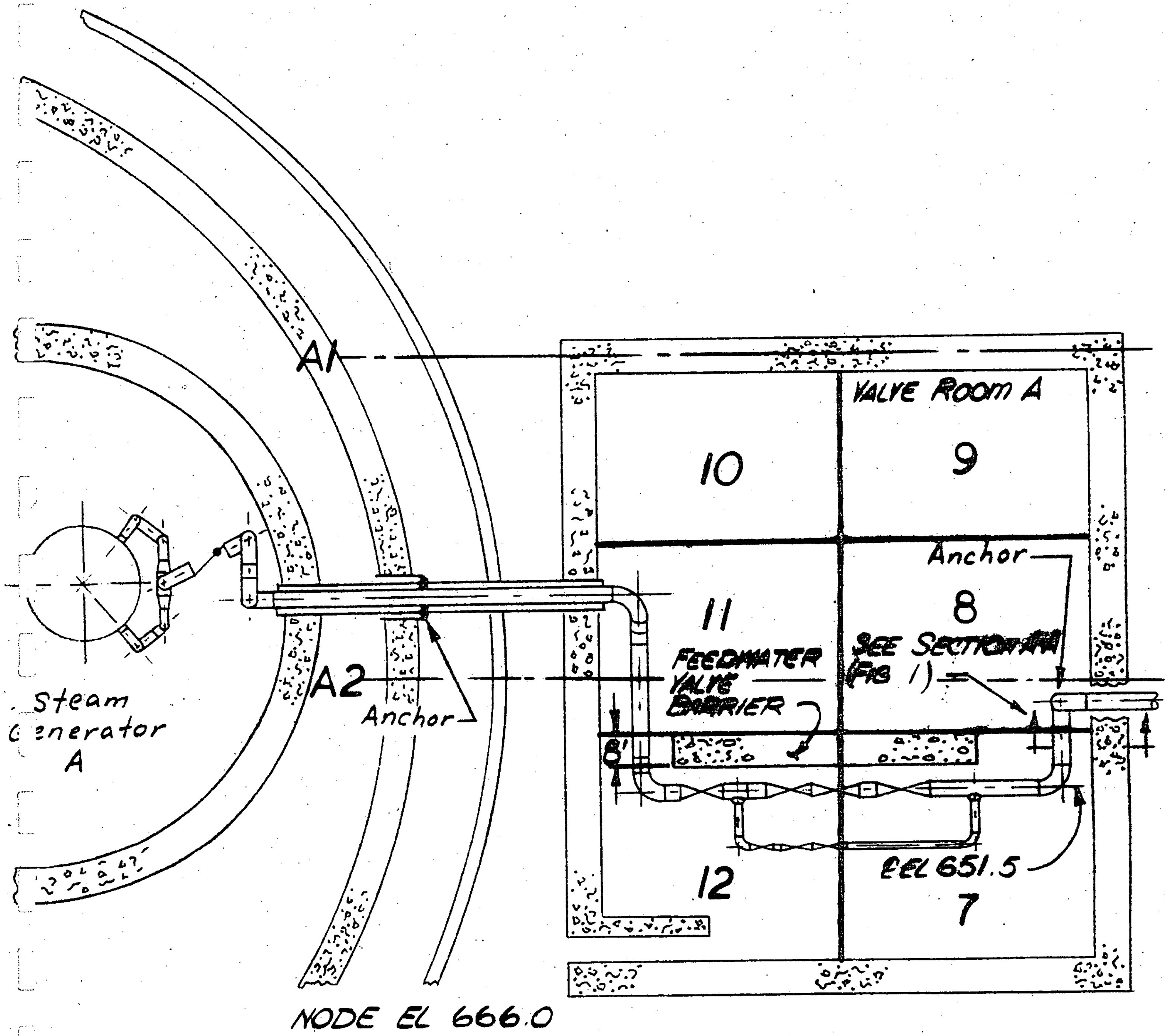


FIGURE A2

BELLEFONTE VALVE ROOM A
SUBCOMPARTMENT NODE SCHEME

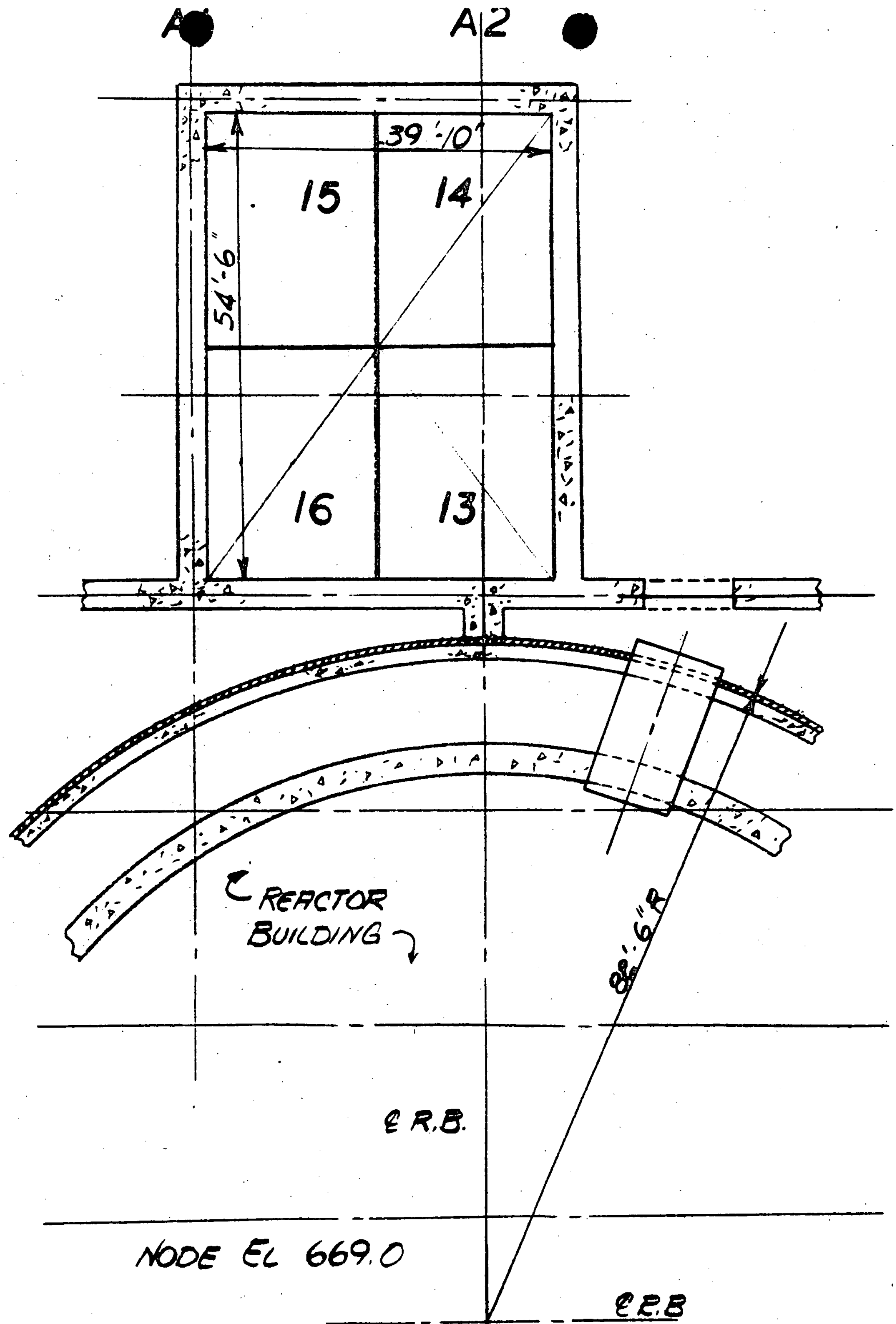


FIGURE A3
BELLEFONTE VALVE ROOM A
SUBCOMPARTMENT NODE SCHEME

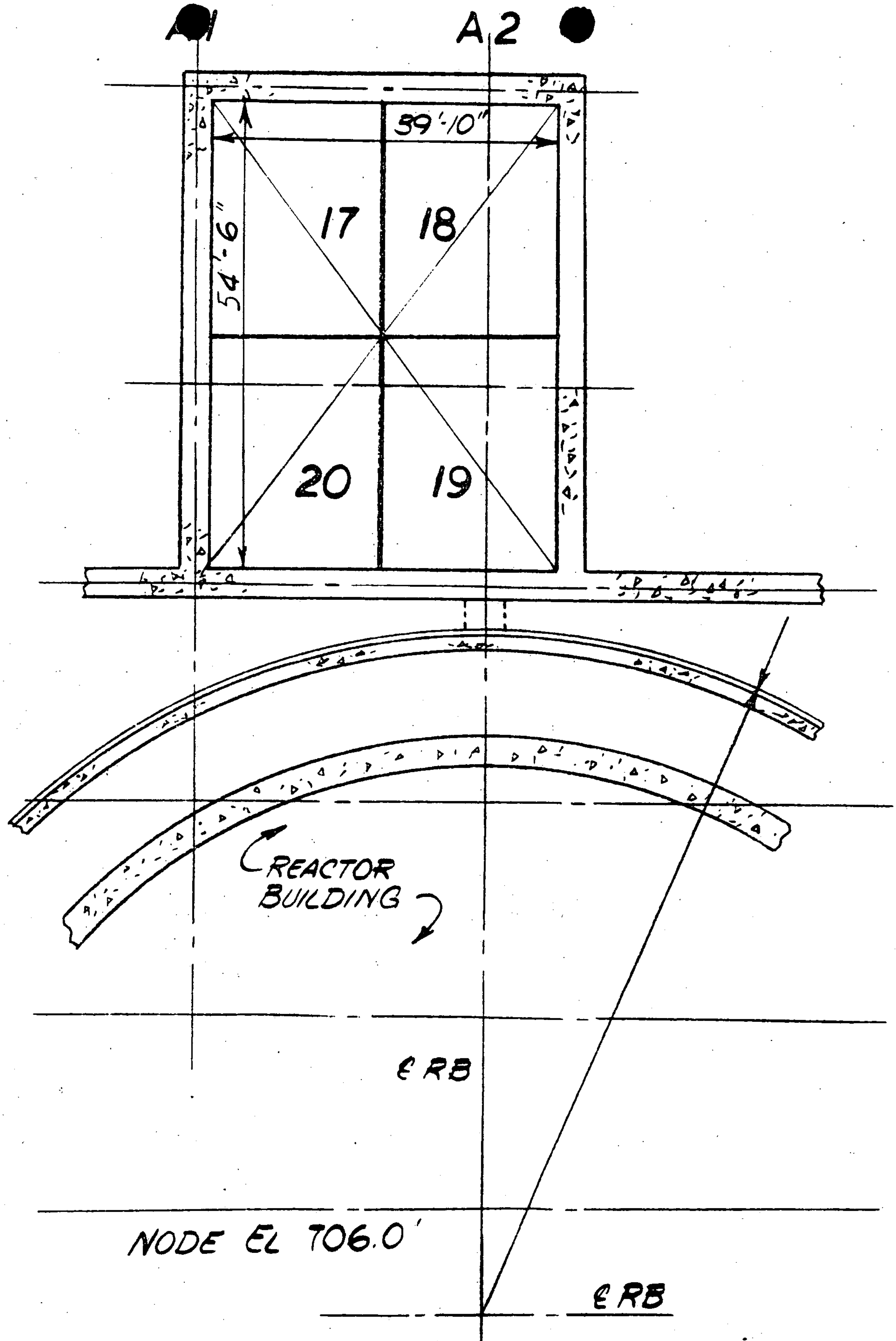


FIGURE A4
BELLEFONTE VALVE ROOM A
SUBCOMPARTMENT NODE SCHEME

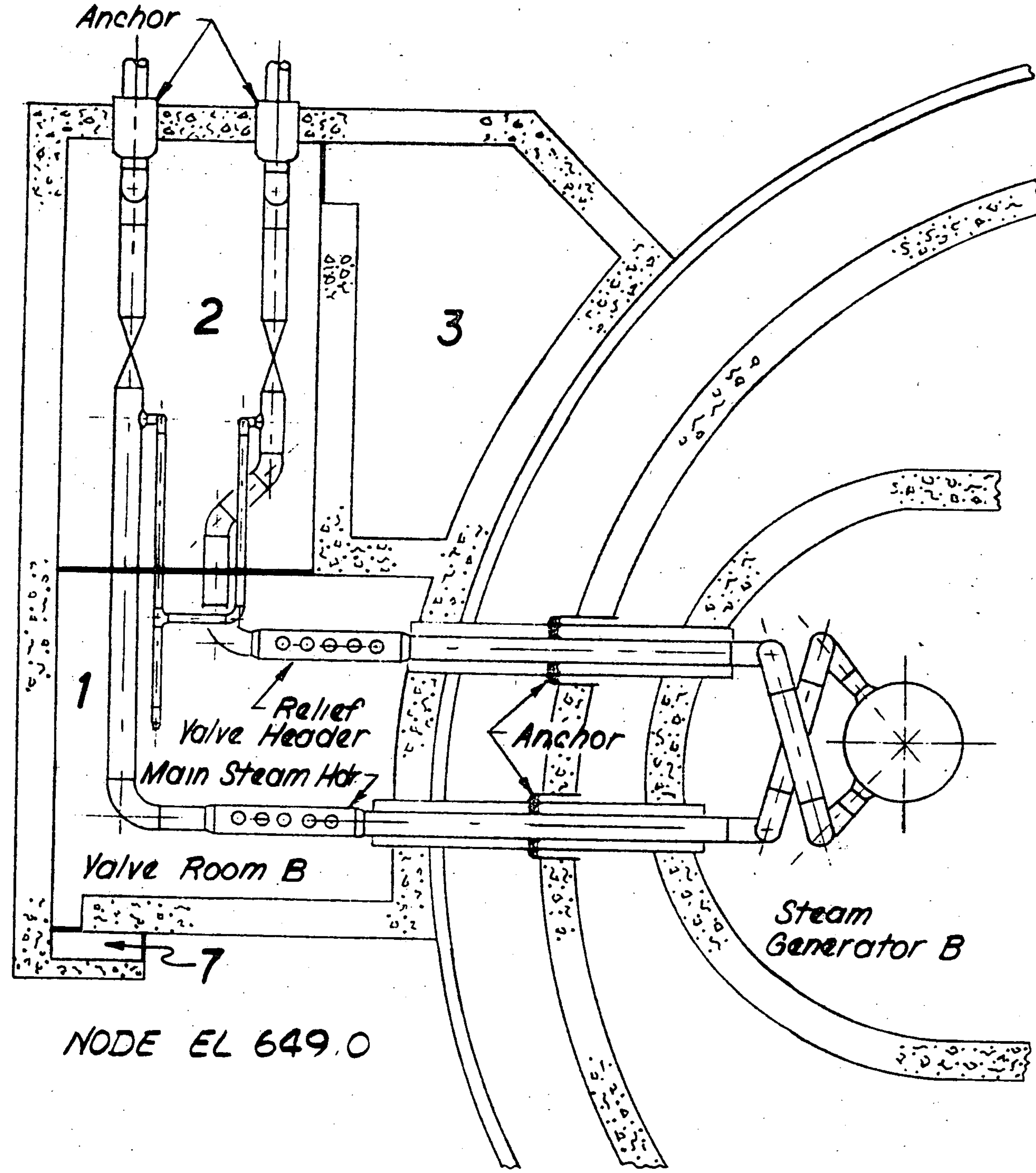


FIGURE A-

BELLEFONTE VALVE ROOM B
SUBCOMPARTMENT NODE SCHEME

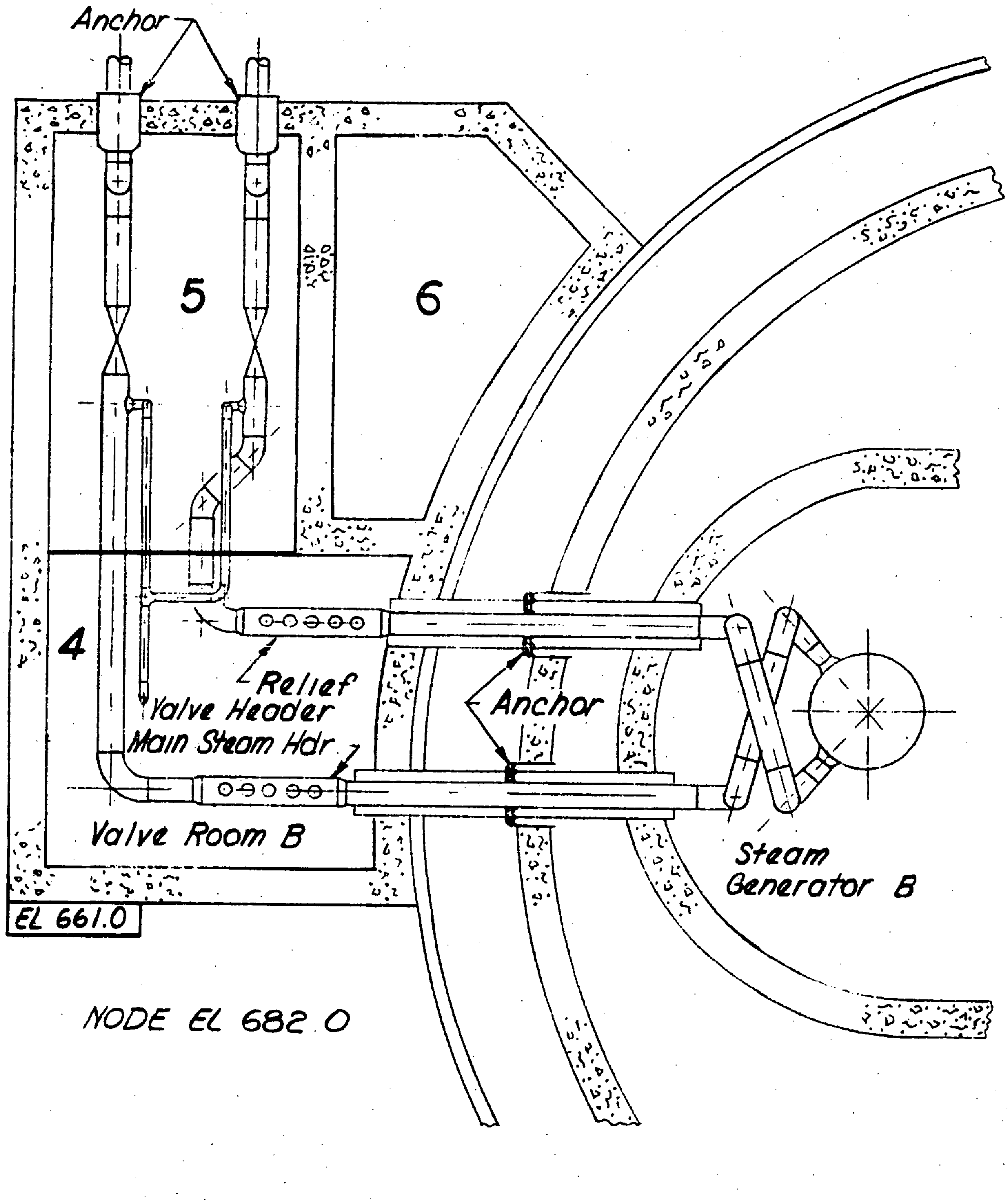


FIGURE A6

BELLEFONTE VALVE ROOM B
SUBCOMPARTMENT NODE SCHEME

BELLEFONTE VALVE ROOM A
ONE AREA MAIN STEAM LINE BREAK
PRESSURE TIME HISTORY - BREAK NODE No 2

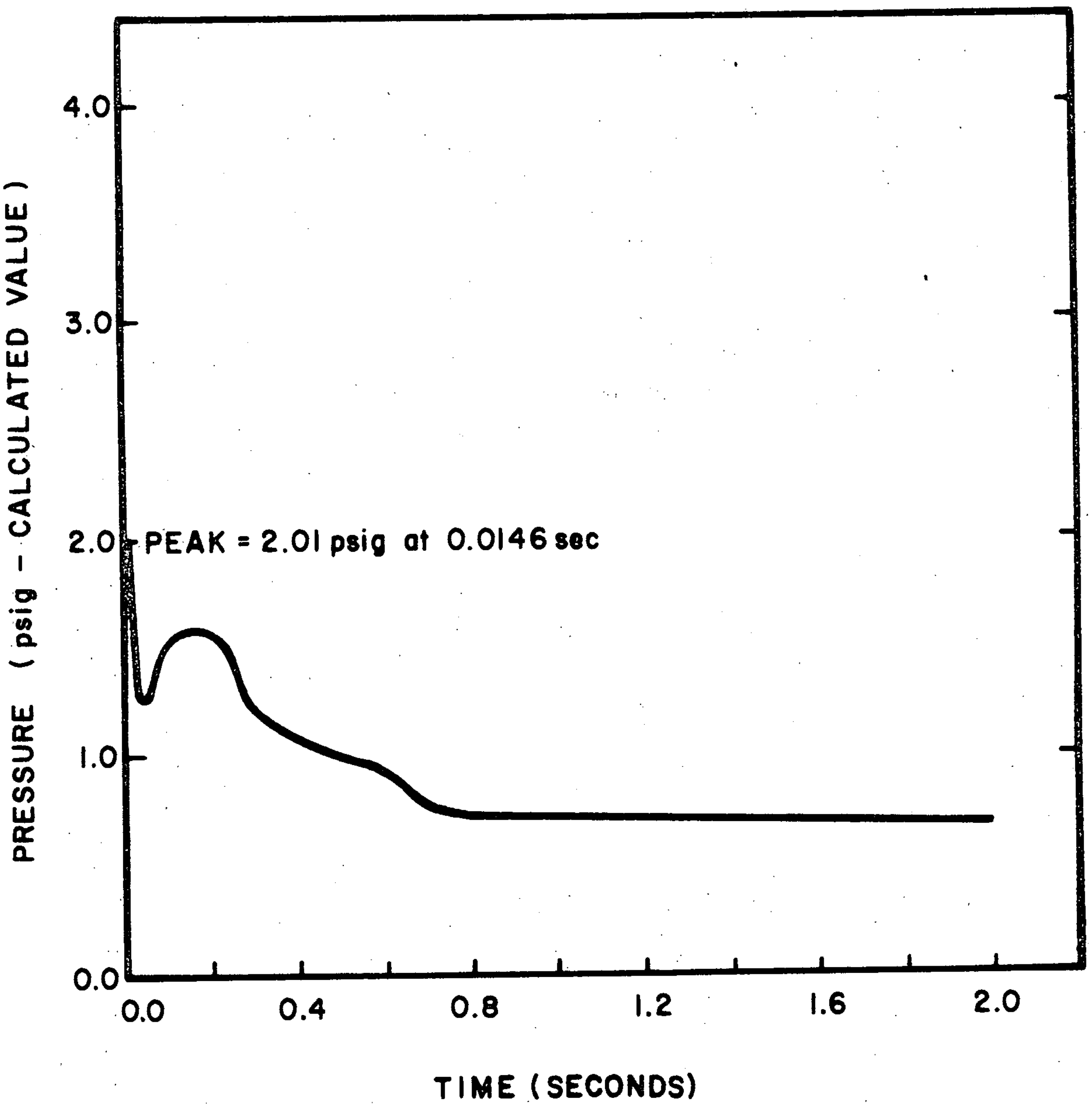


FIGURE A7

BELLEFONTE VALVE ROOM A
ONE AREA MAIN FEEDWATER LINE BREAK
PRESSURE TIME HISTORY - BREAK NODE No 6

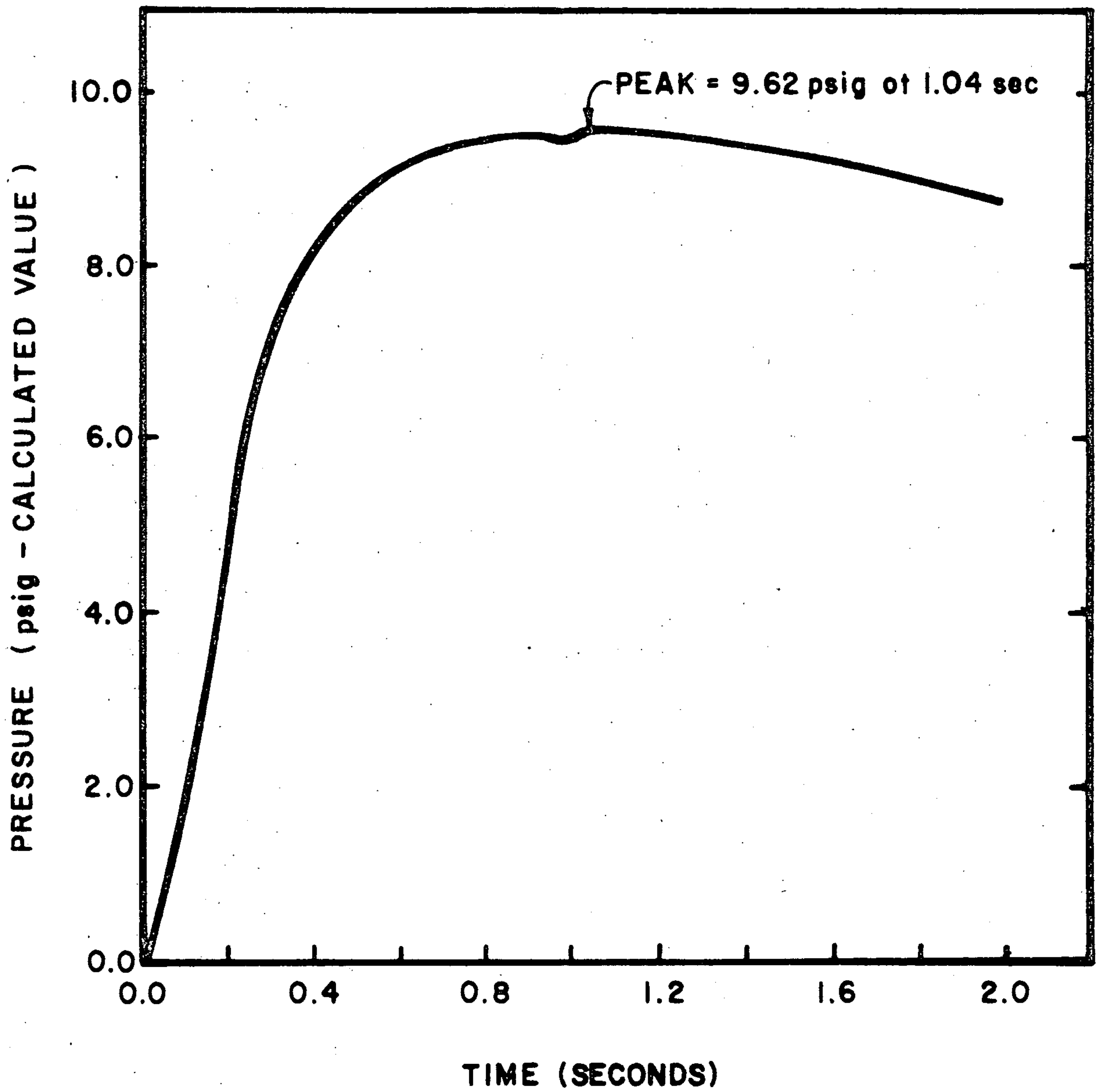


FIGURE A8

BELLEFONTE VALVE ROOM B
ONE AREA MAIN STEAM LINE BREAK
PRESSURE TIME HISTORY - BREAK NODE No 1

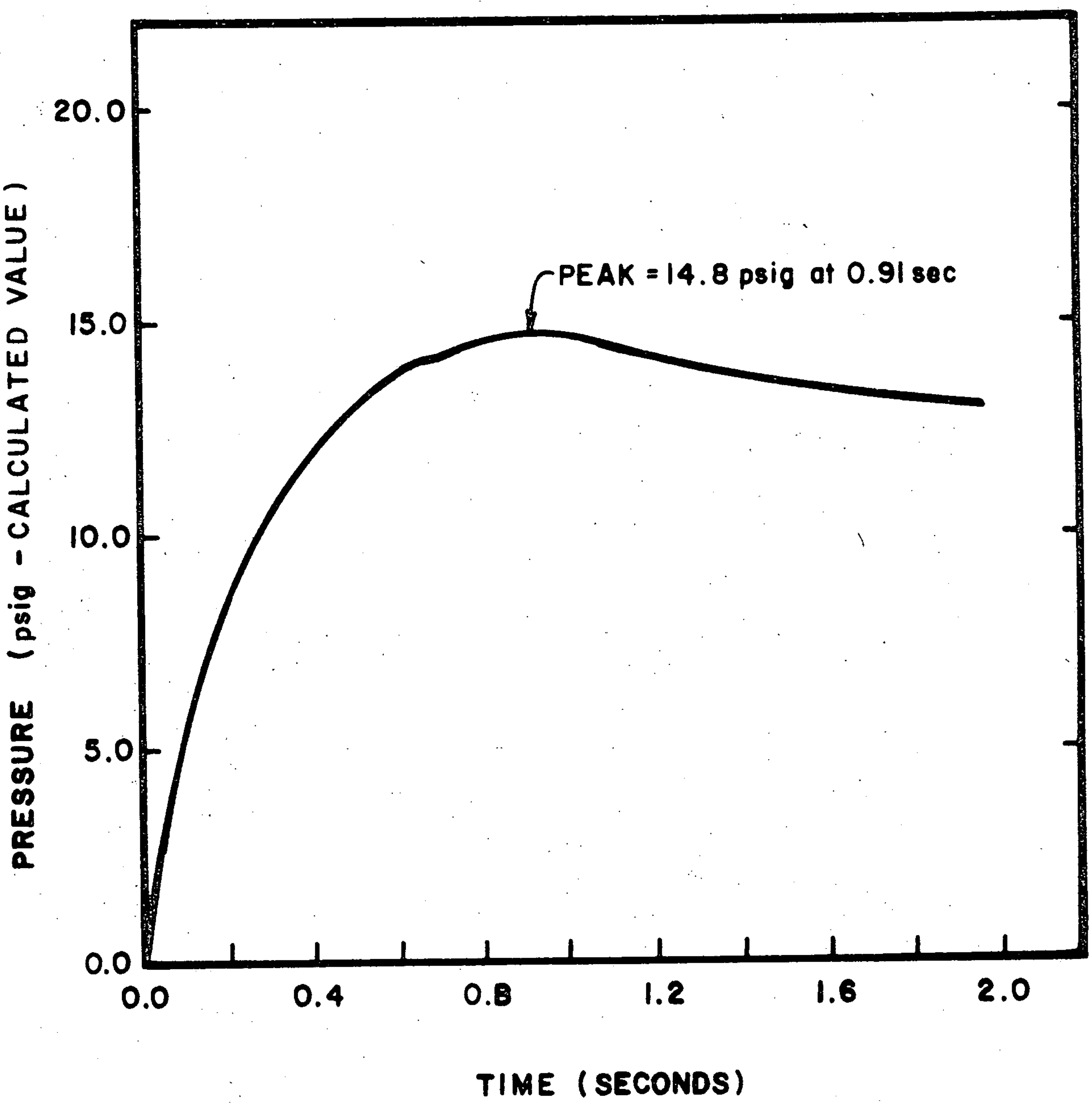


FIGURE A9

BELLEFONTE VALVE ROOM B
ONE AREA MAIN FEEDWATER LINE BREAK
PRESSURE TIME HISTORY - BREAK NODE No 3

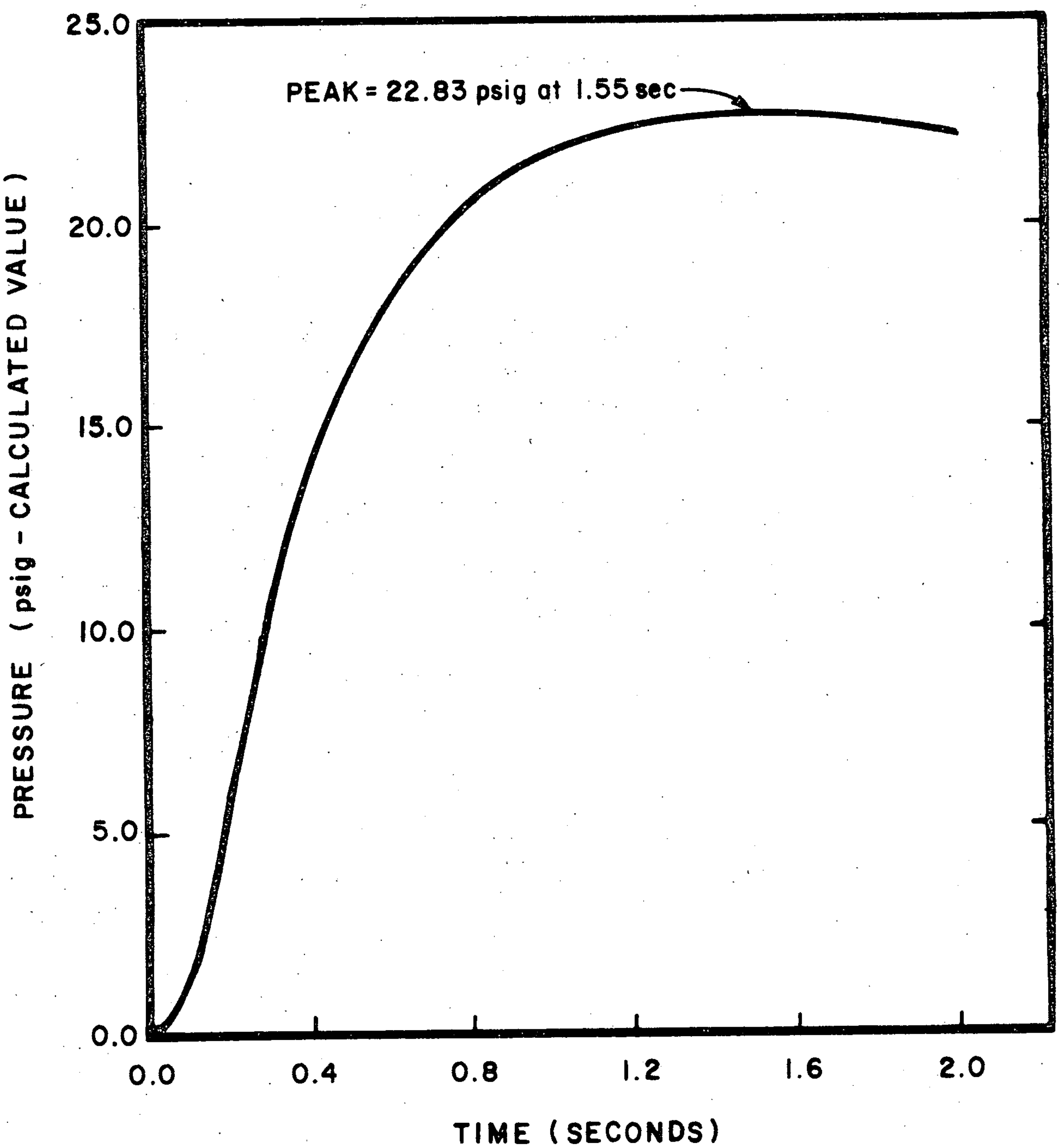


FIGURE A10