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AUTH.NAME AUTHOR AFFILIATION
VAN BRUNT,E.E. Arizona Public Service Co.
RECIP.NAME RECIPIENT AFFILIATION
TEDESCO,R.L. Assistant Director for Licensing

SUBJECT: Forwards response to SER open Item 5 re seismic & LOCA loads.Info concerns asymetric loads evaluation.Analysis of fuel will be forwarded by May 1982.

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Mr. R. L. Tedesco
Assistant Director for Licensing
Division of Licensing
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Subject: Palo Verde Nuclear Generating Station (PVNGS) Units 1, 2 and 3
Docket Nos. STN-50-528/529/530
File: 81-056-026; G.1.10

Reference: NUREG-0857, Safety Evaluation Report related to the operation of Palo Verde Nuclear Generating Station Units 1, 2 and 3, November 1981

Dear Mr. Tedesco:

Please find attached our response to Open Item No. 5 of the referenced PVNGS SER concerning seismic and LOCA loads (3.9.2, 4.2.1). The attached information concerning the assymetric loads evaluation addresses all of the topics discussed in Section 3.9.2 of the PVNGS SER, except for the structural analysis and evaluation of the fuel (also discussed in Section 4.2.1 of the PVNGS SER). The analysis of the fuel will be forwarded to the NRC by May of 1982. Attachment 1 provides a cross-reference list between the information requests and our responses.

Our response to the plant-specific items related to the assymetric loads evaluation is given in the form of current, revised, and new FSAR sections. The FSAR will be updated in a future amendment to incorporate this information.

If you have any questions, please contact me.

Very truly yours,

J M Allen for

E. E. Van Brunt, Jr.
APS Vice President,
Nuclear Projects
ANPP Project Director

B001
S
1/1

EEVBJr/KEJ/av
Attachment
cc: J. Kerrigan (w/a)
P. Hourihan (w/a)
A. C. Gehr (w/a)
D. Terao (w/a)

8112230349 811204
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STATE OF ARIZONA)
) ss.
COUNTY OF MARICOPA)

I, John M. Allen, represent that I am Nuclear Engineering Manager of Arizona Public Service Company, that the foregoing document has been signed by me for Edwin E. Van Brunt, Jr., Vice President Nuclear Projects, on behalf of Arizona Public Service Company with full authority so to do, that I have read such document and know its contents, and that to the best of my knowledge and belief, the statements made therein are true.

John M Allen

John M. Allen

Sworn to before me this 4th day of December, 1981.

Robert K Watt

Notary Public

My Commission expires:

October 2, 1985

Attachment 1

RESPONSE TO REQUEST FOR
FURTHER INFORMATION ON ASYMMETRIC LOADS

1. Definition of Plant Geometrics

   Refer to current FSAR Sections 6.2.1.2.1, 6.2.1.2.2.1, and 6.2.1.2.3.2, current FSAR Tables 6.2.1-13 and 6.2.1-14 and current FSAR Figures 6.2.1-13 and 6.2.1-14.

2. Calculation of Subcompartment Pressurization

   Refer to current FSAR Section 6.2.1.2.3.2, current FSAR Table 6.2.1-13 and current FSAR Figure 6.2.1-17.

3. Evaluation of Building Walls and Foundations

   Refer to revised FSAR Sections 3.8.3.4.2 and 3.8.3.4.3.

4. Structural Analysis of Reactor Coolant System

   Refer to current FSAR Section 3.9.1.4.1.

5. Evaluation of Vessel, RCS and ECCS Piping Support Loads

   Refer to current FSAR Section 3.9.1.4.1 for Vessel and RCS support loads.

   Refer to new FSAR Section 3.9.1.4.4 for ECCS piping support loads.

6. Structural Analysis and Evaluation of Internals and CEDMs

   Refer to current FSAR Section 3.9.1.4.3 for CEDMs.

   Refer to revised FSAR Section 3.9.2.5 for internals.

7. Analysis and Evaluation of ECCS Piping Attached to RCS

   Refer to new FSAR Section 3.9.1.4.4.

8. Structural Analysis and Evaluation of Fuel

   Refer to revised FSAR Section 4.2.3.

9. Overall Summary of Results for each Plant

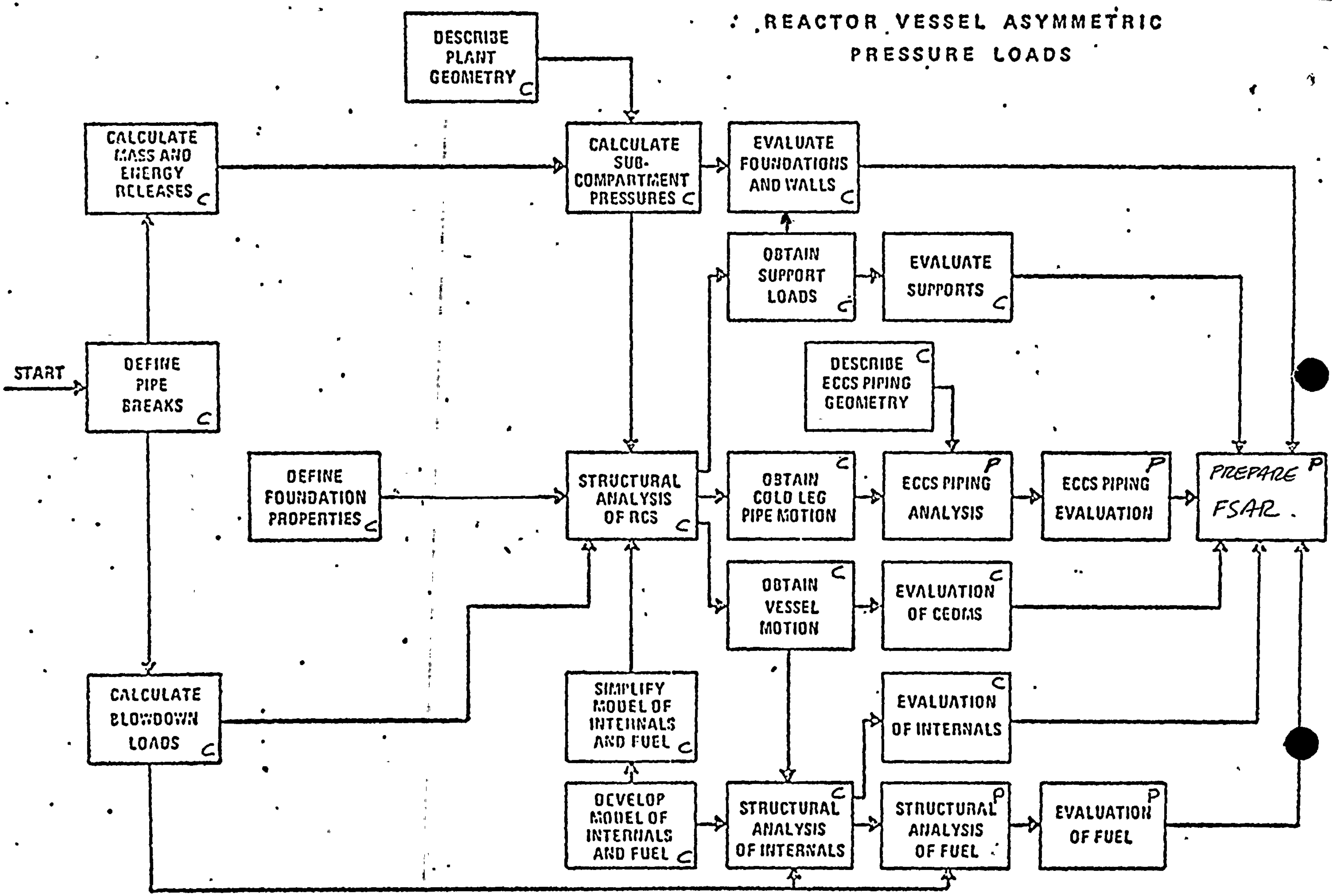
   Refer to FSAR Sections referenced above, associated CESSAR sections and attached Figure 1.

   Copies of above referenced current, revised, and new FSAR sections are attached.

   Revised and new FSAR sections will be included in FSAR Amendment 8.

FIGURE 1

REACTOR VESSEL ASYMMETRIC PRESSURE LOADS



C = COMPLETE
P = IN PROGRESS

3.8.3.4.2 Primary Shield Wall and Reactor Cavity

For the hypothetical LOCA condition, the cavity wall is designed to withstand jet impingement forces and internal pressurization combined with seismic and LOCA loads on the reactor vessel and coolant pipeline without gross damage to the cavity structure. Local damage to the cavity in the immediate vicinity of the NSSS component failure is inevitable. However, vital parts of the containment are protected from this failure to ensure a post-accident leaktight containment structure.

INSERT A

The reactor cavity is designed to withstand a time dependent internal pressure load due to the LOCA. The maximum and minimum static equivalent values of this pressure load are 99.8 psid and 8.0 psid respectively. This pressure acts on the entire cavity for a duration of 1 second. The maximum stress level in the rebar under the worst loading combination is limited to 90% of yield stress of the rebar. 5

For the normal operating condition, the reactor CAVITY is designed to withstand the stresses due to dead loads, live loads, and seismic loads. Under this condition, the stresses in the concrete and the reinforcing steel are significantly below working stress levels. In the stress analysis, flexure tensile cracking is permitted but is controlled by the bonded reinforcing steel.

3.8.3.4.3 Secondary Shield Wall and Steam Generator Compartments

INSERT B

The secondary shield wall, the refueling canal walls, and the walls enclosing steam generator compartments are designed for internal pressures as determined by nodal analyses described in section 6.2.1.2.2.2. The magnitude of these pressures varies between 29.4 and 5.0 psid due to any of the postulated pipe breaks listed in section 6.2.1. 5

INSERT C

The compartments are also designed for jet forces on localized areas of the walls resulting from the impingement of escaping

fluid. In addition, the affect of pipe rupture loadings at various restraints on the walls has been considered with local analysis of the walls.

~~3.8.3.4.4 Refueling Canal~~

For the refueling condition, the walls are designed for the maximum hydrostatic head due to 47.5 feet of water and including the effect of hydrodynamic pressure due to OBE and SSE. The steam generator compartment pressure loads due to postulated pipe rupture and hydrostatic head are not considered to occur simultaneously.

3.8.3.4.5 Pressurizer Compartment

The pressurizer compartment is located outside of the secondary shield structure; therefore the LOCA load due to the rupture of a reactor coolant pipe is not considered in the design of the pressurizer compartment. Instead, the pipe rupture loads due to various pipelines within the pressurizer compartment are used for the design.

The design basis and approach for such pipe rupture loads are similar to that of the primary shield wall as described in section 3.8.3.4.2.

Other major loading conditions considered in the pressurizer compartment design are:

- Reactions from the pressurizer support for operating conditions
- Seismic load due to equipment and structure itself
- Construction load for erection of pressurizer

3.8.3.4.6 Floors

Concrete floor slabs and peripheral structural steel beams supporting the slabs are designed for dead load, live load,

INSERT A TO FSAR SECTION 3.8.3.4.2

The reactor cavity is designed to withstand an internal pressure load and the reactor support loads due to a LOCA. A three dimensional finite element model is used for the analysis of the portion of the primary shield wall affected by the asymmetric loadings (accident pressure and support reaction due to LOCA). The pressure loading is applied statically using an appropriate dynamic load factor. Peak differential pressures for each compartment as determined by the nodal analysis described in Section 6.2.1.2.2.1 are used. The applied pressures ranged between 99.8 and 8 psid. The reactor support loadings are determined by C-E using the support stiffnesses provided by Bechtel. These LOCA loads are combined with the accident pressure, dead load, seismic, etc., using the load combinations in Section 3.8.3.3. The rebar is designed using the OPTCON computer code (see Appendix 3B). A summary of the reinforcing requirements is contained in Table 3.8-4A. The maximum stress level in the rebar under the worst loading combination is limited to 90% of the yield strength of the rebar.

INSERT B TO FSAR SECTION 3.8.3.4.3

The secondary shield walls and the refueling canal walls enclosing the steam generator compartments are designed for the effects of a LOCA condition. Specifically, accident pressures and equipment reaction loads due to LOCA are considered along with the normal operating loads of dead, live, thermal, and seismic in the design of the steam generator compartment walls. A three dimensional finite element model is used for the analysis of the secondary shield wall and internal structure. Peak pressures as determined by the nodal analysis described in Section 6.2.1.2.2.2 are applied statically with an appropriate dynamic load factor.

INSERT C TO FSAR SECTION 3.8.3.4.3

The equipment support LOCA loadings (Steam Generator and Reactor Coolant Pumps) are determined by C-E using the support stiffnesses provided by Bechtel. These asymmetric loads are conservatively applied in the analysis. The maximum support loads from all load cases for one steam generator and two reactor coolant pumps are applied simultaneously in one steam generator compartment to determine the moments and forces in the secondary shield wall. All forces are applied in a direction that would cause axial tension in the wall. This is a conservative approach since not all supports have maximums occurring under the same loading condition or accident. These LOCA loads are combined together with the dead and live loads, etc., using the load combinations listed in Section 3.8.3.3. The reinforcing steel is sized using the OPTCON computer code. The reinforcing requirements are shown in Table 3.8-4A.

3.9.1.4.4 EMERGENCY CORE COOLING SYSTEM (ECCS) PIPING

The ECCS piping, inside containment, is comprised of the high and low pressure piping of the Safety Injection System.

The capability of the Emergency Core Cooling System (ECCS) piping to withstand the effects of design basis pipe breaks is evaluated by analysis. The capability of the ECCS piping to withstand the combined effects of pipe break and Safe Shutdown Earthquake (SSE) seismic loadings is also evaluated. Pipe rupture loadings are experienced by the ECCS piping via the motion of the primary system piping and the SSE loadings are experienced by the ECCS piping via the motion of the primary system piping and the ECCS piping supports.

The primary piping motions due to pipe rupture loadings are calculated as described in CESSAR Section 3.9.1.4.1. Each ECCS pipeline is evaluated by dynamic elastic or dynamic elastic/plastic analysis for these primary piping motions.

The effects of primary system pipe breaks are transmitted to the ECCS piping by the motion of the primary piping. For the evaluation of pipe break loads, the displacement time history of the primary piping (at the ECCS injection nozzle) is applied directly to each dynamic ECCS pipeline analysis.

The analysis results in motions and stresses in the piping. The analysis also results in pipe support motions and loading.

For ECCS piping attached to the broken primary pipe, pressure boundary integrity is assumed by meeting the faulted condition limits found in Appendix F of ASME Boiler and Pressure Vessel Code Section III, Division 1

For ECCS piping attached to the unbroken loops of the primary pipes, functionability can be assumed:

(1) by meeting the Level B (Upset Condition) Limits of ASME Boiler and Pressure Vessel Code Section III Division 1 with fatigue considerations excluded, or

(2) by meeting the criteria found in G.E. Topical Report "Functional Capability Criteria for Essential Mark II Piping," NGDO-21985 dated September 1978 (Reference NCR memorandum for R. L. Tedesco, Assistant Director for Licensing, from J. P. Knight, Assistant Director for Components and Structures Engineering, dated July 17, 1980), or

(3) by demonstrating that the deformations of the piping do not significantly affect ECCS flow.

Table 3.9-4

DESIGN CRITERIA FOR ASME CODE CLASS 1 BECHTEL SUPPLIED PIPING

Condition	Stress Limits[a]
Normal	NB-3653
Upset	NB-3654
Emergency	NB-3655
Faulted	NB-3656

a. As specified by ASME Section III, including the Winter 1975 addenda (Summer 1979 addenda for subsections NB 3650 through NB 3680)

5

4

3.9.2.4 Preoperational Flow-Induced Vibration Testing of Reactor Internals

Refer to CESSAR Section 3.9.2.4. PVNGS Unit One is the prototype System 80 plant for the purposes of the Precritical Vibration Monitoring Program (PVMP). PVNGS Units Two and Three are non-prototype plants. 5

3.9.2.5 Dynamic System Analysis of the Reactor Internals Under Faulted Condition

INSERT

Refer to CESSAR Section 3.9.2.5.

3.9.2.6 Correlations of Reactor Internals Vibration Tests with the Analytical Results

Refer to CESSAR Section 3.9.2.6.

Insert to FSAR Section 3.9.2.5

The analysis of Reactor Internals has been performed in accordance with the methods described in CESSAR Section 3.9.2.5. The calculated stresses are below the allowable stresses for faulted conditions of the ASME Boiler and Pressure Vessel Code Section III, Appendix F. (See CESSAR Table 3.9.5-1)

4.2 FUEL SYSTEM DESIGN

Refer to CESSAR Section 4.2.

4.2.1 DESIGN BASES

Refer to CESSAR Section 4.2.1.

4.2.2 DESCRIPTION AND DESIGN DRAWINGS

Refer to CESSAR Section 4.2.2.

4.2.3 DESIGN EVALUATION

Refer to CESSAR Section 4.2.3.

INSERT →

4.2.4 TESTING AND INSPECTION PLAN

Refer to CESSAR Section 4.2.4.

4.2.5 CESSAR REACTOR INTERFACE REQUIREMENTS

The following interface requirements are repeated from CESSAR Section 4.2.5:

> Below are detailed the interface requirements that the reactor places on certain aspects of the BOP, listed by categories. In addition, applicable GDC and Regulatory Guides which C-E utilizes in its design of the reactor are presented. The GDC and Regulatory Guides are listed only to show what C-E considers to be relevant, and are not imposed as interface requirements unless specifically called out as such in a particular interface requirement.
>
> Relevant GDC - 1, 2, 3, 4, 10, 11, 12, 14, 15, 26, 27, 28, 29, 30, 31, 32, 61, 62, 63

Insert to FSAR Section 4.2.3

The Loss of Coolant Accident (LOCA) evaluation of the fuel, including spacer grids is in progress. The results of the analyses will be compared to the acceptance criteria of CESSAR Section 4.2.3 and reported in May 1982.

3.9.1.4 Consideration for the Evaluation of the Faulted Condition

3.9.1.4.1 Seismic Category I NSSS Items

Analyses of the reactor coolant system components (reactor vessel, steam generator, reactor coolant pump, pressurizer, and reactor coolant piping) and their supports have been performed in accordance with the methods described in CESSAR Section 3.9.1.4.1. For each component and support member, the calculated loads, in combination with the seismic loads, are below the loads specified for design and the stresses (pipe rupture in combination with SSE) are below those listed in CESSAR Table 3.9.3-2.

No components or supports of the reactor coolant system main loop for PVNGS were designed using the inelastic methods defined in Section III of the ASME Code as plastic instability or limit analysis methods. 5

The reactor vessel lower key horizontal supports include load limiting devices in accordance with 5.4.14.2(e) of CESSAR-F. These load limiters are designed to remain elastic for all normal, upset and the SSE loadings, and elastic system analyses are used to establish or confirm the loads specified for design of the components and supports for these conditions. For loads resulting from postulated pipe breaks, the load limiter devices are designed to deflect plastically, and nonlinear system analyses are used accordingly for proper calculation of the distribution of the loads among the system of supports.

3.9.1.4.2 Seismic Category I Non-NSSS Items

Dynamic loads for components loaded in the elastic range are calculated using dynamic load factors, time-history analysis, or any other method that assumes elastic behavior of the component. A component is assumed to be in the elastic range if

yielding across a section does not occur. The limits of the
2 elastic range are defined in Paragraph F-1323 of Appendix F for
Code components. Local yielding due to stress concentration is assumed not to affect the validity of the assumptions of elastic behavior. The stress allowables of Appendix F for elastically analyzed components are used for Code components. For non-Code components, allowables are based on tests or accepted material standards consistent with those in Appendix F for elastically analyzed components.

3.9.1.4.3 Control Element Drive Mechanisms (CEDMs)

The pressure boundary portions of the CEDMS, including the nozzle attached to the reactor vessel head, have been analyzed
5 in accordance with the methods described in CESSAR Section 3.9.1.4.3. The calculated moments and/or stresses for both pipe rupture only and for the combined effects of pipe rupture and the SSE are below those allowed by Section III of the ASME B&PV code for service level D.

~~6.2.1.1.3.7 Postaccident Containment Pressure/Temperature Monitoring. One channel each of containment pressure and temperature instrumentation will be recorded in the main control room. Containment emergency sump temperature is not recorded since it is not required to mitigate the consequences of a DBA. Section 7.5 contains a detailed discussion of range, accuracy, and response of the instrumentation used and the type and accessibility of recorders provided. The tests conducted to qualify the instruments for use in the postaccident containment environment are discussed in section 3.11.~~

6.2.1.2 Containment Subcompartments

6.2.1.2.1 Design Bases

Subcompartments within containment, principally the reactor cavity, the steam generator compartments, and the pressurizer compartment, are designed to withstand the transient differential pressures and jet impingement forces of a postulated pipe break. Venting of these chambers is employed to keep the differential pressures within structural limits. In addition, restraints on the coolant pipes, reactor vessel, and steam generators are designed so that neither pipe whip nor forces transmitted through component supports threatened the integrity of the subcompartments or of the containment structure.

The spectrum of pipe breaks analyzed for each subcompartment are listed in table 6.2.1-1. The characteristics of the main coolant pipe ruptures were determined in accordance with the methods and criteria of section 3.6.2. The accident that results in the maximum differential pressure across the walls of the respective compartment is designated as the subcompartment design basis accident (DBA). Calculated DBA differential pressures are compared to the design differential pressure values used in the structural design of subcompartment walls

and equipment to ensure that calculated values are less than design values.

6.2.1.2.2 Design Features

6.2.1.2.2.1 Reactor Cavity. The reactor cavity is a heavily reinforced concrete structure that performs the dual function of providing reactor vessel support and radiation shielding. Figures 1.2-4, 1.2-5, 1.2-9, and 1.2-10 show the general arrangement of reactor cavity design.

The reactor cavity is formed as a separate subcompartment within the containment above the basemat of the containment (elevation 80 ft). The reactor primary shield wall is attached to the cavity basemat.

The primary shield wall can be approximated by a thick-walled cylinder with an outside diameter of 37 feet and an inside diameter of 24.2 feet. The major vent paths for the reactor cavity are: the four 15.1 ft^2 cold leg penetrations, the two 11.6 ft^2 hot leg penetrations, the 173.8 ft^2 past the reactor vessel flange and below the reactor shield plug, the four 20 in. diameter reactor cavity cooling ducts and the 56.4 ft^2 area below the reactor vessel into the incore instrumentation chase. The reactor shield plug acts as a flow restrictor from the upper region around the reactor, to the lower region, it also supplies some lateral support for the cold leg supports. The net free volume of the reactor cavity is 5566 cubic feet. The total vent area for the cavity is 326.7 square feet. No blowout panels are provided.

Two models of the reactor cavity are analyzed for each of the following postulated primary systems breaks: 100 square-inch hot leg guillotine and 350 square-inch pump discharge guillotine breaks. The model used for the analysis consists of 37 nodes and is depicted in figure 6.2.1-13. Control volume

and vent path descriptions are given in tables 6.2.1-13 and 6.2.1-14. The affected piping system, location, and size for each break is also given in table 3.6-1. The annular volume enclosed by the reactor cavity wall and the reactor vessel, between the bottom of the reactor vessel flange, and the bottom of the vessel is divided into 18 regions. The nozzle annulus is divided into ten regions. The radial boundaries are established by flow area restrictions encountered at each of the reactor coolant pipes and the ex-core detector thimbles as shown in figure 6.2.1-14. The annular region around the lower part of the reactor vessel is divided into eight regions. Radial boundaries in this area are encountered at each of the excore detector thimbles and cold leg supports. The remaining regions of the model consist of the incore instrumentation chase and the containment free volume. The flow paths from the postulated break directly to the containment are the open area between the primary coolant system pipes, the primary shield pipe penetrations, and the annular area between the reactor vessel flange and the cavity wall..

6.2.1.2.2.2 Steam Generator Compartment. The walls of the steam generator compartment are constructed of reinforced concrete that serves to support the equipment enclosed and provides radiation shielding. Figures 1.2-4 through 1.2-7 and 1.2-10 present views of the steam generator compartment arrangement.

The steam generator compartment encloses the steam generator vessel, two reactor coolant pumps and other smaller equipment. The compartment is very nearly symmetrical about the vertical plane through the two generators and the reactor vessel. The nodal model of the steam generator compartment is provided in

6.2.1.2.3.2 Subcompartment Modeling. Subcompartment nodalization models are determined by physical flow restrictions within each compartment. These flow restrictions include consideration of concrete obstructions, doorways, vent shafts, grating, piping, the reactor cavity shield plug, and major equipment component.. By choosing nodal boundaries at the various primary system components and physical flow restrictions, the calculated differential pressures and consequent vessel loads are maximized. A further increase in the number of subcompartment nodes modeled is not feasible unless additional physical flow restrictions are present. The subcompartment models, discussed below, take into account all physical flow restrictions present.

Vent loss coefficients are categorized as either orifices or miscellaneous. Orifice coefficients are calculated by the COPDA computer code (see section 6.2.1.2.3.1). For flow restrictions which cannot be adequately modeled as orifices, a miscellaneous flow coefficient is determined. References 3 and 4 are used in determining miscellaneous flow coefficients. The miscellaneous flow coefficients include friction losses; objects in flow paths; grating; and expansion, contraction, and turning losses.

A. Reactor Vessel Cavity

The pressure transient response of the reactor cavity to the postulated worse case break (350 in.^{2} cold leg guillotine break) is presented in figure 6.2.1-17. The peak differential pressures acting across the
5 primary shield wall are summarized in table 6.2.1-13.

~~A nodal sensitivity study of a geometrically similar reactor cavity has been performed to determine the minimum number of nodes necessary to predict the differential pressure loads acting on the reactor vessel and its supports. The study shows that differential pressure loads increase with finer nodalization at an ever decreasing rate. Thus a point of diminishing~~

Table 6.2.1-13

REACTOR CAVITY NODAL DESCRIPTION (Sheet 1 of 8)

A. 100 in^2 Hot Leg Guillotine Break
Break location: volume numbers 2 and 3

Volume No.[a]	Description	Height (ft)	Cross-Sectional Area (ft^2)	Initial Conditions: Temperature (°F)	Initial Conditions: Pressure (psia)	Initial Conditions: Humidity (%)	Peak Calculated Differential Pressure (psig)	Net Free Volume (ft^3)
1	Cavity above shield plug between adjacent to broken pipe and ex-core detector	14.1	13.3	120	14.4	25	16	198
2	Adjacent to node 1 and hot leg at plant north	14.1	15.7	120	14.4	25	27	229
3	Adjacent to node 2 and the ex-core detector	14.1	15.7	120	14.4	25	27	229
4	Adjacent to node 3 and the next cold leg	14.1	13.3	120	14.4	25	16	198
5	Adjacent to node 4 and the next cold leg	14.1	29.0	120	14.4	25	7	439
6	Adjacent to node 1 and the next cold leg	14.1	29.0	120	14.4	25	7	439
7	Adjacent to node 6 and the next ex-core detector	14.1	13.3	120	14.4	25	4	198
8	Adjacent to node 7 and the hot leg at plant south	14.1	15.7	120	14.4	25	4	229
9	Adjacent to node 8 and the next ex-core detector	14.1	15.7	120	14.4	25	4	229
10	Adjacent to nodes 9 and 5	14.1	13.3	120	14.4	25	4	198

a. Refer to Figure 6.2.1-13.

Table 6.2.1-13

REACTOR CAVITY NODAL DESCRIPTION (Sheet 2 of 8)

A. 100 in^2 Hot Leg Guillotine Break
Break location: volume numbers 2 and 3

Volume No.[a]	Description	Height (ft)	Cross-Sectional Area (ft^2)	Initial Conditions			Peak Calculated Differential Pressure (psig)	Net Free Volume (ft^3)
				Temperature (°F)	Pressure (psia)	Humidity (%)		
11	Between shield plug and bottom of reactor cavity, below node 1	18.2	9.6	120	14.4	25	<2	159
12	Between shield plug and bottom of reactor cavity, below nodes 2 and 3	18.2	29.7	120	14.4	25	<2	500
13	Between shield plug and bottom of reactor cavity, below node 4	18.2	9.6	120	14.4	25	<2	159
14	Between shield plug and bottom of reactor cavity, below node 5	18.2	33.4	120	14.4	25	<2	571
15	Between shield plug and bottom of reactor cavity, below node 6	18.2	33.4	120	14.4	25	<2	571
16	Between shield plug and bottom of reactor cavity, below node 7	18.2	9.6	120	14.4	25	<2	159
17	Between shield plug and bottom of reactor cavity below nodes 8 and 9	18.2	29.7	120	14.4	25	<2	500
18	Between shield plug and bottom of reactor cavity below node 10	18.2	9.6	120	14.4	25	<2	159
19	Region below reactor cavity, above ICI guide tube support plate 1	10.8	200	120	14.4	25	<2	1782

1

Table 6.2.1-13

REACTOR CAVITY NODAL DESCRIPTION (Sheet 3 of 8)

A. 100 in^2 Hot Leg Guillotine Break
Break location: volume numbers 2 and 3

Volume No.[(a)]	Description	Height (ft)	Cross-Sectional Area (ft^2)	Initial Conditions			Peak Calculated Differential Pressure (psig)	Net Free Volume (ft^3)
				Temperature (°F)	Pressure (psia)	Humidity (%)		
20	Region between plates 1 and 2	14.2	125	120	14.4	25	<2	2334
21	Region between plates 2 and 3	7.0	120	120	14.4	25	<2	1032
22	Region between plates 3 and 4	6.5	120	120	14.4	25	<2	733
23	Region between plates 4 and 5	10.5	165	120	14.4	25	<2	916
24	Region between plates 5 and 6	10.9	148	120	14.4	25	<2	1125
25	Region between plates 6 and 7	22.4	62.9	120	14.4	25	<2	1135
26	Region between plates 7 and 8	10.8	102	120	14.4	25	<2	1050
27	Region between plates 8 and 9	10.0	102	120	14.4	25	<2	970
28	Region between plates 9 and 10	9.6	102	120	14.4	25	<2	930
29	Region between plates 10 and the seal table	2.9	102	120	14.4	25	<2	278
30	Volume of reactor cavity cooling system ductwork	-	-	120	14.4	25	<2	1990
31	Hot leg pipe tunnel at plant north adjacent to nodes 2 and 3	11.5	14.9	120	14.4	25	12	89
32	Cold leg tunnel adjacent to nodes 4 and 5	6.0	18.3	120	14.4	25	6	212

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Table 6.2.1-13

REACTOR CAVITY NODAL DESCRIPTION (Sheet 4 of 8)

A. 100 in^2 Hot Leg Guillotine Break
Break location: volume numbers 2 and 3

Volume No.[a]	Description	Height (ft)	Cross-Sectional Area (ft^2)	Initial Conditions Temperature (°F)	Initial Conditions Pressure (psia)	Initial Conditions Humidity (%)	Peak Calculated Differential Pressure (psig)	Net Free Volume (ft^3)
33	Cold leg tunnel adjacent to nodes 5 and 10	11.5	18.3	120	14.4	25	4	212
34	Hot leg tunnel adjacent to nodes 8 and 9	6.0	14.9	120	14.4	25	<2	89
35	Cold leg tunnel adjacent to nodes 1 and 6	11.5	18.3	120	14.4	25	6	212
36	Cold leg tunnel adjacent to nodes 6 and 7	11.5	18.3	120	14.4	25	4	212
37	Reactor containment	-	-	120	14.4	25	-	$2.6x10^6$

Table 6.2.1-13

REACTOR CAVITY NODAL DESCRIPTION (Sheet 5 of 8)

B. 350 in^2 Cold Leg Guillotine Break
Break location: volume numbers 1 and 6

Volume No.[a]	Description	Height (ft)	Cross-Sectional Area (ft^2)	Initial Conditions			Peak Calculated Differential Pressure (psig)	Net Free Volume (ft^3)
				Temperature (°F)	Pressure (psia)	Humidity (%)		
1	Cavity above shield plug between adjacent to broken pipe and ex-core detector	14.1	13.3	120	14.4	25	100	198
2	Adjacent to node 1 and hot leg at plant north	14.1	15.7	120	14.4	25	61	229
3	Adjacent to node 2 and the ex-core detector	14.1	15.7	120	14.4	25	33	229
4	Adjacent to node 3 and the next cold leg	14.1	13.3	120	14.4	25	19	198
5	Adjacent to node 4 and the next cold leg	14.1	29.0	120	14.4	25	15	439
6	Adjacent to node 1 and the next cold leg	14.1	29.0	120	14.4	25	97	439
7	Adjacent to node 6 and the next ex-core detector	14.1	13.3	120	14.4	25	57	198
8	Adjacent to node 7 and the hot leg at plant south	14.1	15.7	120	14.4	25	32	229
9	Adjacent to node 8 and the next ex-core detector	14.1	15.7	120	14.4	25	19	229
10	Adjacent to nodes 9 and 5	14.1	13.3	120	14.4	25	15	198

a. Refer to Figure 6.2.1-13.

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Table 6.2.1-13

REACTOR CAVITY NODAL DESCRIPTION (Sheet 6 of 8)

B. 350 in^2 Cold Leg Guillotine Break
Break location: volume numbers 1 and 6

Volume No.[a]	Description	Height (ft)	Cross-Sectional Area (ft^2)	Initial Conditions Temperature (°F)	Pressure (psia)	Humidity (%)	Peak Calculated Differential Pressure (psig)	Net Free Volume (ft^3)
11	Between shield plug and bottom of reactor cavity, below node 1	18.2	9.6	120	14.4	25	18	159
12	Between shield plug and bottom of reactor cavity, below nodes 2 and 3	18.2	29.7	120	14.4	25	15	500
13	Between shield plug and bottom of reactor cavity, below node 4	18.2	9.6	120	14.4	25	15	159
14	Between shield plug and bottom of reactor cavity, below node 5	18.2	33.4	120	14.4	25	15	571
15	Between shield plug and bottom of reactor cavity, below node 6	18.2	33.4	120	14.4	25	18	571 5
16	Between shield plug and bottom of reactor cavity, below node 7	18.2	9.6	120	14.4	25	18	159
17	Between shield plug and bottom of reactor cavity below nodes 8 and 9	18.2	29.7	120	14.4	25	15	500
18	Between shield plug and bottom of reactor cavity below node 10	18.2	9.6	120	14.4	25	15	159
19	Region below reactor cavity, above ICI guide tube support plate 1	10.8	200	120	14.4	25	14	1782

Table 6.2.1-13

REACTOR CAVITY NODAL DESCRIPTION (Sheet 7 of 8)

B. 350 in^2 Cold Leg Guillotine Break
Break location: volume numbers 1 and 6

Volume No.[a]	Description	Height (ft)	Cross-Sectional Area (ft^2)	Initial Conditions: Temperature (°F)	Initial Conditions: Pressure (psia)	Initial Conditions: Humidity (%)	Peak Calculated Differential Pressure (psig)	Net Free Volume (ft^3)
20	Region between plates 1 and 2	14.2	125	120	14.4	25	14	2334
21	Region between plates 2 and 3	7.0	120	120	14.4	25	14	1032
22	Region between plates 3 and 4	6.5	120	120	14.4	25	13	733
23	Region between plates 4 and 5	10.5	165	120	14.4	25	13	916
24	Region between plates 5 and 6	10.9	148	120	14.4	25	13	1125
25	Region between plates 6 and 7	22.4	62.9	120	14.4	25	12	1135
26	Region between plates 7 and 8	10.8	102	120	14.4	25	10	1050
27	Region between plates 8 and 9	10.0	102	120	14.4	25	7	970
28	Region between plates 9 and 10	9.6	102	120	14.4	25	6	930
29	Region between plates 10 and the seal table	2.9	102	120	14.4	25	6	278
30	Volume of reactor cavity cooling system ductwork	-	-	120	14.4	25	12	1990
31	Hot leg pipe tunnel at plant north adjacent to nodes 2 and 3	11.5	14.9	120	14.4	25	27	89
32	Cold leg tunnel adjacent to nodes 4 and 5	6.0	18.3	120	14.4	25	7	212

Table 6.2.1-13

REACTOR CAVITY NODAL DESCRIPTION (Sheet 8 of 8)

B. 350 in^2 Cold Leg Guillotine Break
Break location: volume numbers 1 and 6

Volume No.[a]	Description	Height (ft)	Cross-Sectional Area (ft^2)	Initial Conditions Temperature (°F)	Initial Conditions Pressure (psia)	Initial Conditions Humidity (%)	Peak Calculated Differential Pressure (psig)	Net Free Volume (ft^3)
33	Cold leg tunnel adjacent to nodes 5 and 10	11.5	18.3	120	14.4	25	7	212
34	Hot leg tunnel adjacent to nodes 8 and 9	6.0	14.9	120	14.4	25	10	89
35	Cold leg tunnel adjacent to nodes 1 and 6	11.5	18.3	120	14.4	25	57	212
36	Cold leg tunnel adjacent to nodes 6 and 7	11.5	18.3	120	14.4	25	42	212
37	Reactor containment	-	-	120	14.4	25	-	2.6×10^6

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Table 6.2.1-14

REACTOR CAVITY VENT PATH DESCRIPTION (Sheet 1 of 12)

A. 100 in^2 Hot Leg Guillotine Break
Break location: volume numbers 2 and 3

Vent Path Number	Vol. Node Number From	Vol. Node Number To	Description of Vent Path Flow: Choked	Description of Vent Path Flow: Unchoked	Vent Area (ft^2)	Friction Factors: Length (ft)	Friction Factors: Hydraulic Diameter (ft)	Head Loss, K: Friction K, fl/d	Head Loss, K: Turning and Obstruction Loss, K	Head Loss, K: Expansion, K	Head Loss, K: Contraction, K	Head Loss, K: Total K_t	L/A (ft^{-1})
1	1	6		X	32.6	-	-	-	.081	1	-	1.081	.210
2	1	11	X		1.86	3.5	1.55	.02	-	1	.5	1.52	3.33
3	1	12	X		.402	-	-	-	.72	1	.5	2.22	9.52
4	1	35		X	7.56	-	-	-	-	1	.5	1.5	.340
5	1	37	X		11.3	-	-	← Modeled as an orifice →					.540
6	2	1		X	17.2	-	-	-	.220	1	-	1.22	.130
7	2	3		X	31.2	-	-	-	.093	1	-	1.093	.179
8	2	12	X		.602	-	-	-	1.14	1	.5	2.64	4.20
9	2	31		X	5.8	-	-	-	-	1	.5	1.5	.220
10	2	37	X		13.7	-	-	← Modeled as an orifice →					.460
11	3	4		X	34.1	-	-	-	.220	1	-	1.22	.130
12	3	12	X		.602	-	-	-	1.14	1	.5	2.64	4.20
13	3	31		X	5.8	-	-	-	-	1	.5	1.5	.220
14	3	37	X		13.7	-	-	← Modeled as an orifice →					.460
15	4	5		X	32.6	-	-	-	.081	1	-	1.081	.210
16	4	12	X		.402	-	-	-	.72	1	.5	2.22	9.52
17	4	13	X		1.86	3.5	1.55	.02	-	1	.5	1.52	3.33
18	4	32		X	7.56	-	-	-	-	1	.5	1.5	.340

(-) Means this value is negligible.

Table 6.2.1-14

REACTOR CAVITY VENT PATH DESCRIPTION (Sheet 2 of 12)

A. 100 in^2 Hot Leg Guillotine Break
Break location: volume numbers 2 and 3

Vent Path Number	Vol. Node Number		Description of Vent Path Flow		Vent Area (ft^2)	Friction Factors		Head Loss, K					L/A (ft^{-1})
	From	To	Choked	Unchoked		Length (ft)	Hydraulic Diameter (ft)	Friction K, fl/d	Turning and Obstruction Loss, K	Expansion, K	Contraction, K	Total K_t	
19	4	37	X		11.3	-	-	← Modeled as an orifice →					.540
20	10	5		X	32.6	-	-	-	.081	1	-	1.081	.210
21	5	14		X	.402	-	-	-	.72	1	.5	2.22	1.33
22	5	32		X	7.56	-	-	-	-	1	.5	1.5	.340
23	5	33		X	7.56	-	-	-	-	1	.5	1.5	.340
24	5	37		X	29.0	-	-	← Modeled as an orifice →					.240
25	6	7		X	32.6	-	-	-	.081	1	-	1.081	.210
26	6	15		X	.402	-	-	-	.72	1	.5	2.22	1.33
27	6	35		X	7.56	-	-	-	-	1	.5	1.5	.340
28	6	36		X	7.56	-	-	-	-	1	.5	1.5	.340
29	6	37		X	29.0	-	-	← Modeled as an orifice →					.240
30	7	8		X	34.1	-	-	-	.220	1	-	1.22	.130
31	7	16		X	1.86	3.5	1.55	.02	-	1	.5	1.52	3.33
32	7	17		X	.402	-	-	-	.72	1	.5	2.22	9.52
33	7	36		X	7.56	-	-	-	-	1	.5	1.5	.340
34	7	37		X	11.3	-	-	← Modeled as an orifice →					.540
35	8	9		X	31.2	-	-	-	.093	1	-	1.093	.179
36	8	17		X	.602	-	-	-	1.14	1	.5	2.64	4.20

Table 6.2.1-14

REACTOR CAVITY VENT PATH DESCRIPTION (Sheet 3 of 12)

A. 100 in^2 Hot Leg Guillotine Break
Break location: volume numbers 2 and 3

Vent Path Number	Vol. Node Number		Description of Vent Path Flow		Vent Area (ft^2)	Friction Factors		Head Loss, K					L/A (ft^{-1})
	From	To	Choked	Unchoked		Length (ft)	Hydraulic Diameter (ft)	Friction K, fl/d	Turning and Obstruction Loss, K	Expansion, K	Contraction, K	Total K_t	
37	8	34		X	5.80	-	-	-	-	1	.5	1.5	.619
38	8	37		X	15.3	-	-	←Modeled as an orifice→					.460
39	9	10		X	34.1	-	-	-	.220	1	-	1.22	.130
40	9	17		X	.602	-	-	-	1.14	1	.5	2.64	4.20
41	9	34		X	5.80	-	-	-	-	1	.5	1.5	.220
42	9	37		X	13.7	-	-	←Modeled as an orifice→					.460
43	10	17		X	.402	-	-	-	.72	1	.5	2.22	9.52
44	10	18		X	1.86	3.5	1.55	.02	-	1	.5	1.52	3.33
45	10	33		X	7.56	-	-	-	-	1	.5	1.5	.340
46	10	37		X	11.3	-	-	←Modeled as an orifice→					.540
47	11	12		X	9.10	4	3.98	.02	.42	1	-	1.44	.390
48	11	15		X	37.2	-	-	-	1.72	1	-	2.72	.160
49	11	19		X	2.28	-	-	-	-	1	.38	1.38	1.00
50	11	30		X	1.10	13.64	1.67	.08	.2	1	.5	1.78	6.25
51	12	13		X	9.10	4	3.98	.02	.42	1	-	1.44	.390
52	12	19		X	15.3	-	-	-	-	1	.20	1.20	.359
53	13	14		X	37.2	-	-	-	1.72	1	-	2.72	.160
54	13	19		X	2.28	-	-	-	-	1	.38	1.38	1.00

Table 6.2.1-14

REACTOR CAVITY VENT PATH DESCRIPTION (Sheet 4 of 12)

A. 100 in^2 Hot Leg Guillotine Break
Break location: volume numbers 2 and 3

Vent Path Number	Vol. Node Number From	Vol. Node Number To	Description of Vent Path Flow Choked	Description of Vent Path Flow Unchoked	Vent Area (ft^2)	Friction Factors Length (ft)	Friction Factors Hydraulic Diameter (ft)	Head Loss, K: Friction K, fl/d	Head Loss, K: Turning and Obstruction Loss, K	Head Loss, K: Expansion, K	Head Loss, K: Contraction, K	Head Loss, K: Total K_t	L/A (ft^{-1})
55	13	30		X	1.10	13.64	1.67	.08	.2	1	.5	1.78	6.25
56	14	18		X	37.2	-	-	-	1.72	1	-	2.72	.160
57	14	19		X	4.56	-	-	-	-	1	.42	1.42	.325
58	14	30		X	2.20	13.64	1.67	.08	.2	1	.5	1.78	6.25
59	15	16		X	37.2	-	-	-	1.72	1	-	2.72	.160
60	15	19		X	4.56	-	-	-	-	1	.42	1.42	.325
61	15	30		X	2.20	13.64	1.67	.08	.2	1	.5	1.78	6.25
62	16	17		X	9.10	4	3.98	.02	.42	1	-	1.44	.390
63	16	19		X	2.28	-	-	-	-	1	.38	1.38	1.00
64	16	30		X	1.10	13.64	1.67	.08	.2	1	.5	1.78	6.25
65	17	18		X	9.10	4	3.98	.02	.42	1	-	1.44	.390
66	17	19		X	15.3	-	-	-	-	1	.20	1.20	.359
67	18	19		X	2.28	-	-	-	-	1	.38	1.38	1.00
68	18	30		X	1.10	13.64	1.67	.08	.2	1	.5	1.78	6.25
69	19	20		X	126.7	-	-	← Modeled as an orifice →					.084
70	19	30		X	13.1	5.5	1.67	.05	-	1	.5	1.55	2.52
71	20	21		X	135.1	-	-	← Modeled as an orifice →					.058
72	21	22		X	74.0	-	-	← Modeled as an orifice →					.056

Table 6.2.1-14

REACTOR CAVITY VENT PATH DESCRIPTION (Sheet 5 of 12)

A. 100 in^2 Hot Leg Guillotine Break
Break location: volume numbers 2 and 3

Vent Path Number	Vol. Node Number From	Vol. Node Number To	Description of Vent Path Flow Choked	Description of Vent Path Flow Unchoked	Vent Area (ft^2)	Friction Factors Length (ft)	Friction Factors Hydraulic Diameter (ft)	Head Loss, K: Friction K, fl/d	Head Loss, K: Turning and Obstruction Loss, K	Head Loss, K: Expansion, K	Head Loss, K: Contraction, K	Head Loss, K: Total K_t	L/A (ft^{-1})
73	22	23		X	64.1	-	-	Modeled as an orifice					.068
74	23	24		X	104.6	-	-	Modeled as an orifice					.076
75	24	25		X	68.7	-	-	Modeled as an orifice					.091
76	25	26		X	27.2	-	-	Modeled as an orifice					.110
77	26	27		X	24.7	-	-	Modeled as an orifice					.102
78	27	28		X	36.4	-	-	Modeled as an orifice					.096
79	28	29		X	50.8	-	-	Modeled as an orifice					.062
80	28	37		X	21.0	-	-	Modeled as an orifice					.110
81	30	37		X	15.1	82.8	4	.21	-	1	.5	1.71	6.57
82	31	37	X		14.9	-	-	-	-	1	-	1	.201
83	32	37		X	18.3	-	-	-	-	1	-	1	.317
84	33	37		X	18.3	-	-	-	-	1	-	1	.317
85	34	37		X	14.9	-	-	-	-	1	-	1	.201
86	35	37		X	18.3	-	-	-	-	1	-	1	.317
87	36	37		X	18.3	-	-	-	-	1	-	1	.317
88	2	12	X		.41	3.5	.17	.21	-	1	.5	1.71	4.20
89	3	12	X		.41	3.5	.17	.21	-	1	.5	1.71	4.20
90	8	17		X	.41	3.5	.17	.21	-	1	.5	1.71	4.20

Table 6.2.1-14

REACTOR CAVITY VENT PATH DESCRIPTION (Sheet 6 of 12)

A. 100 in^2 Hot Leg Guillotine Break
Break location: volume numbers 2 and 3

Vent Path Number	Vol. Node Number From	Vol. Node Number To	Description of Vent Path Flow Choked	Description of Vent Path Flow Unchoked	Vent Area (ft^2)	Friction Factors Length (ft)	Friction Factors Hydraulic Diameter (ft)	Head Loss, K Friction K, fl/d	Head Loss, K Turning and Obstruction Loss, K	Head Loss, K Expansion, K	Head Loss, K Contraction, K	Head Loss, K Total K_t	L/A (ft^{-1})
91	9	17		X	.41	3.5	.17	.21	-	1	.5	1.71	4.20
92	5	14		X	3.79	3.5	.65	.05	-	1	.5	1.55	1.33
93	6	15		X	3.79	3.5	.65	.05	-	1	.5	1.55	1.33

Table 6.2.1-14

REACTOR CAVITY VENT PATH DESCRIPTION (Sheet 7 of 12)

B. 350 in^2 Cold Leg Guillotine Break
Break location: volume numbers 1 and 6

Vent Path Number	Vol. Node Number		Description of Vent Path Flow		Vent Area (ft^2)	Friction Factors		Head Loss, K					L/A (ft^{-1})
	From	To	Choked	Unchoked		Length (ft)	Hydraulic Diameter (ft)	Friction K, fl/d	Turning and Obstruction Loss, K	Expansion, K	Contraction, K	Total K_t	
1	1	6		X	32.6	-	-	-	.081	1	-	1.081	.210
2	1	11	X		1.86	3.5	1.55	.02	-	1	.5	1.52	3.33
3	1	12	X		.402	-	-	-	.72	1	.5	2.22	9.52
4	1	35	X		7.56	-	-	-	-	1	.5	1.5	.340
5	1	37	X		11.3	-	-	Modeled as an orifice					.540
6	2	1		X	17.2	-	-	-	.220	1	-	1.22	.130
7	2	3	X		31.2	-	-	-	.093	1	-	1.093	.179
8	2	12	X		.602	-	-	-	1.14	1	.5	2.64	4.20
9	2	31	X		5.8	-	-	-	-	1	.5	1.5	.220
10	2	37	X		13.7	-	-	Modeled as an orifice					.460
11	3	4		X	34.1	-	-	-	.220	1	-	1.22	.130
12	3	12	X		.602	-	-	-	1.14	1	.5	2.64	4.20
13	3	31		X	5.8	-	-	-	-	1	.5	1.5	.220
14	3	37	X		13.7	-	-	Modeled as an orifice					.460
15	4	5		X	32.6	-	-	-	.081	1	-	1.081	.210
16	4	12		X	.402	-	-	-	.72	1	.5	2.22	9.52
17	4	13		X	1.86	3.5	1.55	.02	-	1	.5	1.52	3.33
18	4	32		X	7.56	-	-	-	-	1	.5	1.5	.340

Table 6.2.1-14

REACTOR CAVITY VENT PATH DESCRIPTION (Sheet 8 of 12)

B. 350 in^2 Cold Leg Guillotine Break
Break location: volume numbers 1 and 6

Vent Path Number	Vol. Node Number		Description of Vent Path Flow		Vent Area (ft^2)	Friction Factors		Head Loss, K					L/A (ft^{-1})
	From	To	Choked	Unchoked		Length (ft)	Hydraulic Diameter (ft)	Friction K, fl/d	Turning and Obstruction Loss, K	Expansion, K	Contraction, K	Total K_t	
19	4	37	X		11.3	-	-	← Modeled as an orifice →					.540
20	10	5		X	32.6	-	-	-	.081	1	-	1.081	.210
21	5	14		X	.402	-	-	-	.72	1	.5	2.22	1.33
22	5	32		X	7.56	-	-	-	-	1	.5	1.5	.340
23	5	33		X	7.56	-	-	-	-	1	.5	1.5	.340
24	5	37		X	29.0	-	-	← Modeled as an orifice →					.240
25	6	7	X		32.6	-	-	-	.081	1	-	1.081	.210
26	6	15	X		.402	-	-	-	.72	1	.5	2.22	1.33
27	6	35	X		7.56	-	-	-	-	1	.5	1.5	.340
28	6	36	X		7.56	-	-	-	-	1	.5	1.5	.340
29	6	37	X		29.0	-	-	← Modeled as an orifice →					.240
30	7	8	X		34.1	-	-	-	.220	1	-	1.22	.130
31	7	16	X		1.86	3.5	1.55	.02	-	1	.5	1.52	3.33
32	7	17	X		.402	-	-	-	.72	1	.5	2.22	9.52
33	7	36		X	7.56	-	-	-	-	1	.5	1.5	.340
34	7	37	X		11.3	-	-	← Modeled as an orifice →					.540
35	8	9		X	31.2	-	-	-	.093	1	-	1.093	.179
36	8	17	X		.602	-	-	-	1.14	1	.5	2.64	4.20

Table 6.2.1-14

REACTOR CAVITY VENT PATH DESCRIPTION (Sheet 9 of 12)

B. 350 in^2 Cold Leg Guillotine Break
Break location: volume numbers 1 and 6

Vent Path Number	Vol. Node Number From	Vol. Node Number To	Description of Vent Path Flow Choked	Description of Vent Path Flow Unchoked	Vent Area (ft^2)	Friction Factors Length (ft)	Friction Factors Hydraulic Diameter (ft)	Head Loss, K Friction K, fl/d	Head Loss, K Turning and Obstruction Loss, K	Head Loss, K Expansion, K	Head Loss, K Contraction, K	Head Loss, K Total K_t	L/A (ft^{-1})
37	8	34	X		5.80	-	-	-	-	1	.5	1.5	.619
38	8	37	X		15.3	-	-	Modeled as an orifice					.460
39	9	10		X	34.1	-	-	-	.220	1	-	1.22	.130
40	9	17		X	.602	-	-	-	1.14	1	.5	2.64	4.20
41	9	34		X	5.80	-	-	-	-	1	.5	1.5	.220
42	9	37	X		13.7	-	-	Modeled as an orifice					.460
43	10	17		X	.402	-	-	-	.72	1	.5	2.22	9.52
44	10	18		X	1.86	3.5	1.55	.02	-	1	.5	1.52	3.33
45	10	33		X	7.56	-	-	-	-	1	.5	1.5	.340
46	10	37		X	11.3	-	-	Modeled as an orifice					.540
47	11	12		X	9.10	4	3.98	.02	.42	1	-	1.44	.390
48	11	15		X	37.2	-	-	-	1.72	1	-	2.72	.160
49	11	19		X	2.28	-	-	-	-	1	.38	1.38	1.00
50	11	30		X	1.10	13.64	1.67	.08	.2	1	.5	1.78	6.25
51	12	13		X	9.10	4	3.98	.02	.42	1	-	1.44	.390
52	12	19		X	15.3	-	-	-	-	1	.20	1.20	.359
53	13	14		X	37.2	-	-	-	1.72	1	-	2.72	.160
54	13	19		X	2.28	-	-	-	-	1	.38	1.38	1.00

Table 6.2.1-14

REACTOR CAVITY VENT PATH DESCRIPTION (Sheet 10 of 12)

B. 350 in^2 Cold Leg Guillotine Break
Break location: volume numbers 1 and 6

Vent Path Number	Vol. Node Number From	Vol. Node Number To	Description of Vent Path Flow Choked	Description of Vent Path Flow Unchoked	Vent Area (ft^2)	Friction Factors Length (ft)	Friction Factors Hydraulic Diameter (ft)	Head Loss, K Friction K, fl/d	Head Loss, K Turning and Obstruction Loss, K	Head Loss, K Expansion, K	Head Loss, K Contraction, K	Head Loss, K Total K_t	L/A (ft^{-1})
55	13	30		X	1.10	13.64	1.67	.08	.2	1	.5	1.78	6.25
56	14	18		X	37.2	-	-	-	1.72	1	-	2.72	.160
57	14	19		X	4.56	-	-	-	-	1	.42	1.42	.325
58	14	30		X	2.20	13.64	1.67	.08	.2	1	.5	1.78	6.25
59	15	16		X	37.2	-	-	-	1.72	1	-	2.72	.160
60	15	19		X	4.56	-	-	-	-	1	.42	1.42	.325
61	15	30		X	2.20	13.64	1.67	.08	.2	1	.5	1.78	6.25
62	16	17		X	9.10	4	3.98	.02	.42	1	-	1.44	.390
63	16	19		X	2.28	-	-	-	-	1	.38	1.38	1.00
64	16	30		X	1.10	13.64	1.67	.08	.2	1	.5	1.78	6.25
65	17	18		X	9.10	4	3.98	.02	.42	1	-	1.44	.390
66	17	19		X	15.3	-	-	-	-	1	.20	1.20	.359
67	18	19		X	2.28	-	-	-	-	1	.38	1.38	1.00
68	18	30		X	1.10	13.64	1.67	.08	.2	1	.5	1.78	6.25
69	19	20		X	126.7	-	-	← Modeled as an orifice →					.084
70	19	30		X	13.1	5.5	1.67	.05	-	1	.5	1.55	2.52
71	20	21		X	135.1	-	-	← Modeled as an orifice →					.058
72	21	22		X	74.0	-	-	← Modeled as an orifice →					.056

Table 6.2.1-14

REACTOR CAVITY VENT PATH DESCRIPTION (Sheet 11 of 12)

B. 350 in^2 Cold Leg Guillotine Break
Break location: volume numbers 1 and 6

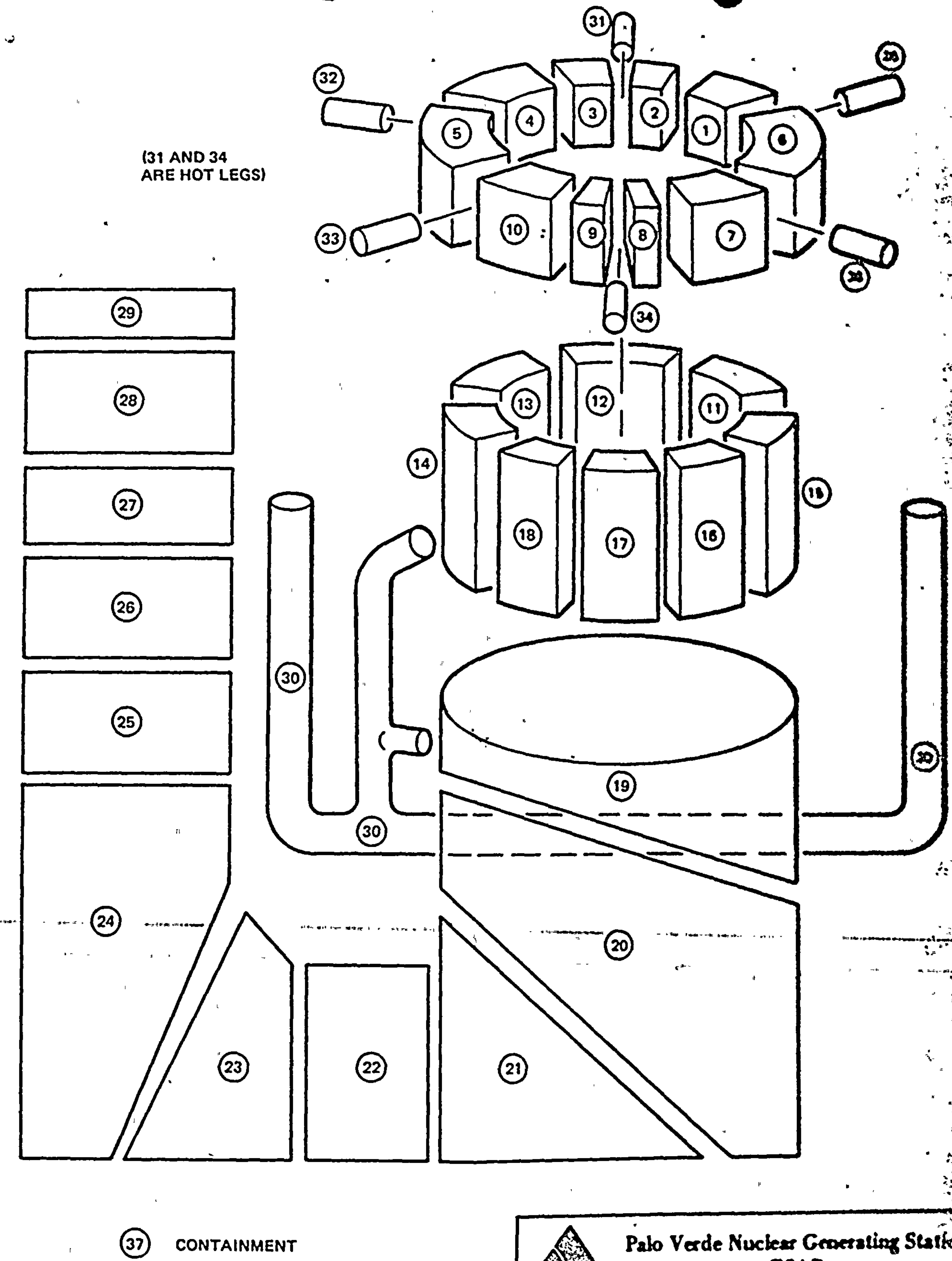
Vent Path Number	Vol. Node Number From	Vol. Node Number To	Description of Vent Path Flow Choked	Description of Vent Path Flow Unchoked	Vent Area (ft^2)	Friction Factors Length (ft)	Friction Factors Hydraulic Diameter (ft)	Head Loss, K Friction K, fl/d	Head Loss, K Turning and Obstruction Loss, K	Head Loss, K Expansion, K	Head Loss, K Contraction, K	Head Loss, K Total K_t	L/A (ft^{-1})
73	22	23		X	64.1	-	-	← Modeled as an orifice →					.068
74	23	24		X	104.6	-	-	← Modeled as an orifice →					.076
75	24	25		X	68.7	-	-	← Modeled as an orifice →					.091
76	25	26		X	27.2	-	-	← Modeled as an orifice →					.110
77	26	27		X	24.7	-	-	← Modeled as an orifice →					.102
78	27	28		X	36.4	-	-	← Modeled as an orifice →					.096
79	28	29		X	50.8	-	-	← Modeled as an orifice →					.062
80	28	37		X	21.0	-	-	← Modeled as an orifice →					.110
81	30	37		X	15.1	82.8	4	.21	-	1	.5	1.71	6.57
82	31	37	X		14.9	-	-	-	-	1	-	1	.201
83	32	37		X	18.3	-	-	-	-	1	-	1	.317
84	33	37		X	18.3	-	-	-	-	1	-	1	.317
85	34	37		X	14.9	-	-	-	-	1	-	1	.201
86	35	37	X		18.3	-	-	-	-	1	-	1	.317
87	36	37	X		18.3	-	-	-	-	1	-	1	.317
88	2	12	X		.41	3.5	.17	.21	-	1	.5	1.71	4.20
89	3	12	X		.41	3.5	.17	.21	-	1	.5	1.71	4.20
90	8	17	X		.41	3.5	.17	.21	-	1	.5	1.71	4.20

Table 6.2.1-14

REACTOR CAVITY VENT PATH DESCRIPTION (Sheet 12 of 12)

B. 350 in^2 Cold Leg Guillotine Break
Break location: volume numbers 1 and 6

Vent Path Number	Vol. Node Number		Description of Vent Path Flow		Vent Area (ft^2)	Friction Factors		Head Loss, K					L/A (ft^{-1})
	From	To	Choked	Unchoked		Length (ft)	Hydraulic Diameter (ft)	Friction K, fl/d	Turning and Obstruction Loss, K	Expansion, K	Contraction, K	Total K_t	
91	9	17		X	.41	3.5	.17	.21	-	1	.5	1.71	4.20
92	5	14		X	3.79	3.5	.65	.05	-	1	.5	1.55	1.33
93	6	15	X		3.79	3.5	.65	.05	-	1	.5	1.55	1.33



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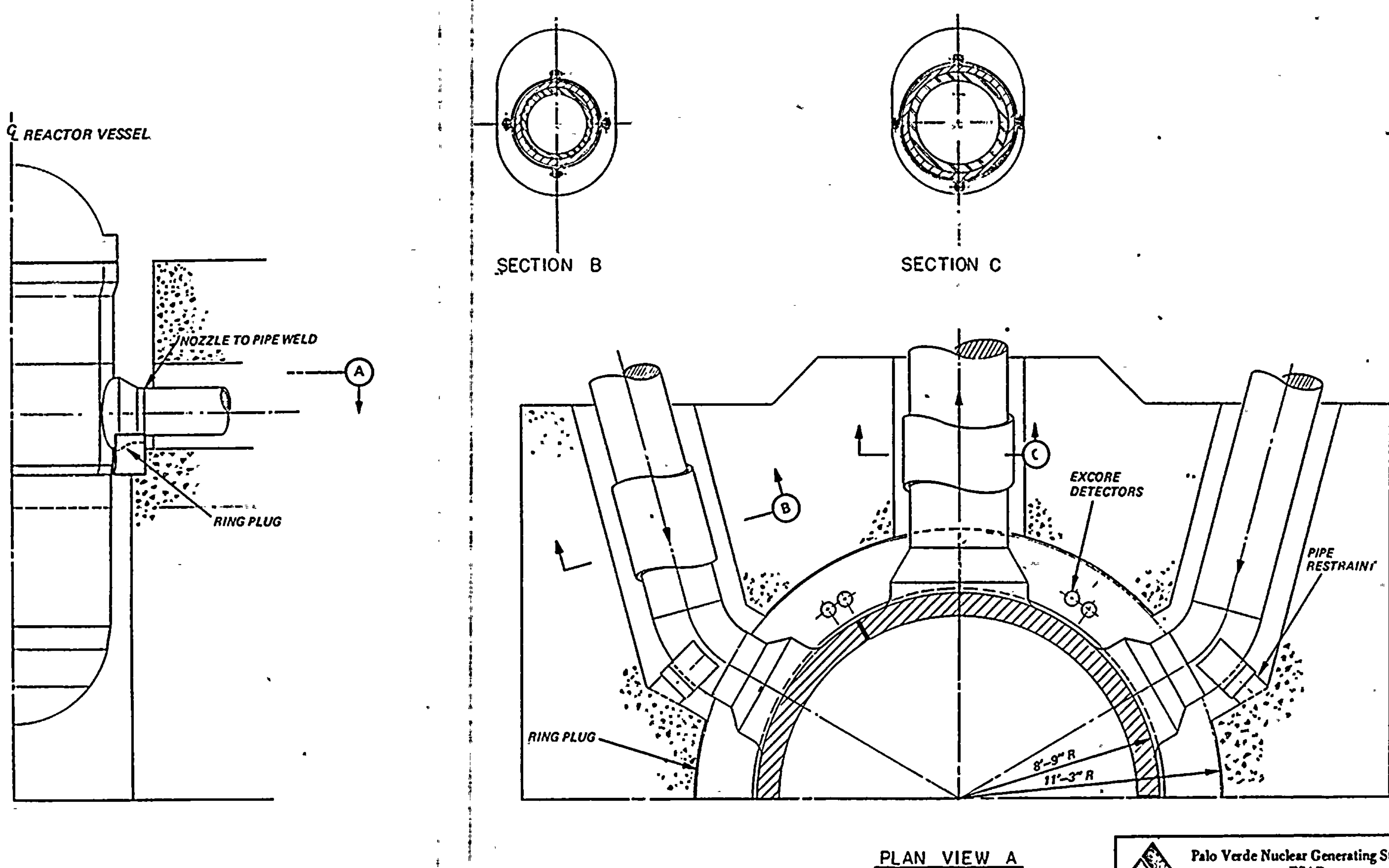
REACTOR CAVITY NODALIZATION

Figure 6.2.1-13



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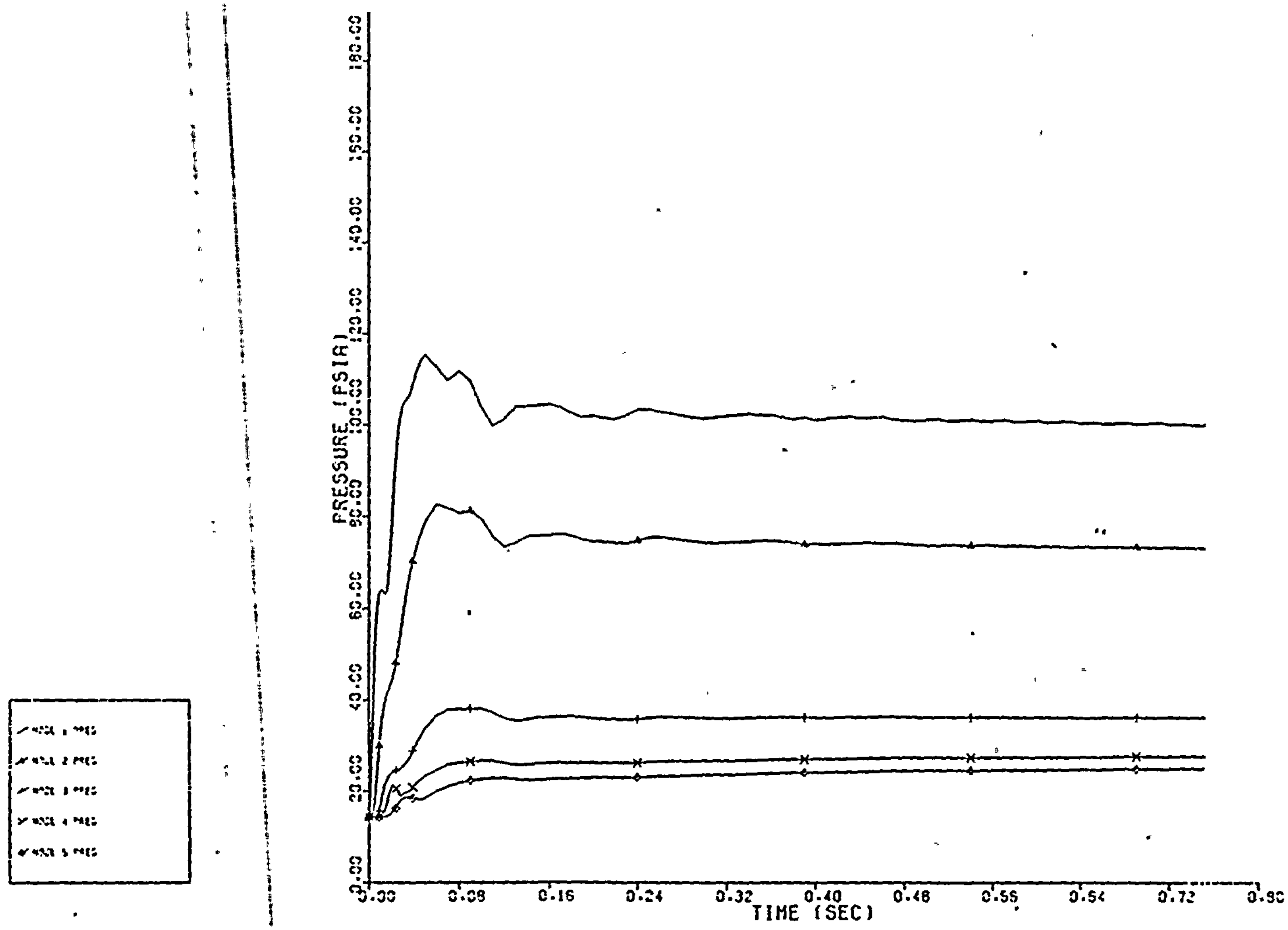
REACTOR CAVITY FLOW NETWORK

Figure 6.2.1-14



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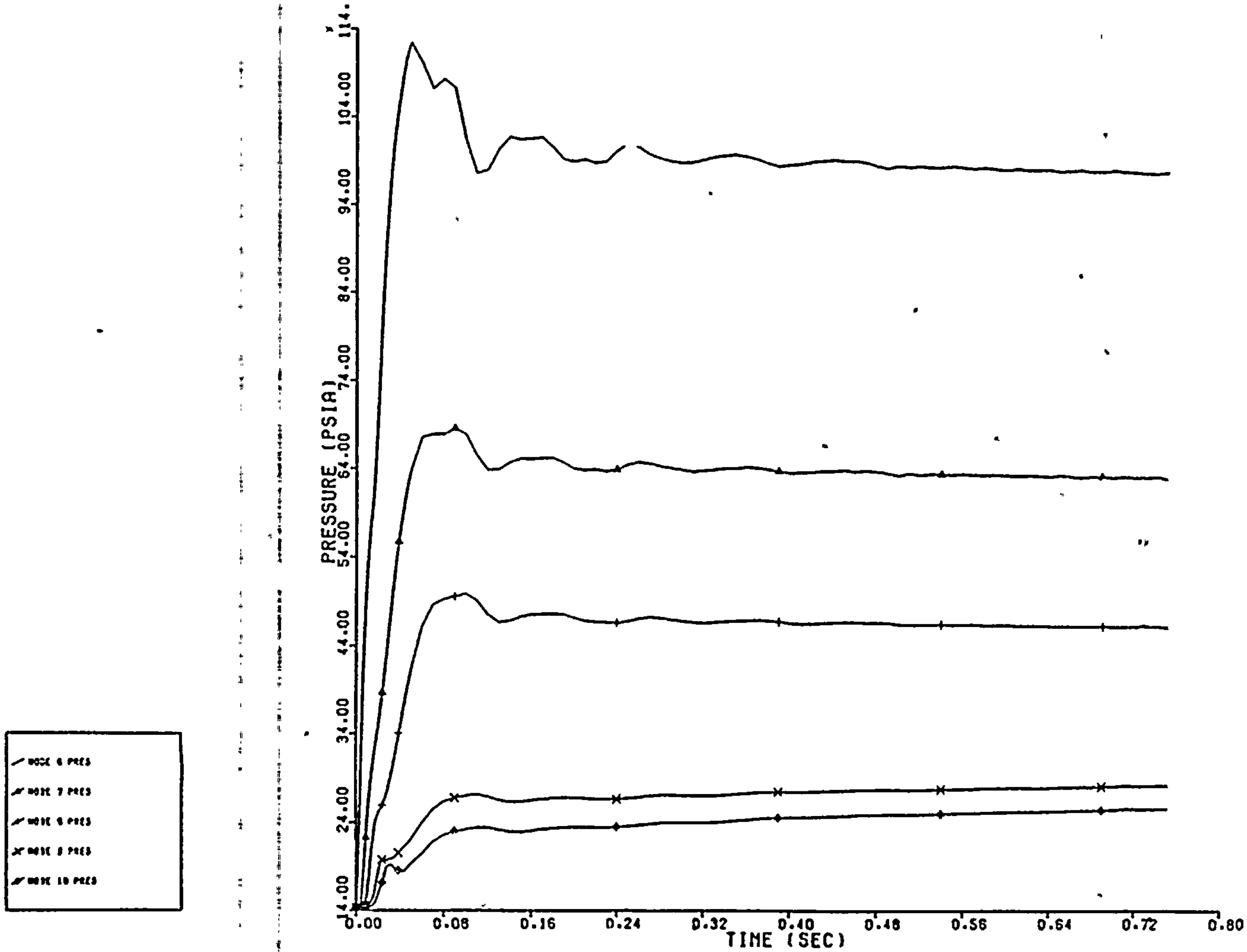
REACTOR CAVITY MODEL, 37 NODES
PRESSURE VS. TIME CURVES
FOR 350 IN^2 COLD LEG BREAK
(Sheet 1 of 7)
Figure 6.2.1-17



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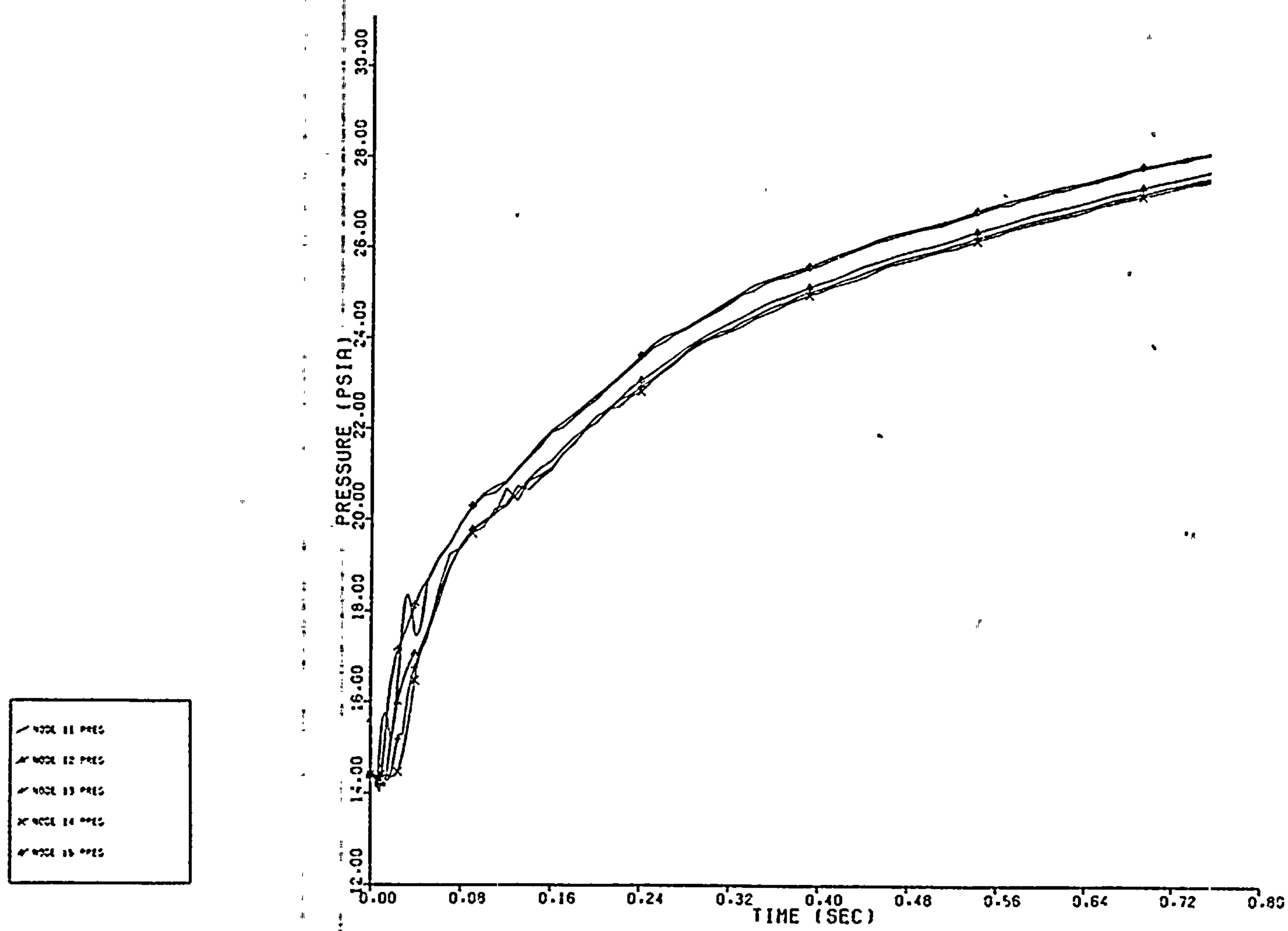
REACTOR CAVITY MODEL, 37 NODES
PRESSURE VS. TIME CURVES
FOR 350 IN^2 COLD LEG BREAK
(Sheet 2 of 7)
Figure 6.2.1-17



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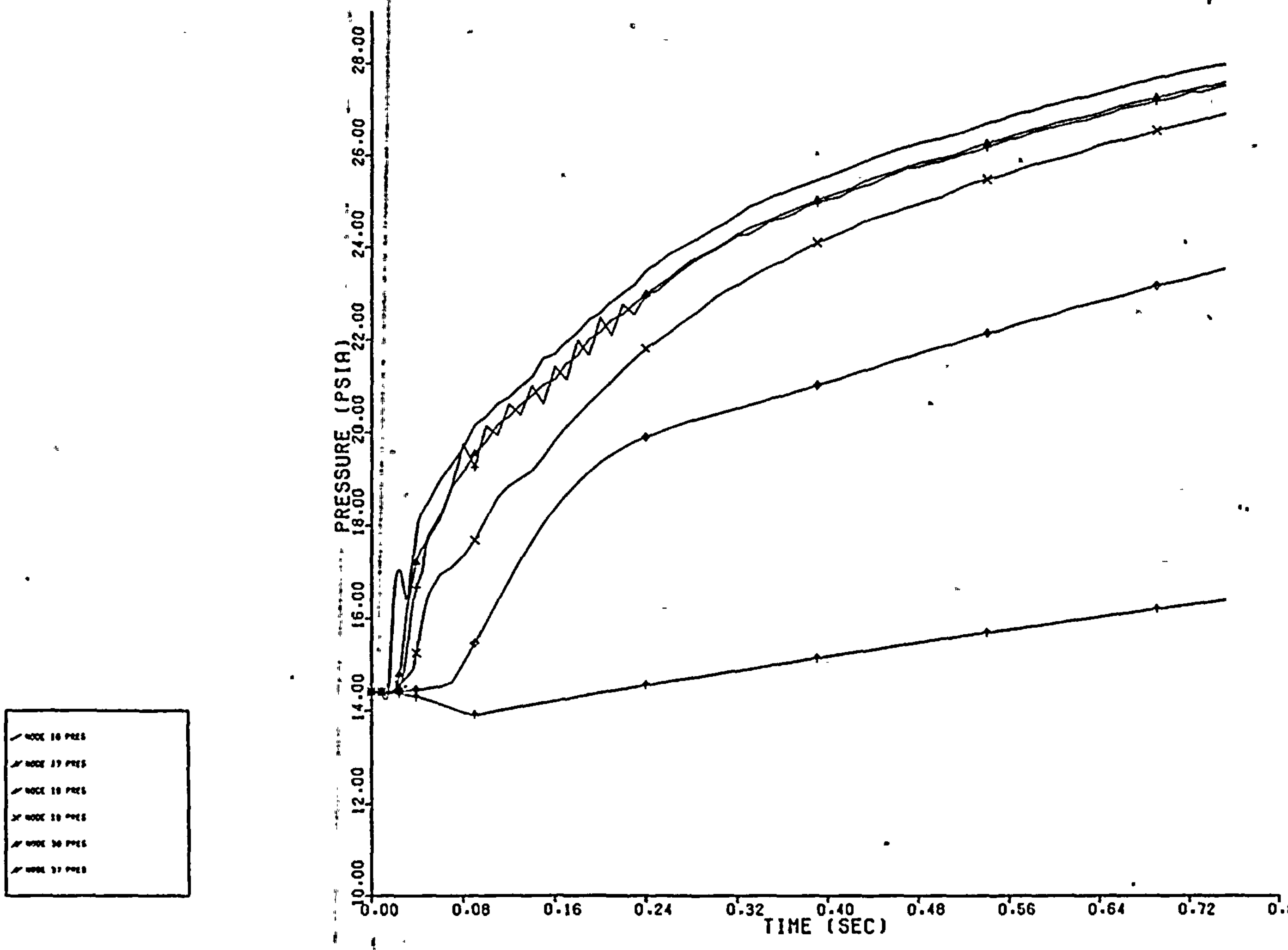
REACTOR CAVITY MODEL, 37 NODES
PRESSURE VS. TIME CURVES
FOR 350 IN^2 COLD LEG BREAK
(Sheet 3 of 7)
Figure 6.2.1-17



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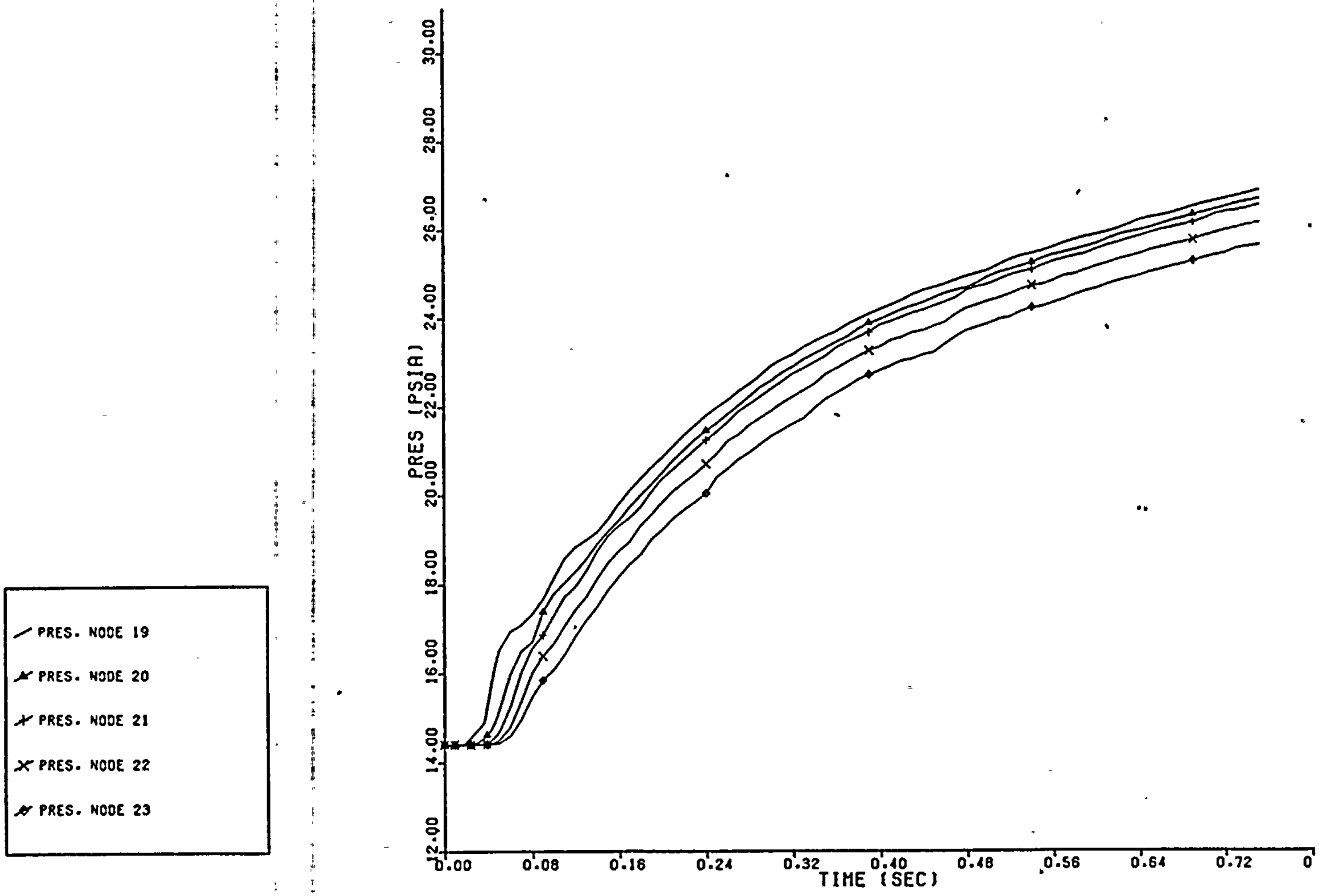
REACTOR CAVITY MODEL, 37 NODES
PRESSURE VS. TIME CURVES
FOR 350 IN^2 COLD LEG BREAK
(Sheet 4 of 7)
Figure 6.2.1-17



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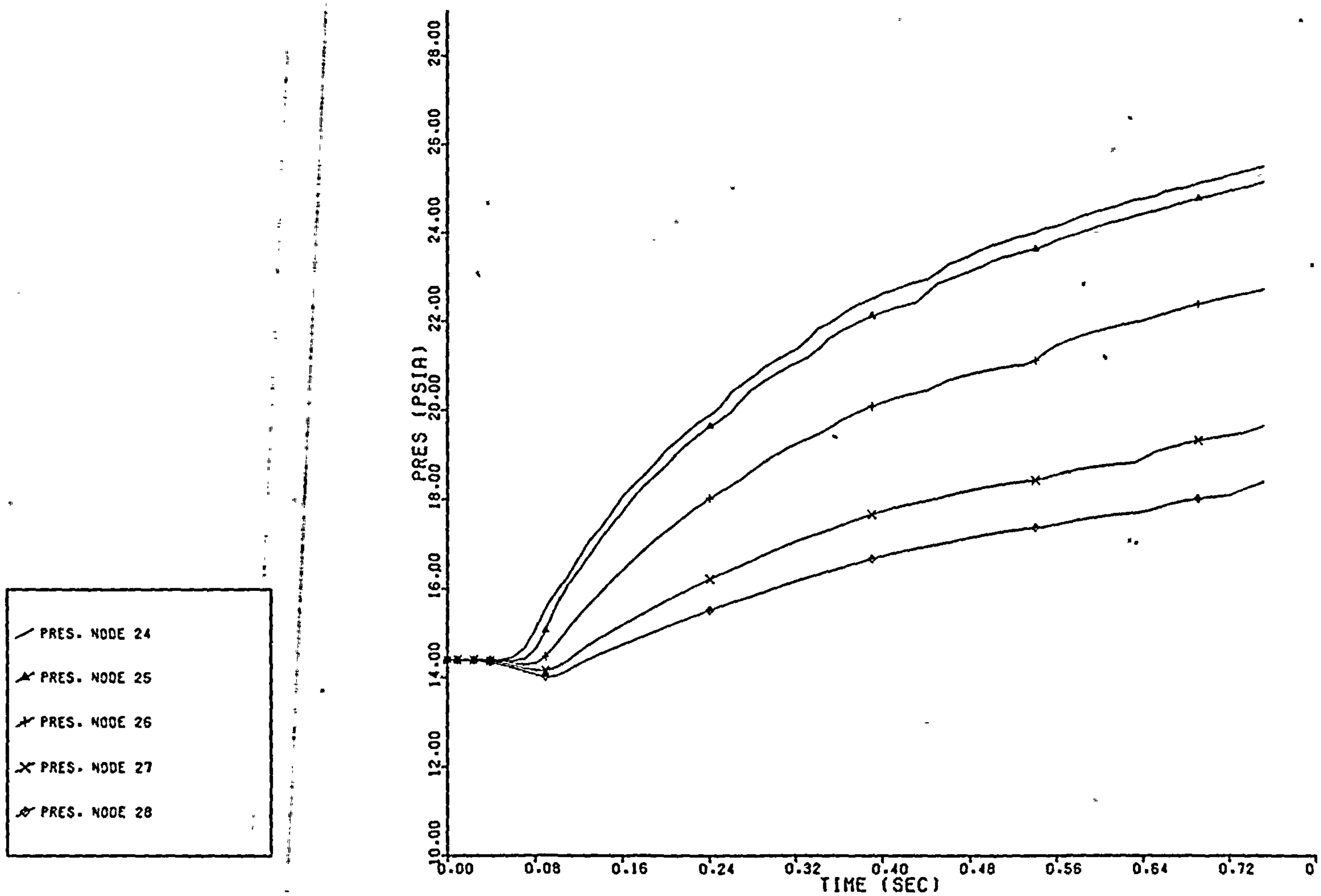
REACTOR CAVITY MODEL, 37 NODES
PRESSURE VS. TIME CURVES
FOR 350 IN^2 COLD LEG BREAK
(Sheet 5 of 7)
Figure 6.2.1-17



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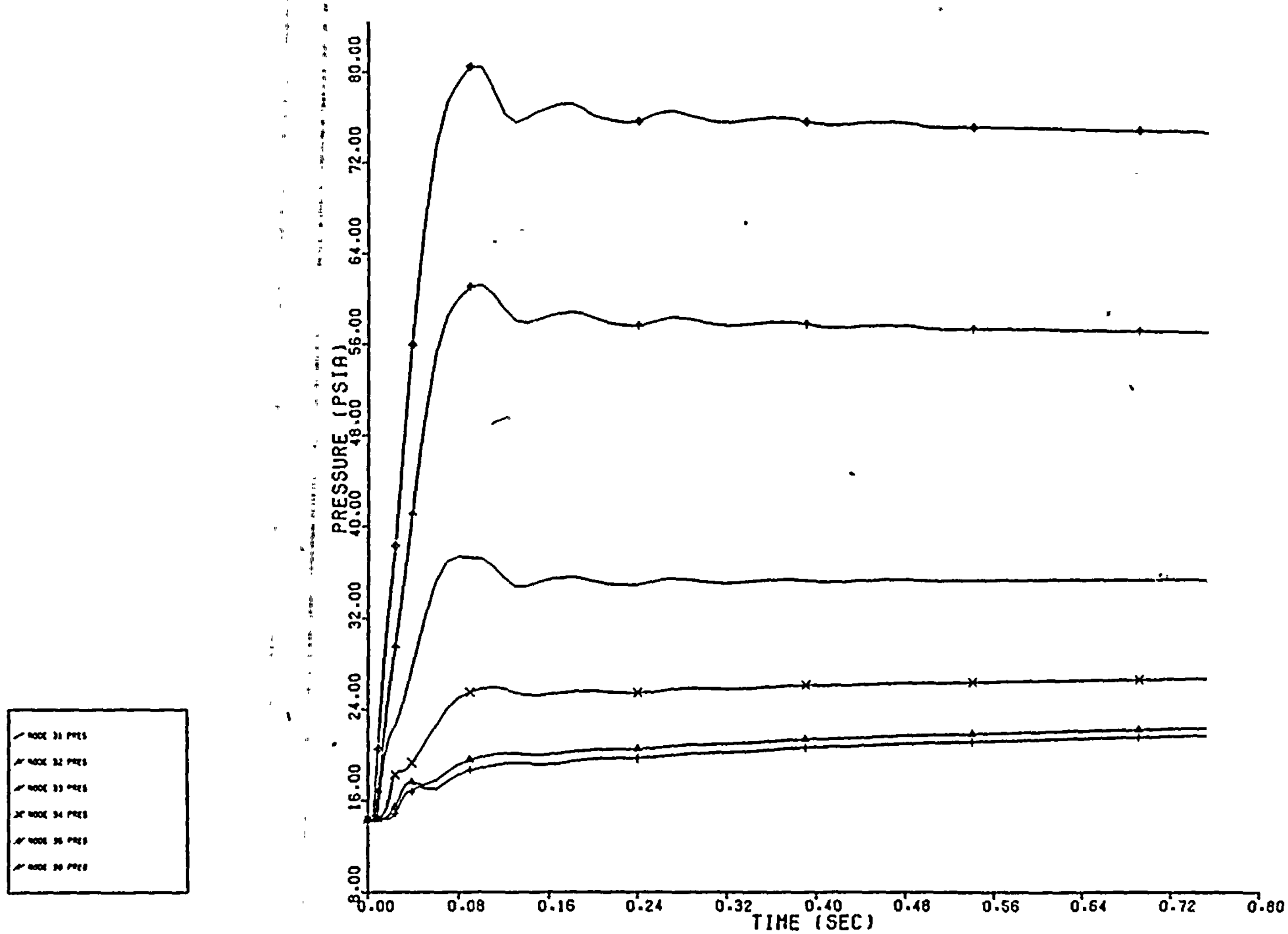
REACTOR CAVITY MODEL, 37 NODES
PRESSURE VS. TIME CURVES
FOR 350 IN^2 COLD LEG BREAK
(Sheet 6 of 7)
Figure 6.2.1-17



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REACTOR CAVITY MODEL, 37 NODES
PRESSURE VS. TIME CURVES
FOR 350 IN^2 COLD LEG BREAK
(Sheet 7 of 7)
Figure 6.2.1-17