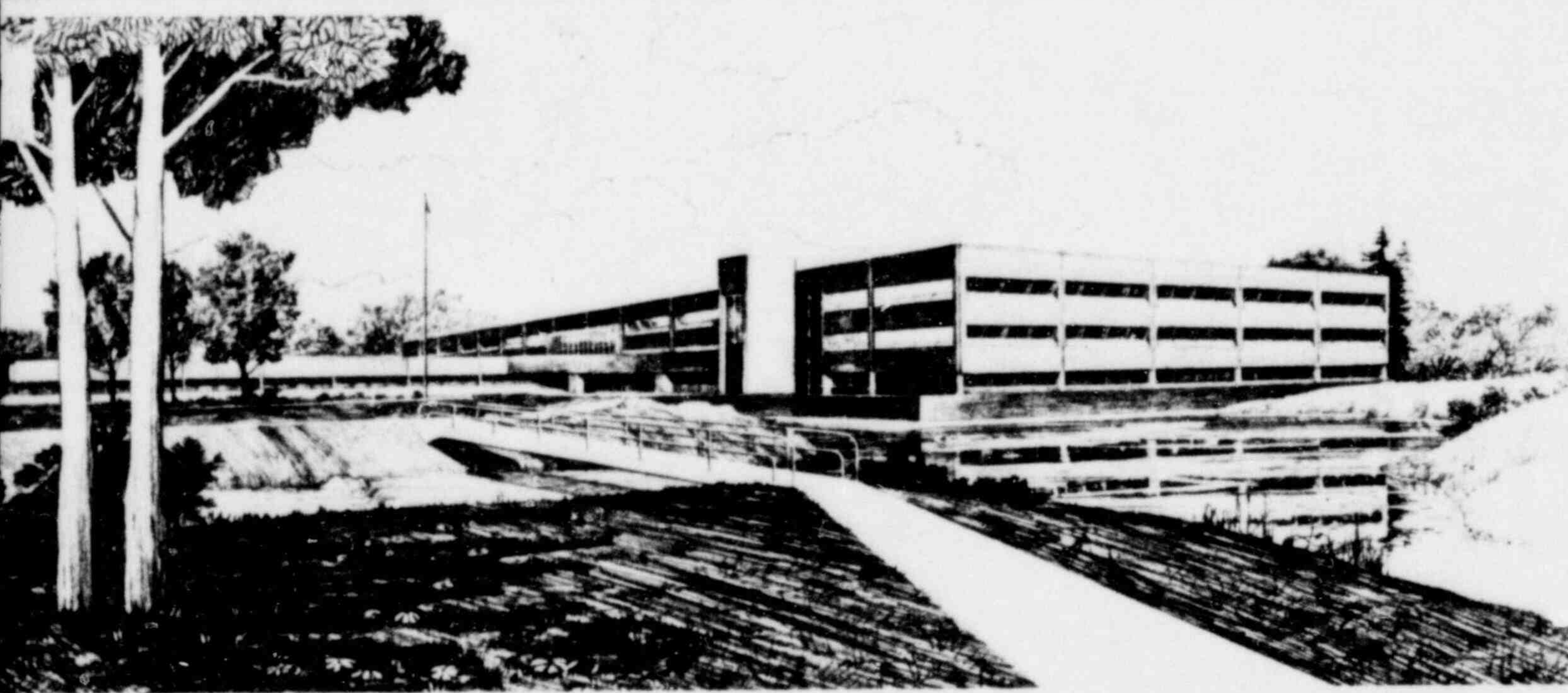
EGG-LOFT-5199

July 1980

BASE INPUT FOR LOFT RELAP5 CALCULATIONS

E. J. Kee
P. J. Schally
L. Winters

U.S. Department of Energy
Idaho Operations Office • Idaho National Engineering Laboratory



This is an informal report intended for use as a preliminary or working document

Prepared for the
U.S. Nuclear Regulatory Commission
Under DOE Contract No. DE-AC07-76ID01570
FIN No. A6048

EG&G Idaho

EG&G Idaho, Inc

FORM EG&G-398
(Rev 11-79)

INTERIM REPORT

Accession No. ______________

Report No. EGG-LOFT-5199

Contract Program or Project Title:

LOFT Program Division

Subject of this Document:

LOFT Input Data Deck for RELAP5

Type of Document:

RELAP5 Computer Code Input Deck Documentation

Author(s):

E. J. Kee
P. J. Schally
L. Winters

Date of Document:

July 1980

Responsible NRC Individual and NRC Office or Division:

G. D. McPherson, Chief, LOFT Research Branch, Division of Reactor Safety Research, USNRC

This document was prepared primarily for preliminary or internal use. It has not received full review and approval. Since there may be substantive changes, this document should not be considered final.

EG&G Idaho, Inc.
Idaho Falls, Idaho 83415

Prepared for the
U.S. Nuclear Regulatory Commission
Washington, D.C.
Under DOE Contract No. DE-AC07-76ID01570
NRC FIN No. A6048

INTERIM REPORT

ABSTRACT

This report describes the input data set, based on the latest information of the LOFT system, to be used with the RELAP5/MOD0 digital computer code. The data set is for simulations of the transient thermal hydraulic behavior occurring in the primary and secondary coolant systems and relaxed subsystems such as the pressurizer and ECC when the LOFT integral test facility undergoes a LOCE or operational transient. Data are included for the intact loop, reactor vessel, broken loop, pressurizer, steam generator secondary, and ECC system.

CONTENTS

FIGURES

TABLES

LIST OF ACRONYMS

BLCL	Broken Loop Cold Leg
BLHL	Broken Loop Hot Leg
BWST	Borated-Water Storage Tank
C-STEEL	Carbon Steel
CYL	Cylindrical
ECC	Emergency Core Cooling
HPIS	High-Pressure Injection System
ILCL	Intact Loop Cold Leg
ILHL	Intact Loop Hot Leg
LOCA	Loss of Coolant Accident
LOFT	Loss of Fluid Test
LPIS	Low-Pressure Injection System
LPWR	Light Pressurized Water Reactor
PCP	Primary Coolant Pump
PCS	Primary Coolant System
QOBV	Quick-Opening Blowdown Valve
RABS	Reflood Assist Bypass System
RV	Reactor Vessel
SCV	Steam-Control Valve
SG	Steam Generators
S-STEEL	Stainless Steel
UO2	Uranium Dioxide
ZR	Zirconium

1. INTRODUCTION

The LOFT Program requires thermal-hydraulic calculations for use in test planning, instrument ranging, test evaluation, safety analysis, and experimental predictions of the LOFT integral test facility. These calculations are performed using computer codes which require sufficient input data to describe the geometric details of the facility.

This document describes the baseline input data set for the LOFT facility to be used in the RELAP5 computer code. These data are suitable, with minor modifications, for simulation of a wide variety of transients, such as large breaks, small breaks, and operational transients. All future RELAP5 input decks for LOFT will be derived from this baseline deck.

The input data set is based on the latest information of the LOFT System. The input data for the intact and broken loop were taken from P. D. Bayless (Reference 1). The reactor vessel input data are based mainly on Bayless and D. L. Reeder (References 1 and 2). Input data for the steam generator secondary side and ECC system were obtained directly from drawings and from Reeder (Reference 2). Pressurizer data were obtained from Reeder (Reference 2). All variables in the input data are in metric units. Sections 1.1 and 1.2 of this introduction provide a brief description of the LOFT facility and the RELAP5 computer code.

1.1 LOFT Facility Description

The intent of the facility is to model the nuclear, thermal-hydraulic phenomena which would hypothetically take place in a LPWR during a LOCA. The general philosophy in scaling coolant volumes and flow areas in LOFT was to use the ratio of the LOFT core 50 MW(t) to a LPWR core 3000 MW(t). For some components, this factor cannot be applied; however, it is used as extensively as practical. In general, components used in LOFT are similar in design to those of a LPWR.

For hydrodynamic calculations, the system can be thought of as a collection of fluid volumes bounded by the pressure boundaries (pipe walls, vessel walls, valves, etc.), and of regions where significant fluid-flow area changes occur (vessel-to-piping contractions, orifices, etc.).

Only major heat conductors of the system are considered in thermal calculations: where large amounts of stored or generated thermal energy (vessel walls, core) or major heat exchangers (steam generator) can release their energy to or between hydrodynamic volumes.

The LOFT facility is described in detail by Bayless (Reference 1). Figures 1 through 7 show the LOFT system. Figures 1 and 2 show the primary coolant system (PCS). Figures 3 through 5 show cutaways of the large vessels in the system. Figure 6 shows the secondary coolant system. Figure 7 shows the ECC system.

1.2 RELAP5 Computer Code Description

RELAP5 is a digital computer program developed to describe the behavior of water-cooled nuclear reactors subjected to postulated transients, such as loss of coolant from large or small breaks, pump failures, etc. The program calculates hydrodynamics or fluid conditions such as velocities, pressures, densities, qualities, temperatures; thermal conditions such as surface temperatures, temperature distributions, heat fluxes; pump conditions; and trip conditions. In addition to reactor applications, the program can be applied to transient analysis of any thermal-hydraulic system having water as the fluid. RELAP5 uses an advanced hydrodynamic model for two-phase flow, which allows different velocities and different temperatures for the phases. A five equation model is used: two continuity equations, two momentum equations, and one energy equation augmented by one of the phases assumed saturated. Additional models include a choking model, abrupt area change model, mass transfer model, interphase drag, wall friction, and a branching model.

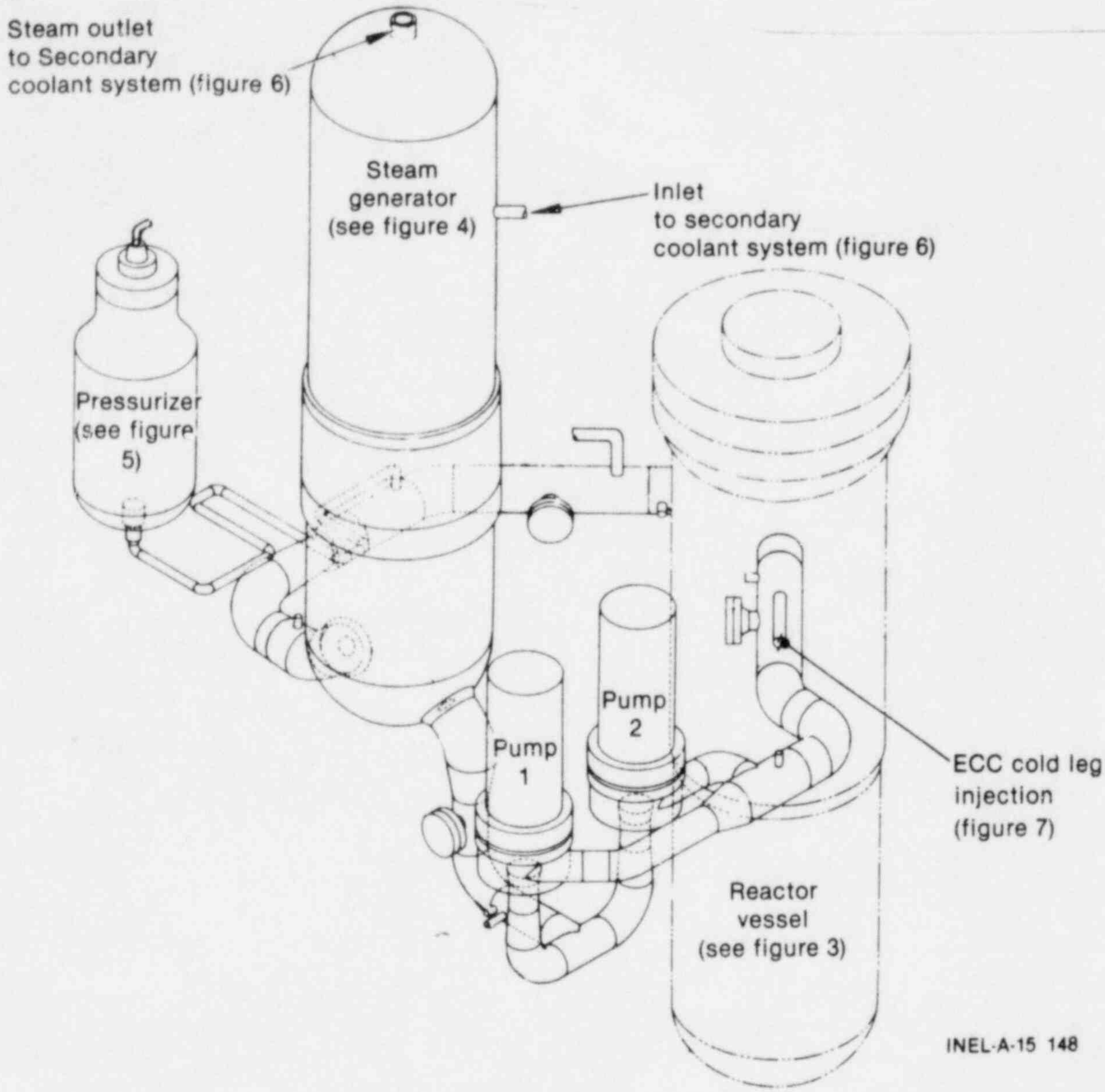


Figure 1. LOFT System--intact loop.

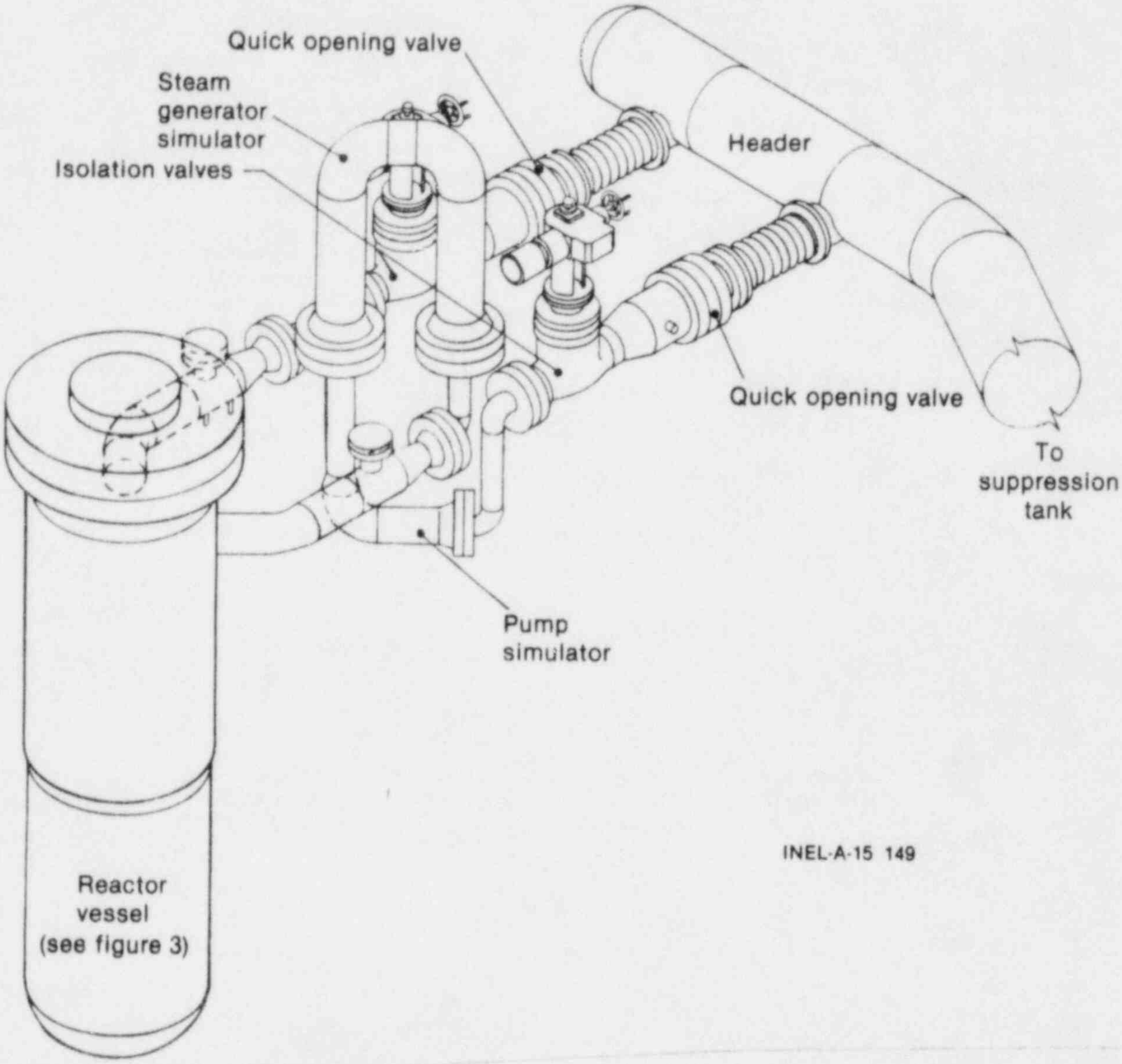


Figure 2. LOFT System--broken loop.

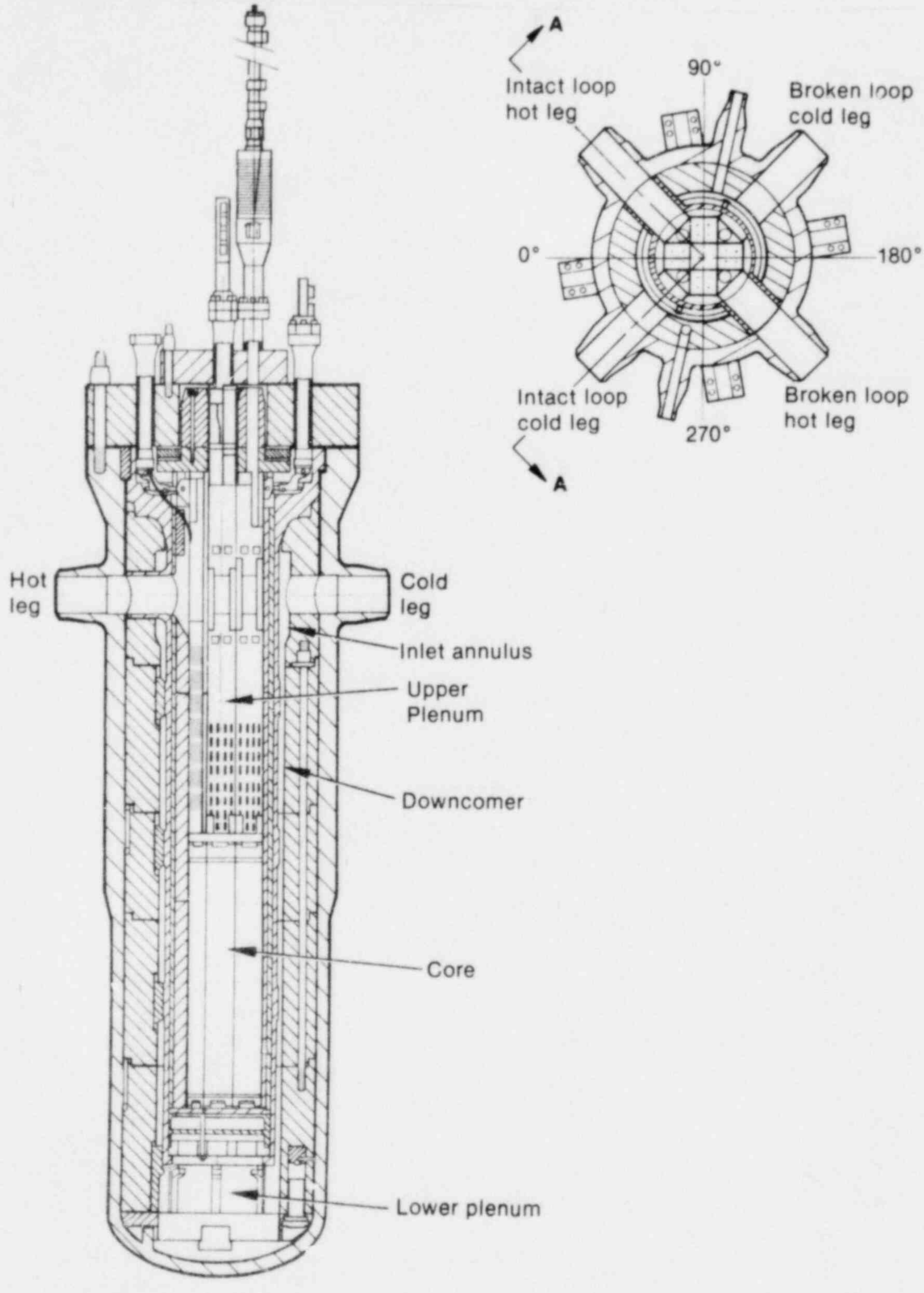


Figure 3. LOFT System--reactor vessel.

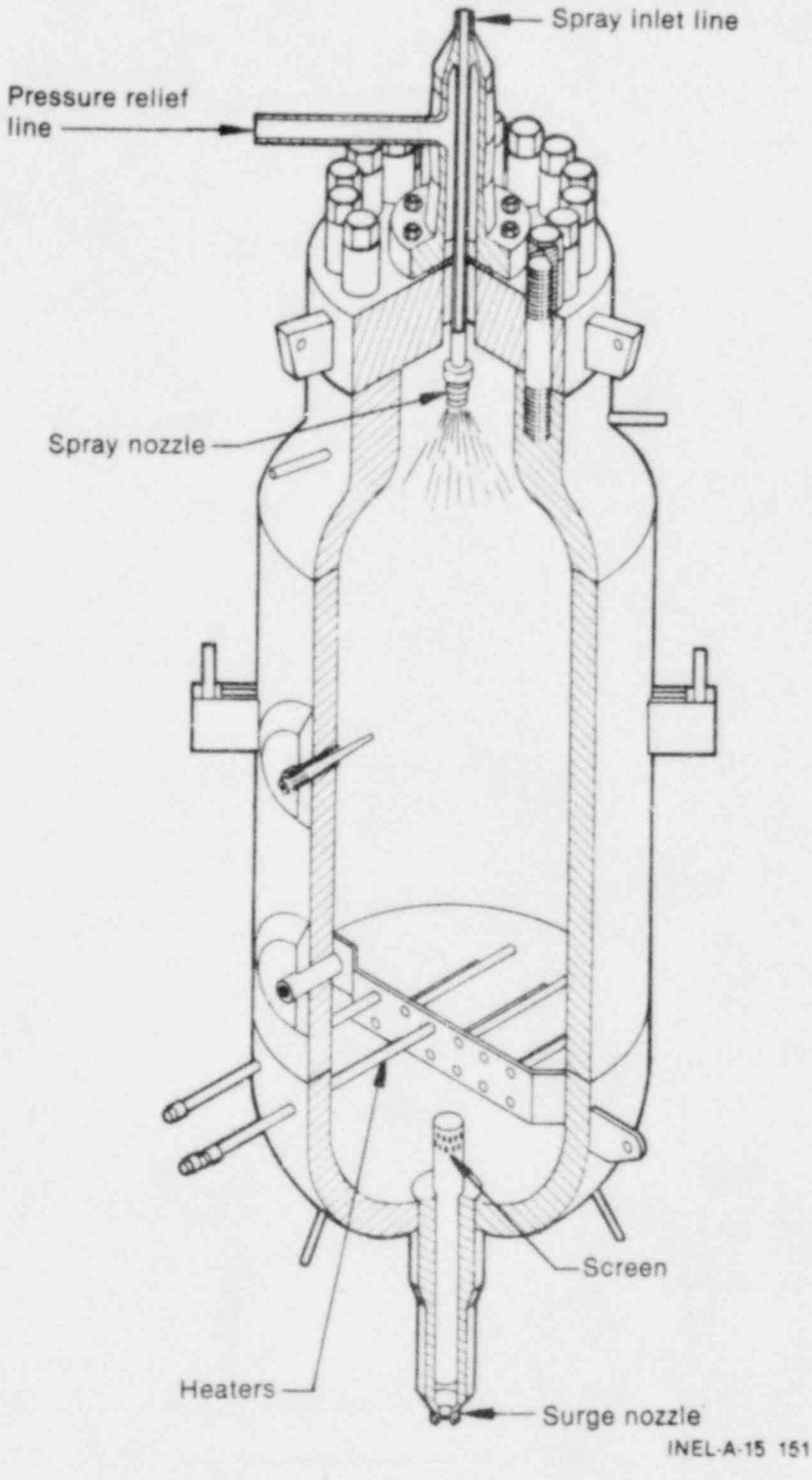


Figure 4. LOFT System--pressurizer.

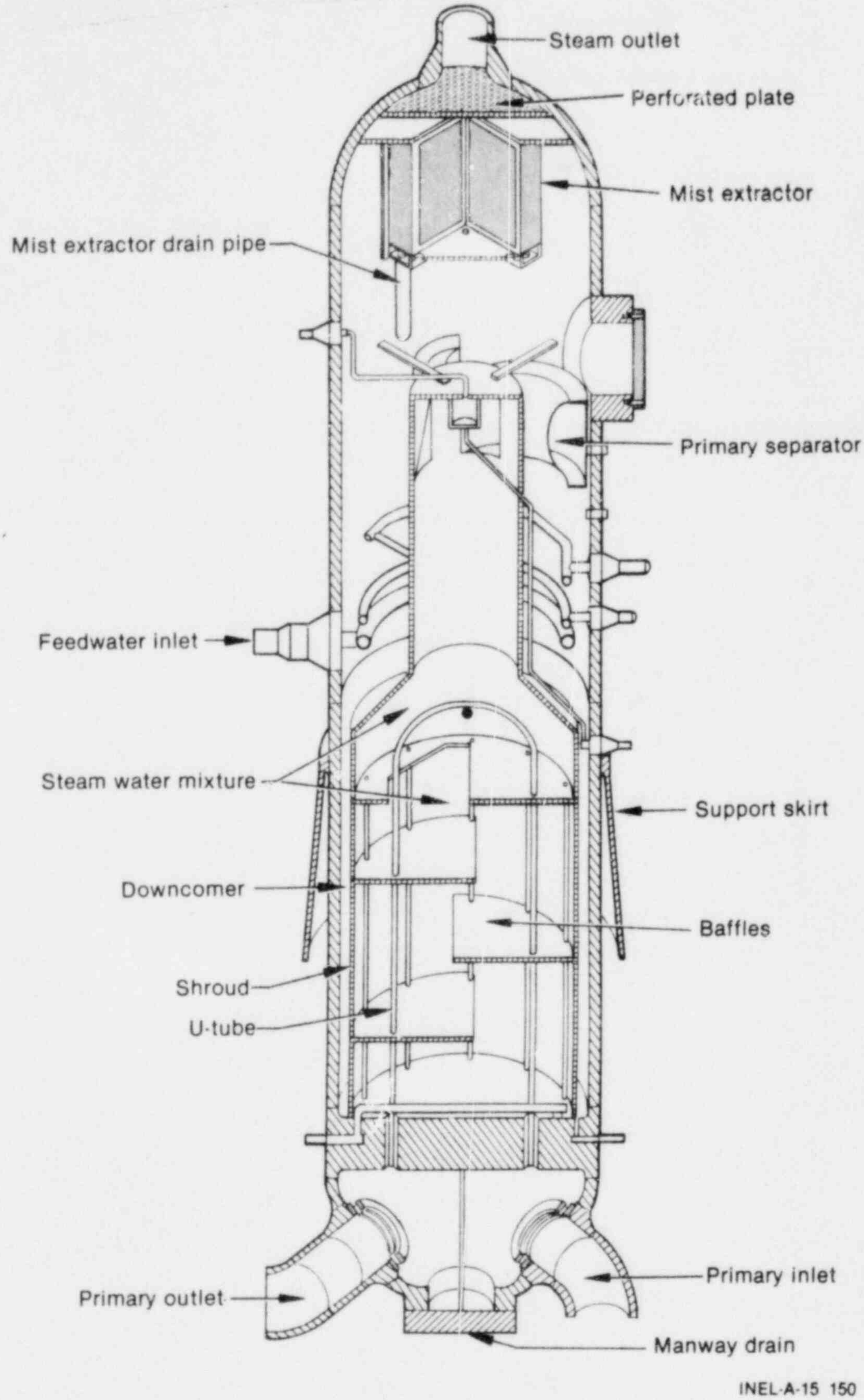


Figure 5. LOFT System--steam generator.

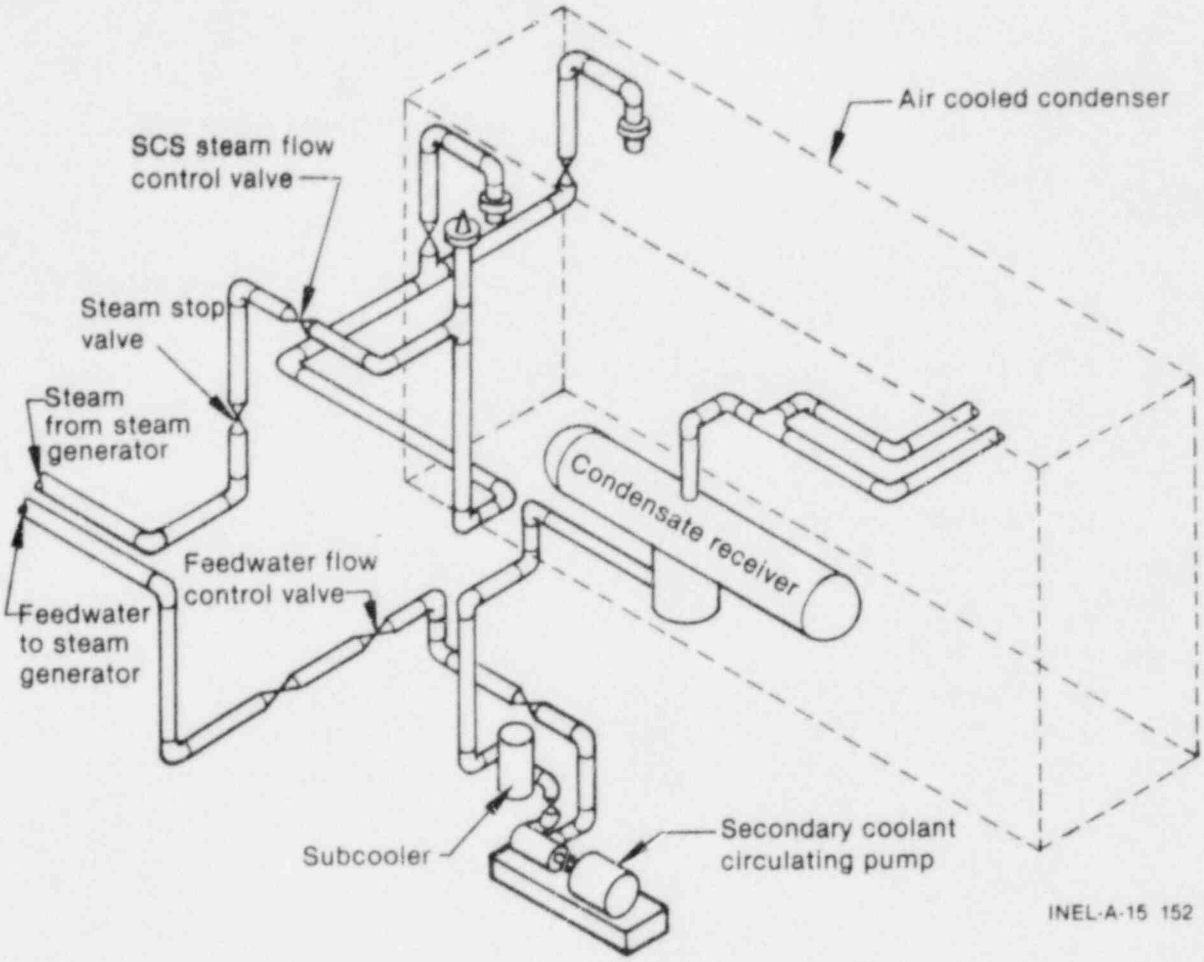


Figure 6. LOFT System--secondary side.

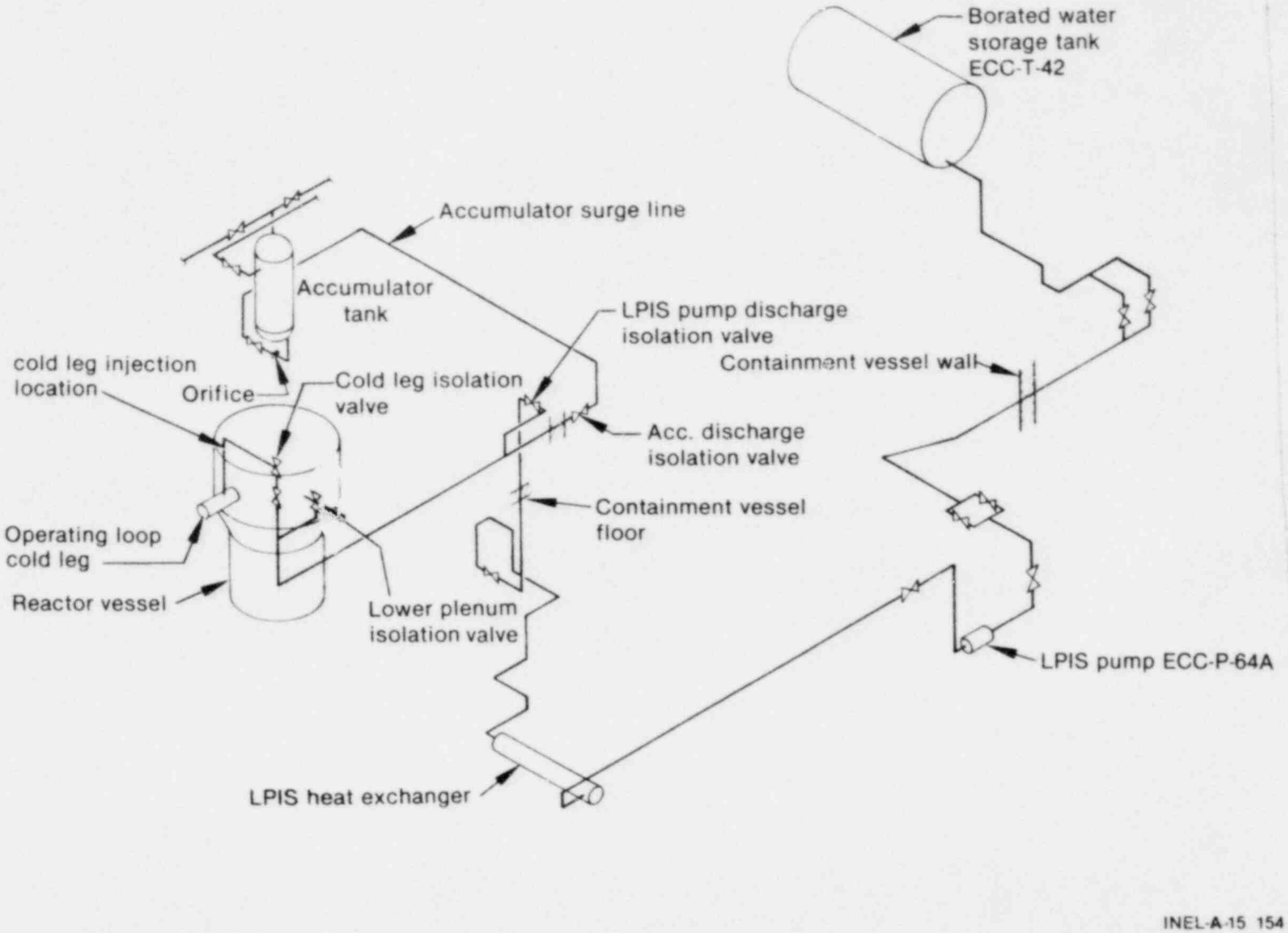


Figure 7. LOFT System--ECC.

The hydrodynamic calculation is primarily organized around volumes and junctions, and to a lesser extent around components. Components are organized collections of volumes and junctions, and are defined for either input convenience or to specify specialized processing. The physical space over which the hydrodynamic behavior is being simulated is divided into volumes. The continuity and energy equations are approximated by finite difference approximations to the volume and surface integrals of these equations over each volume. A junction is the connection of one volume to another, and is associated with the momentum equations. Finite difference approximations to the line integral of the stream tube form of the momentum equations are used.

The thermal calculation is organized around heat structures. Different heat structures attached to the same hydrodynamic component are identified by a geometry number. A heat structure can simulate a conductor consisting of laminations having different thermal properties. Temperatures and heat transfer rates are computed from the one-dimensional form of the transient heat conduction equation.

The RELAP5 code is described in detail by V. H. Ransom et al., (Reference 3).

2. MODEL DESCRIPTION

2.1 General

The detailed LOFT Model for the RELAP5 computer code consists of five parts:

1. Intact Loop Components (100-185)

2. Reactor Vessel Components (200-255)

3. Broken Loop Components (300-365)

4. Pressurizer Components (400-420)

5. Secondary System Components (500-555).

Also included are 33 heat slabs in the reactor vessel, six heat slabs between primary and secondary side, and seven heat slabs in the secondary side. The whole system consists of 113 volumes, 122 junctions, and 43 heat slabs.

Because this model will be used for a large variety of transients, compromises were made to economically simulate the exact physical behavior of the entire system. Particularly in small breaks, a finer nodalization is necessary to simulate liquid levels. Therefore, all vertical volumes are nodalized such that liquid levels can be calculated accurately. On the other hand, it was necessary to avoid excessively detailed nodalization that would result in high computing times. The size of the different volumes was chosen such that all volumes have approximately the same flow length.

Another basic decision was to connect each branch with more than one connection at an end to another branch. This will simplify the later inclusion of parallel flow paths.

To achieve momentum flux cancellation in tees, the junction connection is made to both the inlet and outlet of the main flow path volume of a tee. The simulation of tees in the model is slightly different from the simulation proposed in the user's manual. In this simulation, all junctions to the branch begin and end at the same elevation.

If the area for a junction is set at zero, the minimum flow area of the adjacent volumes is used. The loss coefficients do not include friction or form losses due to abrupt area changes. Only turning losses and other additional losses, as in packed orifice plates, are included in these values.

Figure 8 shows the nodalization scheme that is used in the input data. The dashed lines indicate components which can be included in the input data, such as a hot channel and the valve in the Reflood Assist Bypass System (RABS).

2.2 Intact Loop

All input data for the intact loop are based on Bayless (Reference 1). A brief summary of the intact loop geometric data is shown in Figure 9.

2.2.1 Volume-Related Data. Figure 10a identifies the 18 intact loop components, including two primary coolant pumps and the primary side of the steam generator. Figure 10b describes the nodalization components. One of the values of length, area, and volume is always set to zero, which means this value is calculated by the code. If the hydraulic diameter is input as 0.0, it also is calculated by the code. The pump inlet and outlet tees are simulated as tees. The ECC connection tee and the pressurizer

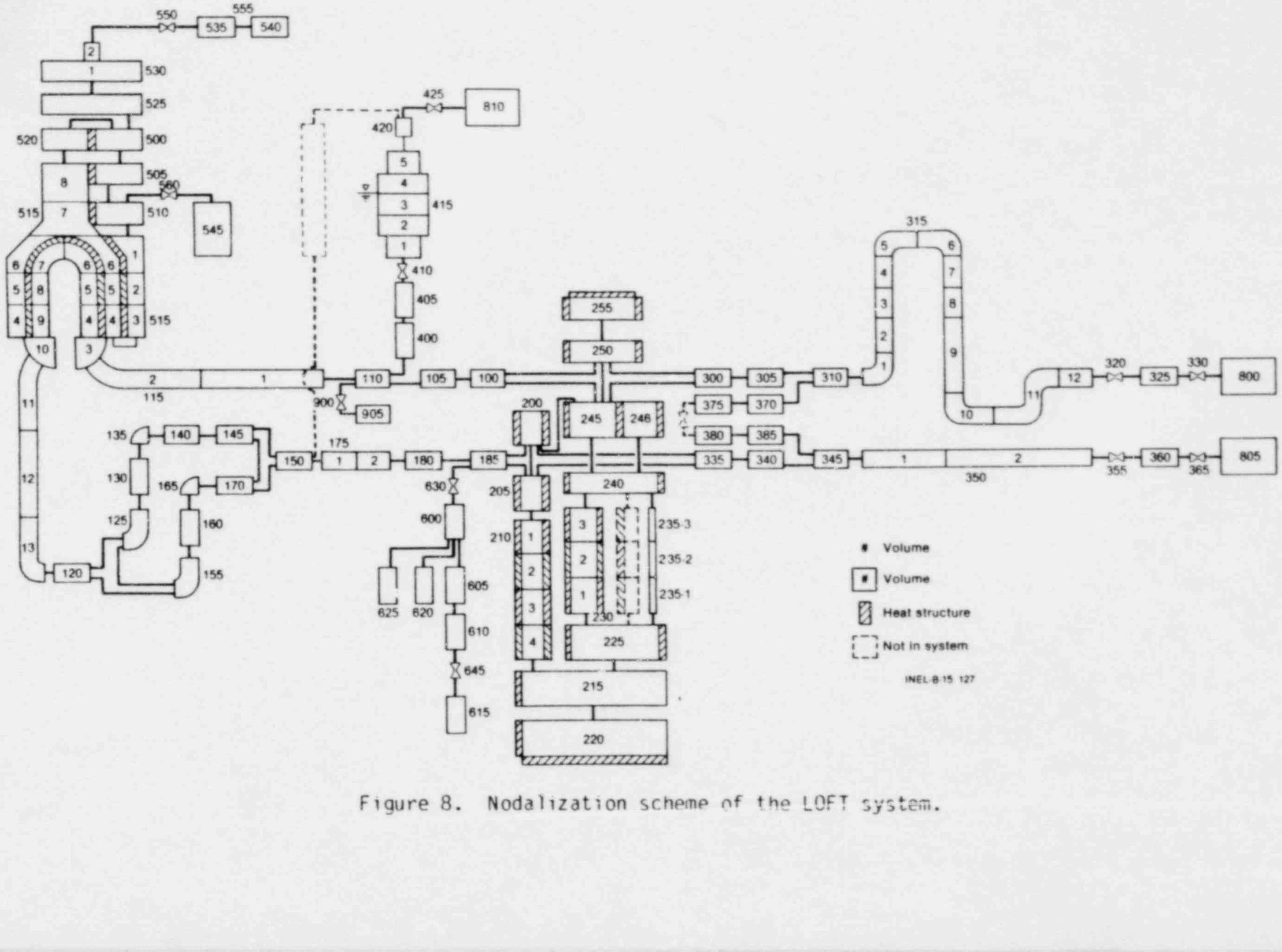


Figure 8. Nodalization scheme of the LOFT system.

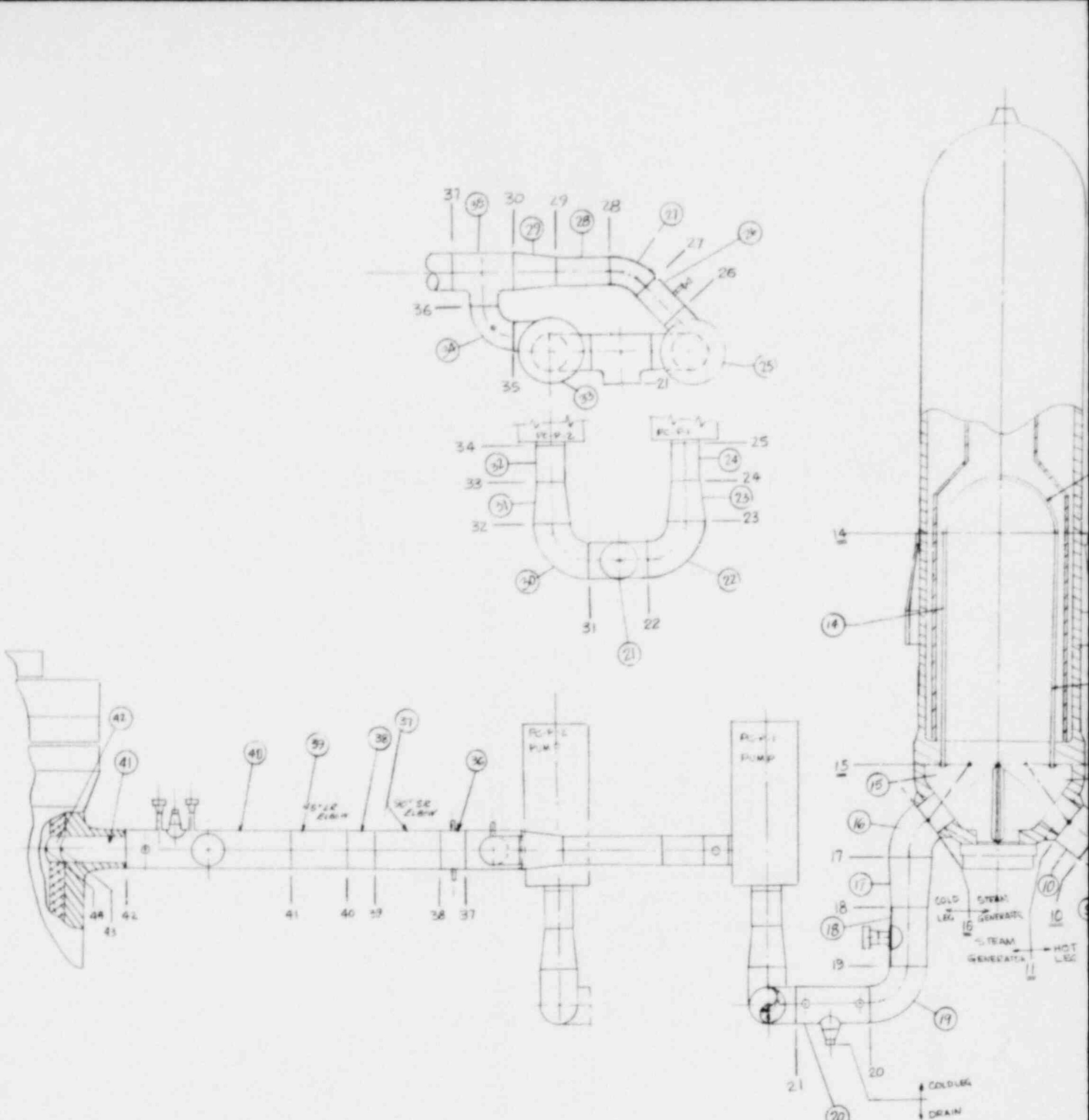
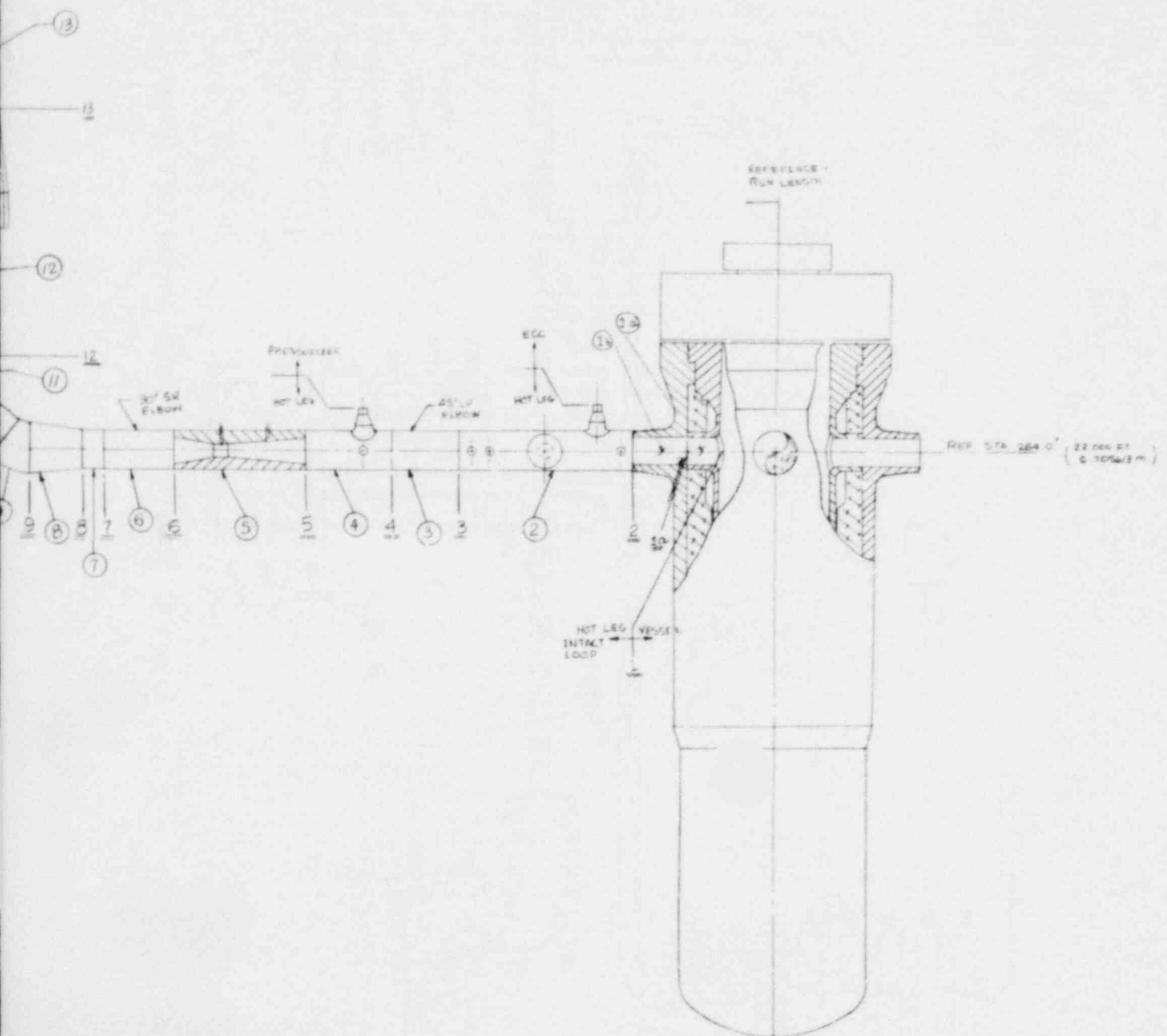


Figure 9. Geometr



y of the intact loop.

Piece Number	Node Number	Description	Length (Flow) C (m)		Elevation (m)		Equivalent Diameter (m)		Area (m^2)		Volume (m^3)
			Individual Piece	Refer to Exit	Entry	Exit	Entry	Exit	Entry	Exit	
1	1, 1A	Core barrel nozzle	0.350521	0.731552	6.705622	6.705622	0.292101	0.292101	0.067012	0.067012	0.0238962
1A	1A, 2	Vessel nozzle	0.525782	1.681317	6.705622	6.705622	0.284176	0.284176	0.063455	0.063455	0.033645
2	2, 3	14 SCH 160	1.322074	2.584458	6.705613	6.705613	0.284176	0.284176	0.063455	0.063455	0.086908
3	3, 4	14 SCH 160 45° LR elbow	0.418933	3.003395	6.705613	6.705613	0.284176	0.284176	0.063455	0.063455	0.026571
4	4, 5	14 SCH 160	0.719076	3.722472	6.705613	6.705613	0.284176	0.284176	0.63455	0.063455	0.046135
5	5, 6	Venturi	0.965203	4.687675	6.705613	6.705613	0.284176	0.28951	0.063426	0.065852	0.049024
--	--	--	--	--	--	(Throat)	0.205995	--	0.033336	--	--
6	6, 7	14 SCH 160 90° SR elbow	0.558577	5.246252	6.705613	6.705613	0.284176	0.284176	0.63455	0.063455	0.035428
7	7, 8	14 SCH 160 straight	0.194819	5.441071	6.705613	6.705613	0.284176	0.284176	0.063455	0.063455	0.012385
8	8, 9	16 x 14 SCH 160 Conc. reducer	0.355601	5.796672	6.705613	6.705613	0.284176	0.325477	0.063426	0.083201	0.025991
9	9, 10	16 SCH 160 90° SR MOD to 38°	0.269536	6.066208	6.705613	6.791775	0.325477	0.325477	0.083201	0.083201	0.022426
10	10, 11	16 SCH 160 straight	0.260351	6.326559	6.791775	6.952062	0.325477	0.325477	0.083201	0.083201	0.021661
11	11, 12	Steam gen. lower plenum, hot side	0.629795	6.956354	6.952062	7.464814	0.325477	0.438723	0.083201	0.151171	0.223336
12	12, 13	Steam generator straight tube, hot side	2.134640	9.090993	7.464814	9.599454	0.438723	0.438723	0.495968	0.495968	0.322591

Figure 9. (continued).

Piece Number	Node Number	Description	Length (Flow) C (m)		Elevation (m)		Equivalent Diameter (m)		Area (m^2)		Volume (m^3)
			Individual Piece	Refer to Exit	Entry	Exit	Entry	Exit	Entry	Exit	
13	13, 14	Steam generator curved tube	0.898985	9.989979	9.599454	9.599454	0.438723	0.438723	0.495968	0.495968	0.135902
14	14, 15	Steam generator straight tube cold side	2.134640	12.124618	9.599454	7.464814	0.438723	0.438723	0.151171	0.151171	0.322591
15	15, 16	Steam gen. lower plenum, cold side	0.629795	12.754413	7.464814	6.952062	0.438723	0.325477	0.151171	0.083201	0.223336
16	16, 17	16 SCH 160 90° SR elbow mod to 52°	0.368838	13.123251	6.952062	6.631814	0.325477	0.325477	0.083201	0.083201	0.030688
17	17, 18	16 x 14 SCH 160 Conc. reducer	0.355601	13.478852	6.631814	6.276213	0.325477	0.284176	0.083201	0.063425	0.025991
18	18, 19	14 SCH 160 straight	0.510796	13.989648	6.276213	5.765417	0.284176	0.284176	0.063425	0.063425	0.033246
19	19, 20	14 SCH 160 SR 90° elbow	0.558577	14.548225	5.765417	5.409816	0.284176	0.284176	0.063425	0.063425	0.035428
20	20, 21	14 SCH 160 straight	0.622302	15.170527	5.409816	5.409816	0.284176	0.284176	0.063425	0.063425	0.040105
		Pump Inlets Division Point June 21 - 22 (Main Run)									
21	21, 22, 31	14 SCH 160	0.438888	15.609415	5.409816	5.409816	0.284176	0.284176	0.063425	0.063425	0.046404
		June 21, 31 (Branch Run)									
			0.438888	0.438888	5.409816	5.409816	0.284176	0.284176	0.063425	0.063425	

Figure 9. (continued).

Piece Number	Node Number	Description	Length (Flow) C (m) Individual Piece	Refer to Exit	Elevation (m) Entry	Exit	Equivalent Diameter (m) Entry	Exit	Area (m^2) Entry	Exit	Volume (m^3)
	Main Run Volumes 22, 23, 24, 25, 26, 27, 28, and 29 (Pump PC-P-1 Inlet Junction 22 to Discharge Junction 30)										
22	22, 23	14 SCH 160 SR 90° elbow	0.558577	16.167992	5.409816	5.765417	0.284176	0.284176	0.063425	0.063425	0.035428
23	23, 24	14 x 10 SCH 160 Conc. reducer	0.330201	16.498193	5.765417	6.095618	0.284176	0.215901	0.063425	0.036610	0.016314
24	24, 25	10 SCH 160 straight	0.292101	16.790294	6.095618	6.387718	0.215901	0.215901	0.036610	0.036610	0.010694
25	25, 26	Pump PC-P-1	0.4572	17.247496	6.387718	6.705622	0.215901	0.215901	0.036610	0.036610	
26	26, 27	10 SCH 160 straight	0.202947	17.450442	6.705622	6.705622	0.215900	0.215900	0.036610	0.036610	0.007442
27	27, 28	10 SCH 160 LR 45° elbow	0.299238	17.749679	6.705622	6.705622	0.215900	0.215900	0.036610	0.036610	0.010955
28	28, 29	10 SCH 160 straight	0.798833	18.548512	6.705622	6.705622	0.215900	0.215900	0.036610	0.036610	0.29245
29	29, 30	10 x 14 SCH 160 Conc. reducer	0.330201	18.878713	6.705622	6.705622	0.215900	0.284176	0.036610	0.063426	0.016314
	Branch Run Volumes 30, 31, 32, 33, 34 (Pump PC-P-2 Inlet Junction 31 to Discharge Junction 36)										
30	31, 32	14 SCH 160 SR 90° elbow	0.558577	0.997465	5.409816	5.765417	0.284176	0.284176	0.063425	0.063425	0.035428
31	32, 33	14 x 10 SCH 160 Conc. reducer	0.330201	1.3276[illegible]	5.765417	6.095618	0.284176	0.215901	0.063425	0.036610	0.016314
32	33, 34	10 SCH 160 straight	0.292101	1.619767	6.095618	6.387718	0.215901	0.215901	0.036610	0.036610	0.010694
33	34, 35	Pump PC-P-2	0.4572	6.819178							

Figure 9. (continued).

Piece Number	Node Number	Description	Length (Flow) C (m) Individual Piece	Length (Flow) C (m) Refer to Exit	Elevation (m) Entry	Elevation (m) Exit	Equivalent Diameter (m) Entry	Equivalent Diameter (m) Exit	Area (m^2) Entry	Area (m^2) Exit	Volume (m^3)
34	35, 36	10 SCH 160 SR 90° elbow	0.398984		6.705622	6.705622	0.215901	0.215901	0.036610	0.036610	0.014619
		Pump Outlets Summing Point June 36, 37 (Branch Run)									
35	30, 36, 37	14 x 10 SCH 160 tee	0.423920		6.705622	6.705622	0.215901	0.284176	0.036609	0.063426	0.040808
		June 30, 37 (Main Run)									
			0.558802	19.437515	6.705622	6.705622	0.284176	0.284176	0.063426	0.063426	
36	37, 38	14 SCH 160 straight	0.217171	19.654686	6.705622	6.705622	0.284176	0.284176	0.063426	0.063426	0.013796
37	38, 39	14 SCH 160 SR 90° elbow	0.558577	20.213263	6.705622	6.705622	0.284176	0.284176	0.063426	0.063426	0.035428
38	39, 40	14 SCH 160 straight	0.194311	20.407573	6.705622	6.705622	0.284176	0.284176	0.063426	0.063426	0.012324
39	40, 41	14 SCH 160 LR 45° elbow	0.4189333	20.826506	6.705622	6.705622	0.284176	0.284176	0.063426	0.063426	0.026571
40	41, 42	14 SCH 160 straight	1.412245	22.238751	6.705622	6.705622	0.284176	0.284176	0.063426	0.063426	0.091656
41	42, 43	Nozzle	0.525782	22.764532	6.705622	6.705622	0.284176	0.284176	0.063426	0.063426	0.033645
42	43, 44	Vessel filler	0.223520	22.988053	6.705622	6.705622	0.285751	0.285751	0.064130	0.064130	0.014334

Figure 9. (continued).

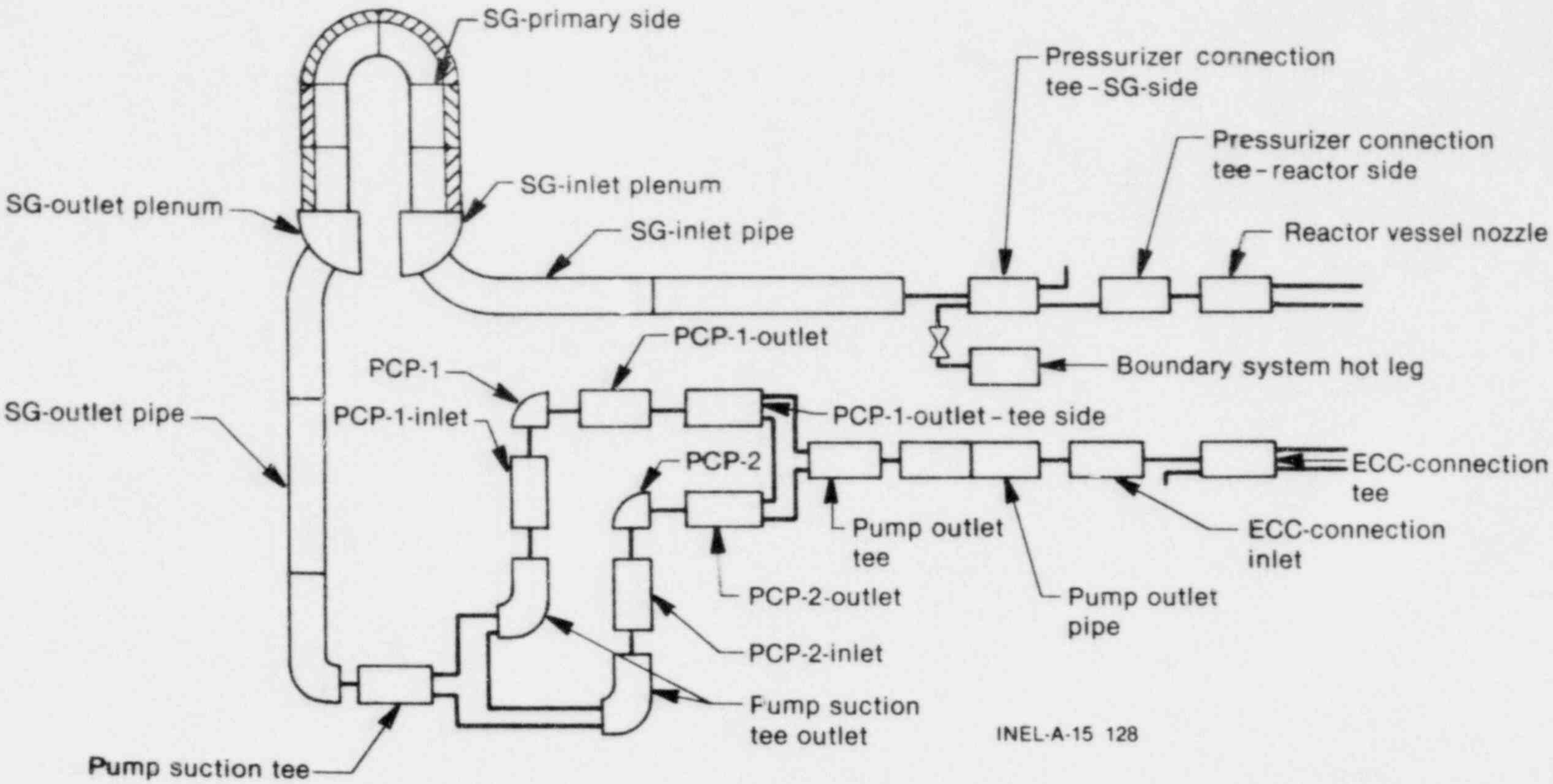


Figure 10a. Nodalization and description of the components in the intact loop (identification).

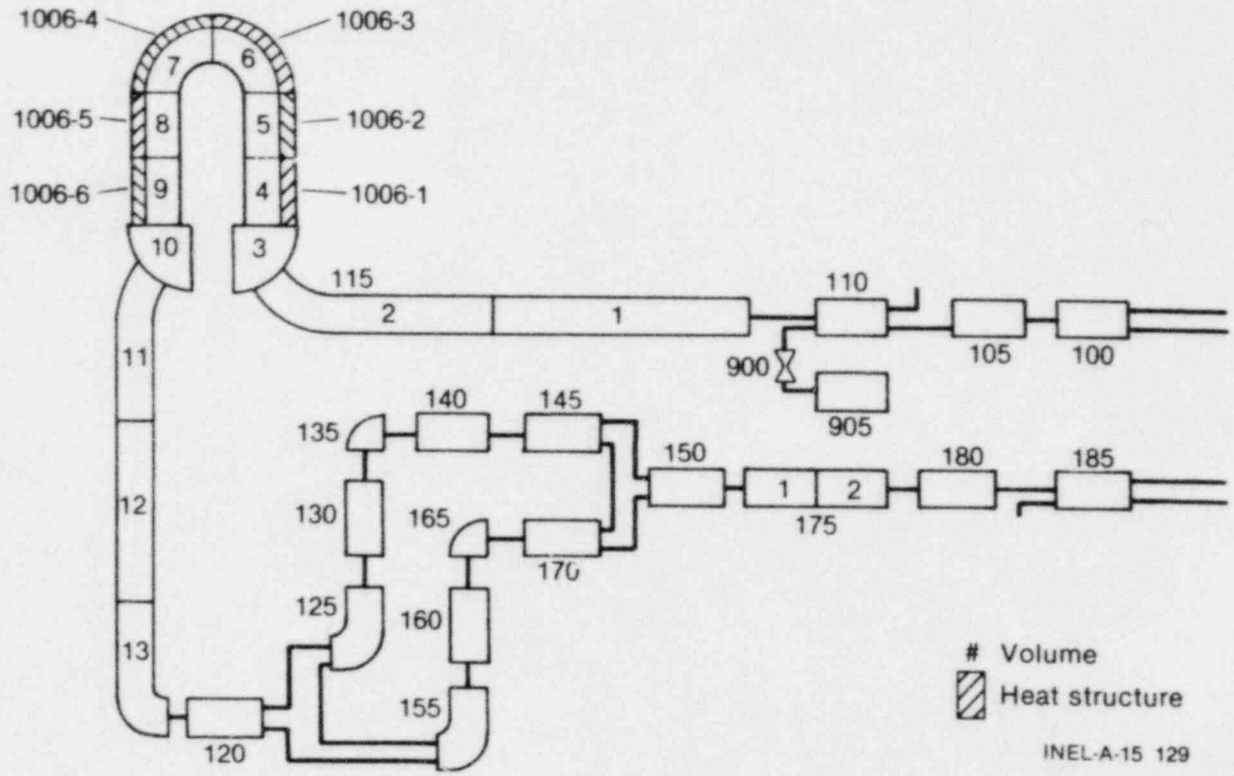


Figure 10b. Nodalization and description of the components in the intact loop (description and legend).

Component Number	Component Volume Number	Length (m)	Area (m^2)	Volume (m^3)	Hydraulic Diameter (m)	Elevation Change (m)	Elevation Outlet (m)	Component Type	Number of Junctions	Description	Volume Number (See Figure 9)
100	1	1.5373	0.0634	0.0	0.0	0.0	0.0	Branch	3	Core barrel nozzle Vessel nozzle Half of flow device	1 1A 2
105	1	1.634	0.0634	0.0	0.0	0.0	0.0	Branch	1	Half of flow device 45 degree elbow Pipe till pressurizer connection	2 3 4
110	1	1.1303	0.0	0.06204	0.0	0.0	0.0	Branch	1	Pipe from pressurizer connection Venturi	4 5
115	1	0.93124	0.0	0.05826	0.0	0.0	0.0	Pipe	12	90 degree elbow Pipe section Half of reducer	6 7 8
	2	0.708	0.0	0.057	0.0	0.246	0.246			Half of reducer 38 degree elbow Pipe section	8 9 10
	3	0.63	0.0	0.223	0.0102	0.513	0.759			Steam generator inlet plenum	11
	4	1.067	0.151	0.0	0.0103	1.067	1.826			Vertical steam generator tubes	12
	5	1.067	0.151	0.0	0.0103	1.067	2.893			Vertical steam generator tubes	12
	6	0.45	0.151	0.0	0.0103	0.2865	3.1795			90 degree elbow SG. tubes	13
	7	0.45	0.151	0.0	0.0103	-0.2865	2.893			90 degree elbow SG. tubes	13
	8	1.067	0.151	0.0	0.0103	-1.067	1.826			Vertical steam generator tubes	14
	9	1.067	0.151	0.0	0.0103	-1.067	0.759		12	Vertical steam generator tubes	14
	10	0.63	0.0	0.223	0.0102	-0.513	0.246			Steam generator outlet plenum	15
	11	0.547	0.0	0.0437	0.0	-0.498	-0.252			52 degree elbow Half of reducer	16 17
	12	0.689	0.0	0.0462	0.0	-0.689	-0.941			Half of reducer Pipe section	17 18
	13	0.559	0.0634	0.0	0.0	-0.356	-1.297			90 degree elbow	19

Figure 10b. (continued).

Component Number	Component Volume Number	Length (m)	Area (m^2)	Volume (m^3)	Hydraulic Diameter (m)	Elevation Change (m)	Elevation Outlet (m)	Component Type	Number of Junctions	Description	Volume Number (See Figure 9)
120	1	0.76	0.0634	0.0	0.0	0.0	-1.297	Branch	3	Pipe section Inlet pipe of pump suction tee	20 21
125	1	1.003	0.0	0.0613	0.0	0.521	-0.776	Branch	2	Half of pump suction tee 90 degree elbow Half of reducer	21 22 23
130	1	0.457	0.0	0.0189	0.0	0.457	-0.319	Snglvol	0	Half of reducer Pump 1 inlet pipe	23 24
135	1	0.0	0.0366	0.099	--	0.319	0.0	Pump	2	Primary coolant Pump 1	25
140	1	0.502	0.0366	0.0	0.0	0.0	0.0	Snglvol	0	Pump 1 outlet pipe 45 degree elbow	26 27
145	1	1.4084	0.0	0.0633	0.0	0.0	0.0	Branch	2	Pipe section Reducer Half of pump inlet tee	28 29 35
150	1	0.4966	0.0634	0.0	0.0	0.0	0.0	Branch	2	Half of pump outlet tee Pipe section	35 36
155	1	1.003	0.0	0.0613	0.0	0.521	-0.776	Branch	2	Half of pump suction tee 90 degree elbow Half of reducer	21 30 31
160	1	0.457	0.0	0.0189	0.0	0.457	-0.319	Snglvol	0	Half or reducer Pump 2 inlet pipe	31 32
165	1	0.0	0.0366	0.099	--	0.319	0.0	Pump	2	Primary coolant Pump 2	33
170	1	0.514	0.0366	0.0	0.0	0.0	0.0	Branch	1	90 degree elbow Inlet of pump outlet tee	34 35

Figure 10b. (continued).

Component Number	Component Volume Number	Length (m)	Area (m^2)	Volume (m^3)	Hydraulic Diameter (m)	Elevation Change (m)	Elevation Outlet (m)	Component Type	Number of Junctions	Description	Volume Number (See Figure 9)
175	1	0.559	0.0634	0.0	0.0	0.0	0.0	Pipe	1	90 degree elbow	37
	2	0.613	0.0634	0.0	0.0	0.0	0.0			Pipe section 45 degree elbow	38 39
180	1	1.152	0.0634	0.0	0.0	0.0	0.0	Branch	1	Pipe section till ECC connection	40
185	1	1.01	0.0634	0.0	0.0	0.0	0.0	Branch	3	Pipe section from ECC connection Vessel nozzle Vessel filler	40 41 42

Figure 10b. (continued).

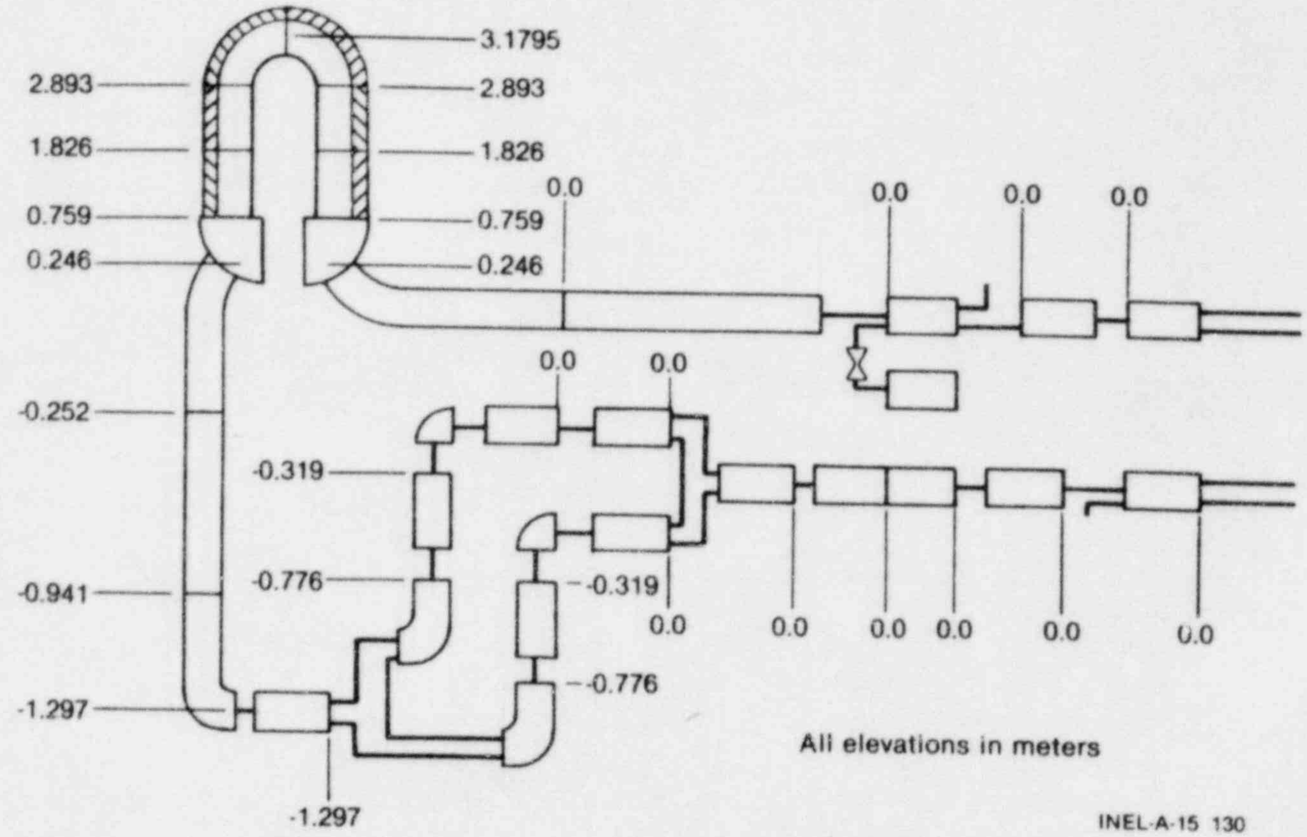


Figure 11. Volume outlet elevations in the intact loop.

connection tee are simulated one-dimensionally because the diameters of the pressurizer surge line and the ECC connection line are much smaller than the diameter of the PCS pipe. The connection of the intact loop to the reactor vessel is included in the description of the intact loop.

Figure 11 shows the volume outlet elevations of the intact loop. The boundary system, which consists of Components 900 and 905, is used only for steady-state runs to adjust the pressure in the system. For a transient calculation the valve 900 is closed. The pipe wall roughness used in the volumes is 4.0×10^{-5} m for the pipes and 1.5×10^{-5} m for the tubes in the steam generator.

2.2.2 Junction-Related Data. Table 1 describes the junction-related input data for the intact loop. The following definition is used:

The from/to volume number has the format--XXXNNMM,

where

XXX = Component number

NN = Volume number

MM = 00 for inlet,

= 01 for outlet.

The junction flow is described in detail in the RELAP5 user's manual. The loss coefficients for the intact loop include only the form losses due to bends. They are adjusted to give the right pressure drop as specified in the LOFT System and Test Description (Reference 2).

TABLE 1. JUNCTION-RELATED DATA--INTACT LOOP

Component Number	Junction Number	Volume Number From	Volume Number To	Area (m^2)	Junction Flag	Loss Coefficient Forward	Loss Coefficient Reverse	Description
100	1	2450101	1000100	0.0317	0100	0.0	0.0	Reactor vessel nozzle intact loop hot leg
	2	1000101	1050100	0.0	0100	0.05	0.05	Reactor vessel nozzle to Pressurizer tee
	3	2500100	1000100	0.0317	0100	0.0	0.0	Reactor vessel nozzle intact loop hot leg
105	1	1050101	1100100	0.0	0100	0.1	0.1	Pressurizer tee RV. side
110	1	1100101	1150100	0.0	0100	0.0	0.0	Pressurizer tee SG. side
115	1	1150101	1150200	0.0	0100	0.15	0.15	Pipe downstream of venturi
	2	1150201	1150300	0.0512	0100	0.05	0.05	SG. inlet plenum inlet
	3	1150301	1150400	0.0	0100	0.0	0.0	SG. inlet plenum outlet
	4	1150401	1150500	0.0	0000	0.0	0.0	
	5	1150501	1150600	0.0	0000	0.1	0.1	
	6	1150601	1150700	0.0	0000	0.2	0.2	SG. tubes
	7	1150701	1150800	0.0	0000	0.1	0.1	
	8	1150801	1150900	0.0	0000	0.0	0.0	
	9	1150901	1151000	0.0	0100	0.0	0.0	SG. tube outlet
	10	1151001	1151100	0.0512	0100	0.05	0.05	SG. outlet plenum outlet
	11	1151101	1151200	0.0	0100	0.05	0.05	
	12	1151201	1151300	0.0	0100	0.1	0.1	
120	1	1151301	1200100	0.0	0000	0.1	0.1	Inlet pump suction tee
	2	1200101	1250100	0.0317	0100	0.2	0.2	#1 pump side of tee
	3	1200101	1550100	0.0317	0100	0.2	0.2	#2 pump side of tee

TABLE 1. (continued)

Component Number	Junction Number	Volume Number From	Volume Number To	Area (m^2)	Junction Flag	Loss Coefficient Forward	Loss Coefficient Reverse	Description
125	1	1250101	1300100	0.0	0100	0.1	0.1	#1 pump inlet pipe
	2	1250100	1550100	0.0	0100	0.0	0.0	Connection inlet tee pump #1 and #2
135	--	1300101	1350100	0.0	0100	0.0	0.0	#1 pump inlet
	--	1350101	1400100	0.0	0100	0.05	0.05	#1 pump outlet
145	1	1400101	1450100	0.0	0100	0.1	0.1	#1 pump discharge to pump discharge tee
	2	1450101	1500100	0.0	0100	0.0	0.0	#1 pump side of tee
150	1	1700101	1500100	0.0183	0100	0.2	0.2	#2 pump discharge to tee
	2	1500101	1750100	0.0	0100	0.1	0.0	Pump tee outlet
155	1	1550101	1600100	0.0	0100	0.1	0.1	#1 pump side of pump suction tee
165	--	1600101	1650100	0.0	0100	0.0	0.0	#2 pump inlet
	--	1650101	1700100	0.0	0100	0.1	0.1	#2 pump outlet
170	1	1450101	1700101	0.0183	0100	0.2	0.2	#1 pump to #2 pump discharge
175	1	1750101	1750200	0.0	0100	0.15	0.15	45° Bend
180	1	1750201	1800100	0.0	0100	0.05	0.05	Inlet to pump side of ECC tee
185	1	1850101	2050100	0.0317	0100	1.0	1.0	Intact cold leg to RV. inlet annulus
	2	1800101	1850100	0.0	0100	0.0	0.0	Pump side of ECC tee to RV. side of ECC tee
	3	1850101	2000100	0.0317	0100	1.0	1.0	Intact cold leg to RV. inlet annulus

The two junctions at the pump suction tee which connect Component 120 with 125 and 155 have half of the flow area of Component 120. Similarly, the junctions from Component 170 to Component 145 and 150 have half of the flow area of Component 170. Junctions 11502 and 11510 have smaller flow areas than the minimum flow areas of the adjacent volumes, thus simulating the orifices installed at the steam generator-inlet and -outlet plenum.

2.2.3 Heat Slabs. The only heat slab included in the intact loop represents the SG tubes, and connects the primary with the secondary side. This heat slab has six heat structures. It is described in Table 2.

2.3 Reactor Vessel

The reactor vessel input data are based on Bayless and Reeder (References 1 and 2). Because of the complicated geometry of the reactor vessel, particulary in the core region, simplifications were made to simulate the reactor vessel consistently with the remainder of the system.

2.3.1 Nodalization of the Reactor Vessel. The reactor vessel is simulated with 13 hydraulic components and 13 heat slabs. Twenty volumes and 20 junctions are used. All components in the reactor vessel region are identified (Figure 12a), and the volumes vertically orientated and described (Figure 12b).

Components 200, 205, and 210 simulate the annulus. The lower plenum is subdivided into two components. The region between core inlet and core tie plate is also described as a specific component. Component 230 simulates the core, whereas Component 235 simulates the core bypass. Component 240 simulates the mixing region between the upper core tie plate and the location where the fuel modules have no holes. Component 245 simulates the upper flow skirt region and Component 246, the dead end of the fuel modules. Components 250 and 255 simulate the upper plenum. Tees simulate the inlet annulus distributor and the outlet nozzle.

TABLE 2. HEAT SLAB DATA--INTACT LOOP

Heat Structure Number	Geometry Type	Left Boundary Volume	Right Boundary Volume	Area/Length (m^2/m)	Interval Number	Components	Left Boundary (m)	Right Boundary (m)
1006-1	CYL	11504	51504	1397.324	1-8	Inconel	0.0051054	0.006349
-2		11505	51505	1397.324	1-8	Inconel	0.0051054	0.006349
-3		11506	51506	1397.324	1-8	Inconel	0.0051054	0.006349
-4		11507	51506	1397.324	1-8	Inconel	0.0051054	0.006349
-5		11508	51505	1397.324	1-8	Inconel	0.0051054	0.006349
-6		11509	51504	1397.324	1-8	Inconel	0.0051054	0.006349

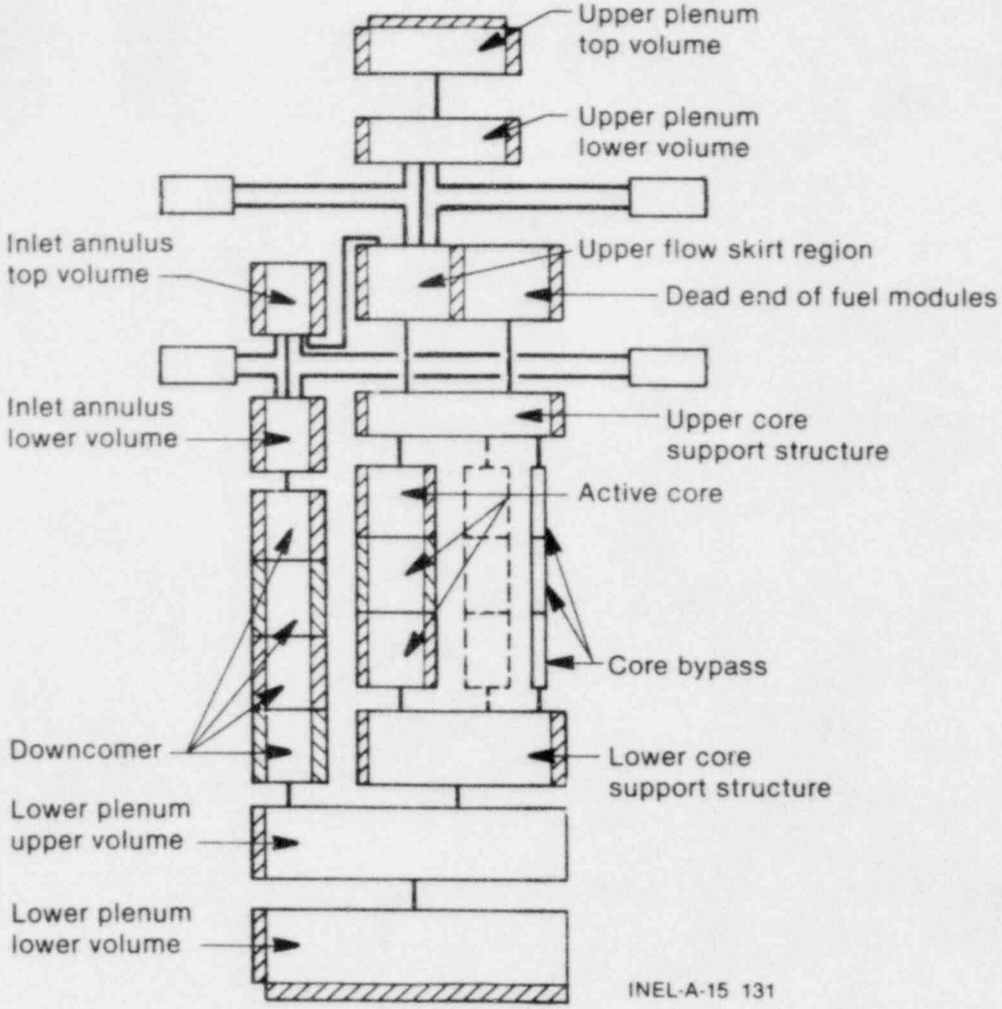


Figure 12a. Nodalization and description of the reactor vessel components (identification).

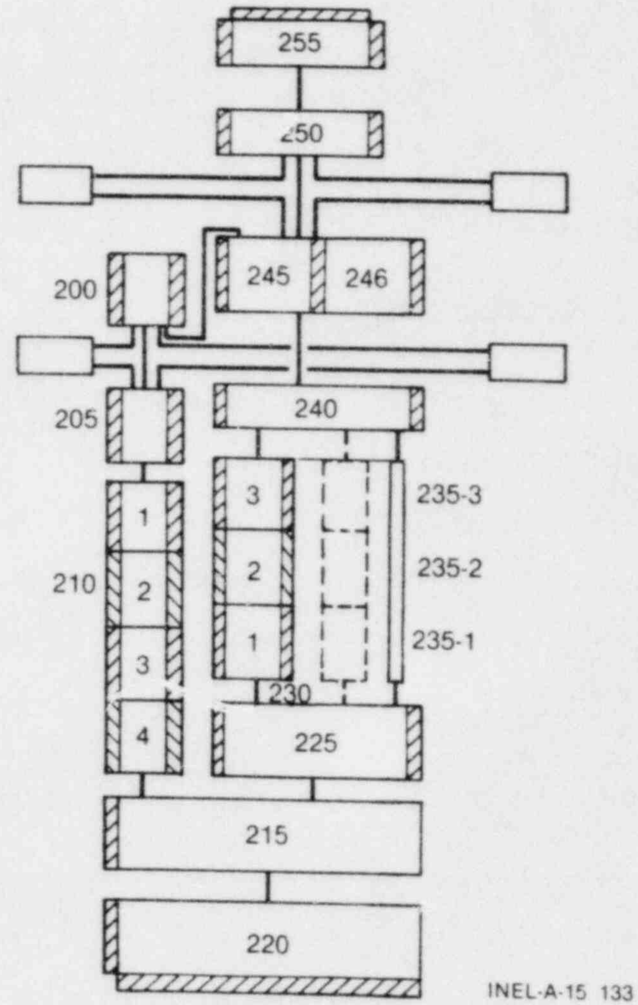


Figure 12b. Nodalization and description of the reactor vessel components (description and legend).

Component Number	Component Type	Component Volume Number	Number of Junctions	Description
200	Branch	1	2	Upper part of inlet annulus distributor
205	Branch	1	1	Lower part of inlet annulus distributor
210	Pipe	1	3	Downcomer
		2		Downcomer
		3		Downcomer
		4		Downcomer
215	Branch	1	3	Upper part of the lower plenum
220	Snglvol	1	0	Lower part of the lower plenum
225	Branch	1	2	Lower core support structure
230	Pipe	1	2	Active core lower part
		2		Active core central part
		3		Active core upper part
235	Pipe	1	2	Core bypass
		2		Core bypass
		3		Core bypass
240	Branch	1	2	Upper core support structure
245	Branch	1	1	Upper flow skirt region
246	Branch	1	1	Dead end of the fuel modules
250	Branch	1	2	Nozzle region of upper plenum
255	Snglvol	1	0	Upper part of the upper plenum

Figure 12b. (continued).

2.3.2 Volume-Related Components - Reactor Vessel. Table 3 includes the description of the volume-related components in the reactor vessel. The inlet annulus is divided at the elevation of the cold leg pipe centerline into two volumes. The downcomer, Component 210, includes four volumes with equal lengths of 0.958 m. In order to track liquid level, it might be necessary in some cases to use a finer nodalization in the downcomer. The lower plenum is divided into two components, which simulate the mixing section and the dead end of the lower plenum. The component which is marked with dashed lines is a hot channel that is not included in the current data. The elevations of different volume outlets are shown in Figure 13.

2.3.3 Junction-Related Data. The geometric data of the junction-related components in the reactor vessel are shown in Table 4. The bypass flow from the inlet annulus to the upper plenum is included in the description. For this junction, the flow area is chosen to give approximately 2% bypass flow under steady-state conditions. The junction areas in the core bypass are chosen to give approximately 5% flow.

Because only the pressure drop from the intact loop cold leg to the intact loop hot leg is known, all additional loss coefficients in the reactor vessel region are chosen to sum to this pressure drop.

2.3.4 Heat Slabs in the Reactor Vessel Region. The heat slab components are shown in Figure 14. The following main heat structures are used, as shown in Figure 15:

1. Filler blocks

2. Core support barrel

3. Reactor vessel bottom

4. Lower core support structure

TABLE 3. VOLUME-RELATED DATA--REACTOR VESSEL

Component Number	Component Volume Number	Length (m)	Area (m^2)	Volume (m^3)	Elevation Change (m)	Hydraulic Diameter (m)	Elevation Outlet (m)	Component Type	Description
200	1	0.33	0.0	0.0855	0.33	0.178	+0.33	Branch	Inlet annulus top volume
205	1	0.424	0.0	0.11	-0.424	0.172	-0.424	Branch	Inlet annulus lower volume
210	1	0.958	0.142	0.0	-0.958	0.102	-1.382	Pipe	Downcomer
	2	0.958	0.142	0.0	-0.958	0.102	-2.34		
	3	0.958	0.142	0.0	-0.958	0.102	-3.298		
	4	0.958	0.142	0.0	-0.958	0.102	-4.256		
215	1	0.36	0.74	0.0	-0.36	0.9707	-4.616	Branch	Lower plenum upper volume
220	1	0.37	0.79	0.0	-0.37	1.003	-4.986	Snglvol	Lower plenum lower volume
225	1	0.52	0.25	0.0	0.52	0.095	-3.736	Branch	Lower core support structure
230	1	0.559	0.1705	0.0	0.559	0.012	-3.177	Pipe	Active core
	2	0.559	0.1705	0.0	0.559	0.012	-2.618		
	3	0.657	0.1705	0.0	0.657	0.012	-1.961		
235	1	0.559	0.015	0.0	0.559	0.003	-3.177	Pipe	Bypass core 5% core flow
	2	0.559	0.015	0.0	0.559	0.003	-2.618		
	3	0.657	0.015	0.0	0.657	0.003	-1.961		
240	1	1.118	0.297	0.0	1.118	0.145	-0.769	Branch	Upper core support structure
245	1	0.843	0.114	0.0	0.843	0.131	±0.0	Branch	Upper flow skirt region
246	1	0.7	0.183	0.0	0.7	0.214	-0.163	Branch	Dead end of fuel modules
250	1	0.854	0.288	0.0	0.854	0.0	+0.854	Branch	Upper plenum lower volume
255	1	0.712	0.244	0.0	0.712	0.0	+1.566	Snglvol	Upper plenum upper volume

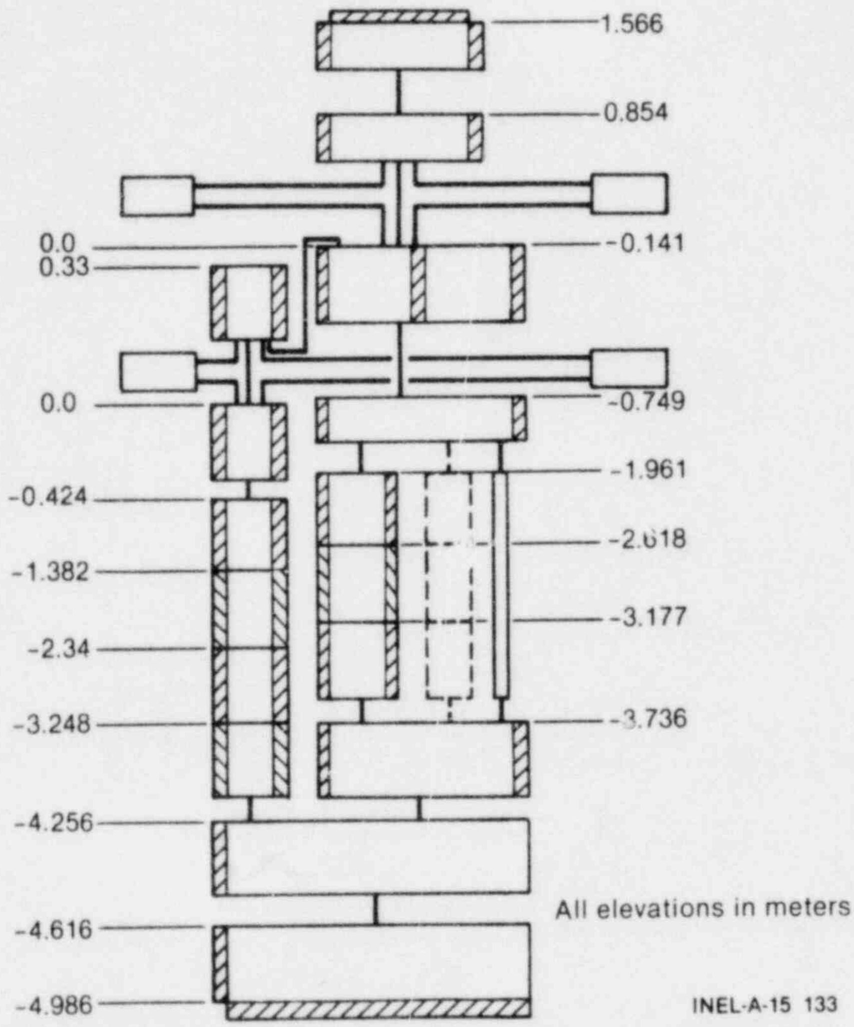


Figure 13. Volume outlet elevations in the reactor vessel.

TABLE 4. JUNCTION-RELATED DATA--REACTOR VESSEL

Component Number	Junction Number	Volume Number From	Volume Number To	Area (m^2)	Junction Flag	Loss Coefficient Forward	Loss Coefficient Reverse	Description
200	1	2000100	2050100	0.0	0100	0.0	0.0	
	2	2000100	2450101	0.001	0100	0.0	0.0	Bypass ILCL ILHL
205	1	2050101	2100100	0.0	0100	0.0	0.0	Inlet annulus distribution
210	1	2100101	2100200	0.0	0000	0.0	0.0	
	2	2100201	2100300	0.0	0000	0.0	0.0	Downcomer
	3	2100301	2100400	0.0	0000	0.0	0.0	
215	1	2100401	2150100	0.0	0100	0.0	0.0	Connections to lower plenum
	2	2150101	2200100	0.0	0100	0.0	0.0	Connections to lower plenum
	3	2150100	2250100	0.15	0100	0.0	0.0	
225	1	2250101	2300100	0.0975	0100	0.3	0.3	Core inlet flow
	2	2250101	2350100	0.0	0100	0.0	0.0	Core bypass flow
230	1	2300101	2300200	0.144	0100	0.5	0.5	Active core
	2	2300201	2300300	0.144	0100	0.5	0.5	
235	1	2350101	2350200	0.0	0000	0.0	0.0	Bypass
	2	2350201	2350300	0.0	0000	0.0	0.0	
240	1	2300301	2400100	0.12	0100	0.3	0.3	Core outlet flow
	2	2350301	2400100	0.0	0100	0.0	0.0	Bypass outlet flow
245	1	2400101	2450100	0.0	0100	0.0	0.0	
246	1	2400101	2460100	0.0	0100	0.0	0.0	
250	1	2450101	2500100	0.0	0100	0.0	0.0	
	2	2500101	2550100	0.0	0100	0.0	0.0	

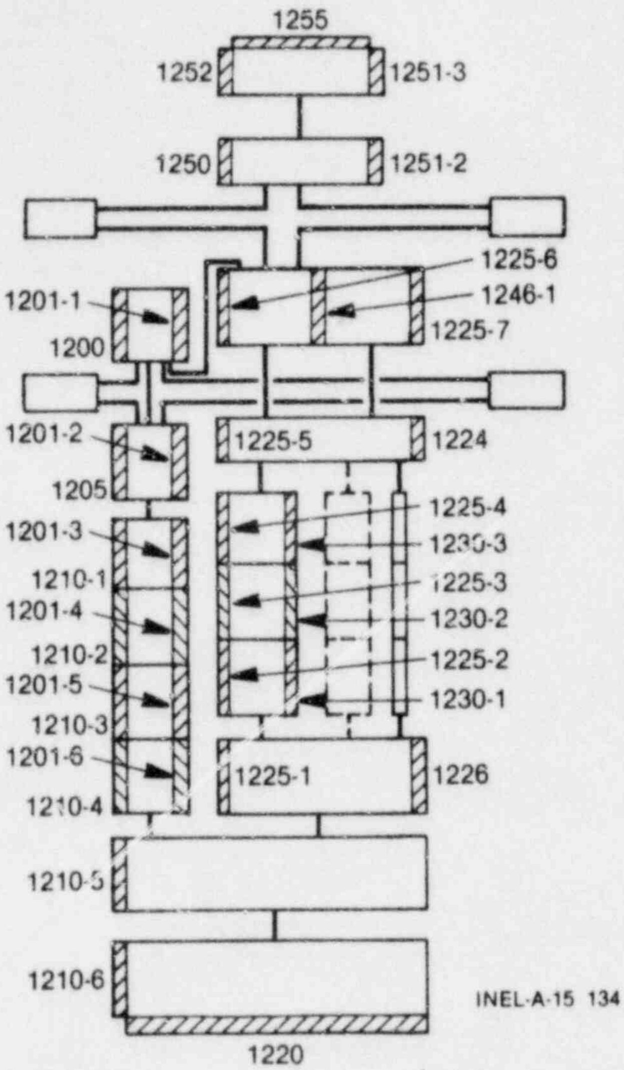


Figure 14. Reactor vessel heat slab components.

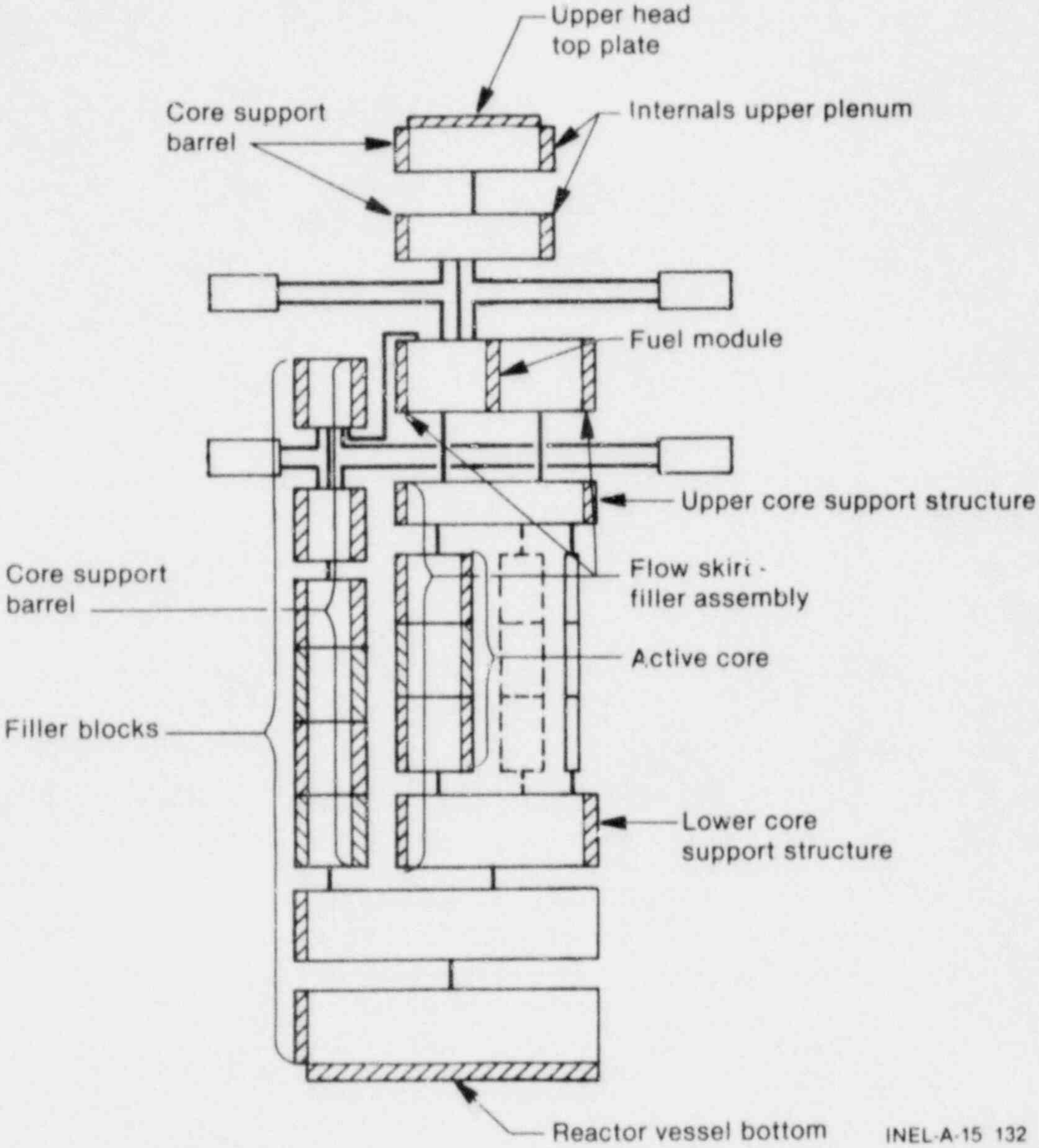


Figure 15. Description of heat slabs in the reactor vessel.

5. Flow skirt - filler assembly

6. Active core

7. Upper core support structure

8. Fuel modules in the upper plenum region

9. Upper core support structure

10. Internals in the upper plenum

11. Upper head top plate.

All heat slabs in the reactor vessel are assumed to be adiabatic (symmetric) on one side. A detailed description of the geometric data for the heat slabs is given in Table 5.

2.4 Broken Loop

The input data for the broken loop are based on Bayless and Reeder (References 1 and 2). Figure 16 shows a brief summary of the broken loop geometric data.

The composition of the piping in the legend of Figure 16 is for a hot leg break, whereas the schematic shows the composition for a cold leg break.

2.4.1 Volume-Related Components. The broken loop is simulated by 18 components with 26 volumes, 26 junctions, and four valves. Figure 17 identifies the components, and Figure 17b describes the nodalization schematic of the broken loop. The Reflood Assist Bypass System (RABS) is simulated by four volumes. The reflood bypass valves are not included in

TABLE 5. HEAT SLAB DATA--REACTOR VESSEL

Heat Structure Number	Geometry Type	Left Boundary Volume	Right Boundary Volume	Area/Length (m^2/m)	Interval Number	Components	Left Boundary (m)	Right Boundary (m)
1210-1	CYL	21001	--	0.958	1-4	S-STEEL	0.47	0.735
-2		21002	--	0.958	1-4	S-STEEL	0.47	0.735
-3		21003	--	0.958	1-4	S-STEEL	0.47	0.735
-4		21004	--	0.958	1-4	S-STEEL	0.47	0.735
-5		21501	--	0.36	1-4	S-STEEL	0.47	0.735
-6		22001	--	0.37	1-4	S-STEEL	0.47	0.735
1201-1	CYL	20001	--	0.33	1-4	S-STEEL	0.419	0.459
-2		20501	--	0.424	1-4	S-STEEL	0.419	0.459
-3		21001	--	0.958	1-4	S-STEEL	0.419	0.459
-4		21002	--	0.958	1-4	S-STEEL	0.419	0.459
-5		21003	--	0.958	1-4	S-STEEL	0.419	0.459
-6		21004	--	0.958	1-4	S-STEEL	0.419	0.459
1225-1	CYL	22501	--	0.52	1-4	S-STEEL	0.3	0.38
-2		23001	--	0.559	1-4	S-STEEL	0.3	0.38
-3		23002	--	0.559	1-4	S-STEEL	0.3	0.38
-4		23003	--	0.651	1-4	S-STEEL	0.3	0.38
-5		24001	--	1.118	1-4	S-STEEL	0.3	0.38
-6		24501	--	0.42	1-4	S-STEEL	0.3	0.38
-7		24601	--	0.35	1-4	S-STEEL	0.3	0.38
1230-1	CYL	0	23001	725.1	1-4	U02	0.0	4.647 E-3
					5	GAP	4.647 E-3	4.742 E-3
					6-9	ZR	4.742 E-3	5.35 E-3
-2		0	23002	725.1	1-4	U02	0.0	4.647 E-3
				5	GAP	4.647 E-3	4.742 E-3	
				6-9	ZR	4.742 E-3	5.35 E-3	
-3		0	2303	725.1	1-4	U02	0.0	4.647 E-3
				5	GAP	4.647 E-3	4.742 E-3	
				6-9	ZR	4.742 E-3	5.35 E-3	

TABLE 5. (continued)

Heat Structure Number	Geometry Type	Left Boundary Volume	Right Boundary Volume	Area/Length (m^2/m)	Interval Number	Components	Left Boundary (m)	Right Boundary (m)
1246-1	PLATE	24501	24601	1.8	1-4	S-STEEL	0.0	0.01
1220-1	PLATE	22001	--	1.68	1-4	S-STEEL	0.0	0.092
1226-1	CYL	22501	--	0.52	1-4	S-STEEL	0.282	0.3
1240-1	CYL	24001	--	0.118	1-4	S-STEEL	0.282	0.31
1255-1	PLATE	25501	--	0.712	1-4	S-STEEL	0.0	0.474
1200-1	CYL	20001	--	0.33	1-4	S-STEEL	0.508	0.773
1205-1	CYL	20501	--	0.424	1-4	S-STEEL	0.501	0.768
1250-1	CYL	25001	--	0.854	1-4	S-STEEL	0.381	0.419
1251-1	PLATE	25001	--	1.0	1-4	S-STEEL	0.0	0.005
-2		25501	--	1.0	1-4	S-STEEL	0.0	0.005
1252-1	CYL	25501	--	0.712	1-4	S-STEEL	0.381	0.728

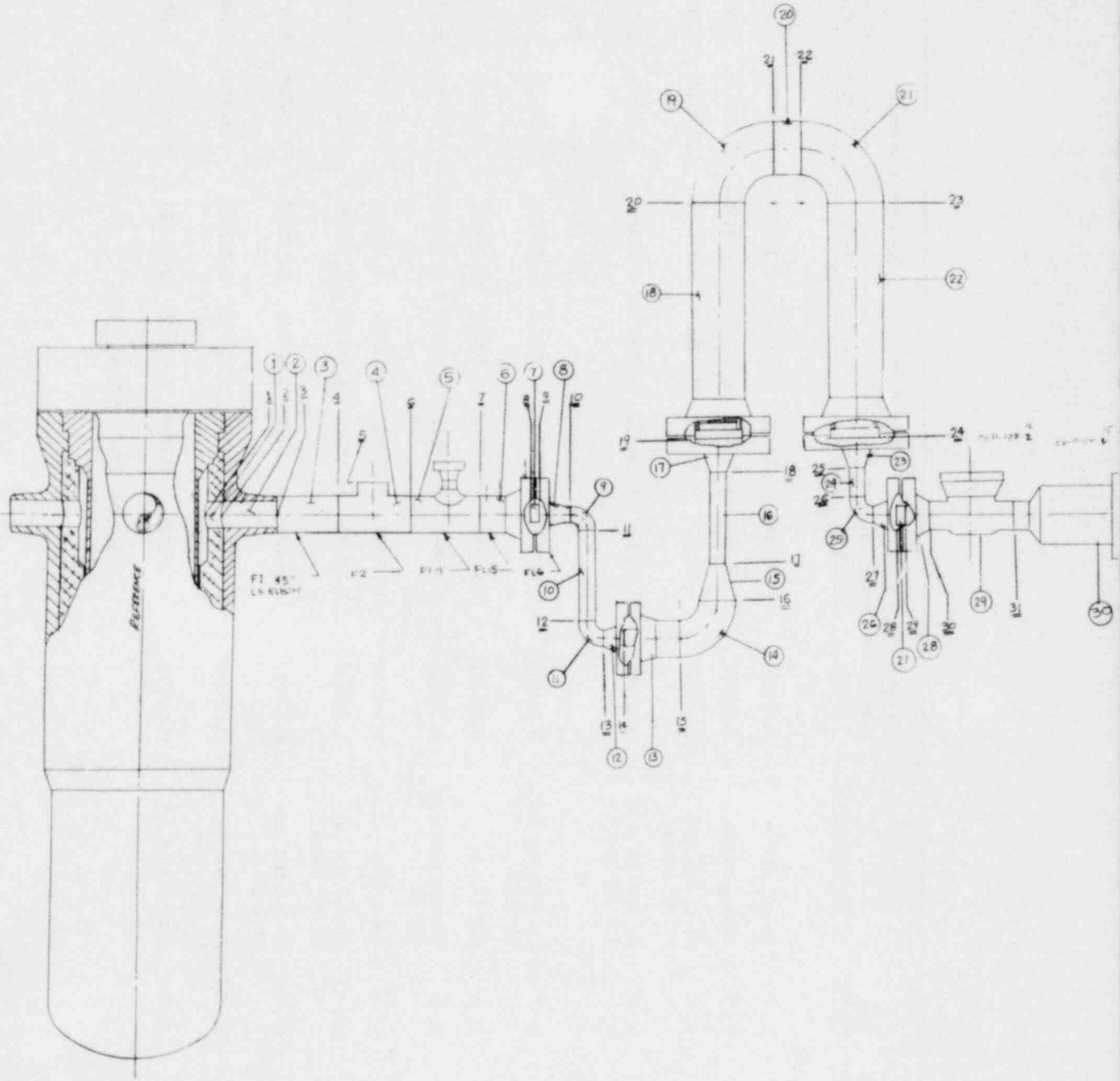
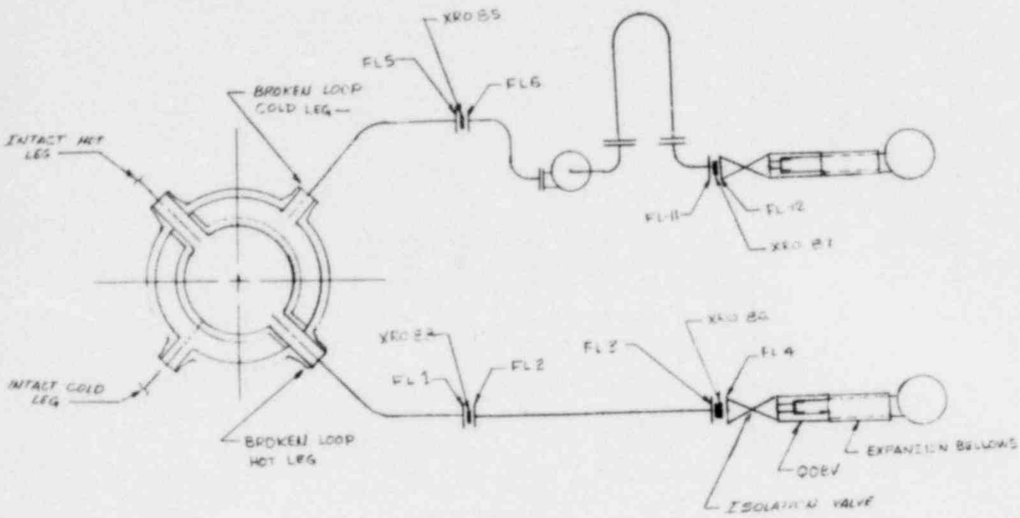
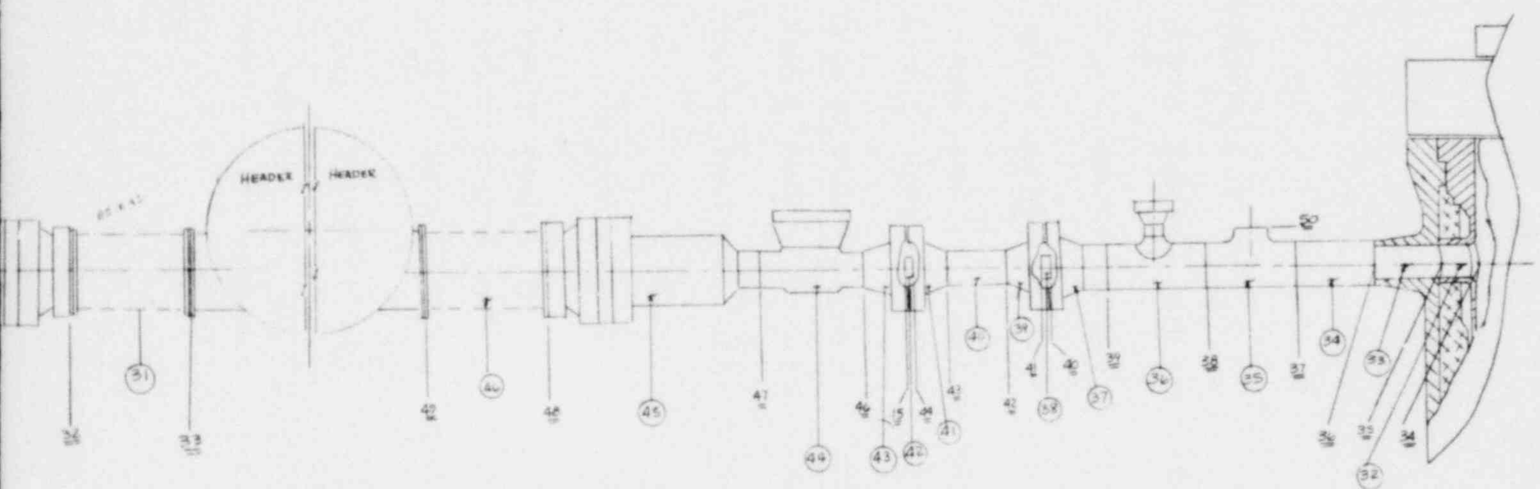


Figure 16. Ge





ometry of the broken loop.

Piece Number	Node Number	Description	Length (Flow) C (m) Individual Piece	Refer to Exit	Elevation (m) Entry	Exit	Equivalent Diameter (m) Entry	Exit	Area (m^2) Entry	Exit	Volume (m^3)
Cold Leg											
1	1, 2	Vessel filler	0.223520	0.731524	6.705622	6.705622	0.285751	0.285751	0.064130	0.064130	0.014334
2	2, 3	Vessel nozzle	0.525782	1.681317	6.705622	6.705622	0.284176	0.284176	0.063426	0.063426	0.033645
3	3, 4	F1 14 SCH 160 LR 45° elbow	0.418933	1.681317	6.705622	6.705622	0.284176	0.284176	0.063426	0.063426	0.026571
4	4, 5, 6	F2 14 x 14 x 10 SCH 160 tee	0.558802	2.240119	6.705622	6.705622	0.284176	0.284176	0.063426	0.063426	0.040343
							10" Branch	0.215901	Branch	0.120111	
5	6, 7	P1-1 14 SCH 160 straight	0.694946	2.935065	6.705622	6.705622	0.284176	0.284176	0.063426	0.063426	0.044926
6	7, 8	FL5 flange	0.449581	3.384646	6.705612	6.705622	0.284176	0.103200	0.063425	0.0083647	0.005035
7	8, 9	Orifice plate XRO 85	0.076200	3.460847	6.705622	6.705622	0.103200	0.103200	0.008365	0.008365	0.0006374
8	9, 10	FL6 flange	0.168276	3.435937	6.705622	6.705622	0.103200	0.103200	0.008365	0.008365	0.001408
9	10, 11	F14 5" SCH XX LR 90° elbow	0.299238	3.735175	6.705622	6.515121	0.103200	0.103200	0.008365	0.008365	0.002503
10	11, 12	P9-1 6 SCH 160 straight	0.831853	4.567028	6.515121	5.683269	0.131801	0.131801	0.013643	0.013643	0.011357
11	12, 13	F14 5" SCH XX LR 90° elbow	0.299238	4.866266	5.683269	5.492768	0.103201	0.103201	0.008365	0.008365	0.002503
12	13, 14	FL13 flange	0.168276	5.034541	5.492768	5.492768	0.103201	0.103201	0.0083647	0.0083647	0.001408

Figure 16. (continued).

Piece Number	Node Number	Description	Length (Flow) C (m) Individual Piece	Refer to Exit	Elevation (m) Entry	Exit	Equivalent Diameter (m) Entry	Exit	Area (m²) Entry	Exit	Volume (m³)
Cold Leg (continued)											
13	14, 15	Pump simulator	0.473076	5.507617	5.442768	5.492768	0.103201	0.266513	0.008364	0.064473	0.010249
							Support Plate Exit	0.152401	Section at Orifice Plate	0.010068	
							Cross Section Orifice Plate	0.008068			
14	15, 16	F15 14 SCH 160 SR 90° elbow	0.558577	6.066195	5.492768	5.848369	0.284176	0.284176	0.063425	0.063425	0.035428
15	16, 17	F16 14 x 5 SCH 160 Conc. reducer	0.330202	6.396396	5.848369	6.178569	0.284176	0.109551	0.063425	0.009425	0.10709
16	17, 18	P11-1 5" SCH 160 straight	0.936501	7.332897	6.178569	7.115071	0.109551	0.109551	0.009426	0.009426	0.008827
17	18, 19	FL-7 flange	0.206376	7.539272	7.115071	7.321447	0.103200	0103200	0.008365	0.008365	0.0008497
18	19, 20	Steam generator simulator	2.051311	9.590583	7.321447	9.372757	0.103124	0.370587	0.0083525	0.107862	0.172533
							Support Plate Exit	0.119380	Suppo[illegible] Plate Exit	0.0111932	
							Section at Orifice Plate	0.123556	Section at Orifice Plate	0.032603	
19	20, 21	Steam generator simulator 18 SCH 160 SR 90° elbow	0.718170	10.308753	9.372757	9.829959	0.366726	0.366726	0.105626	0.105626	0.075858

Figure 16. (continued).

Piece Number	Node Number	Description	Length (Flow) C (m) Individual Piece	Length (Flow) C (m) Refer to Exit	Elevation (m) Entry	Elevation (m) Exit	Equivalent Diameter (m)	Equivalent Diameter (m) Exit	Area (m^2) Entry	Area (m^2) Exit	Volume (m^3)
Cold Leg (continued)											
20	21, 22	Steam gen. sim. 18 SCH 160 straight	0.263145	10.571898	9.829959	9.829959	0.36	0.366726	0.105626	0.105626	0.027795
21	22, 23	Steam gen. sim. 18 SCH 160 SR 90° elbow	0.718170	11.290068	9.829959	9.372757	0.366726	0.366726	0.105626	0.105626	0.0758577
22	23, 24	Steam generator simulator	2.051311	13.341379	9.372757	7.321447	0.370587	0.103124	0.107862	0.0083525	0.172533
							Support Plate Entry	0.119380	Support Plate Entry	0.0111932	
							Section at Orifice	0.123556	Section at Orifice	0.032603	
23	24, 25	FL-10 flange	0.206376	13.547755	7.321447	7.115071	0.103200	0.103200	0.008365	0.008365	0.00084975
24	25, 26	P13-1 5 SCH XX straight	0.282448	13.830204	7.115071	6.832622	0.103201	0.103201	0.0083647	0.0083647	0.00236261
25	26, 27	F-18 5" 90° elbow oversize	0.199492	14.029695	6.832612	6.705622	0.103201	0.103201	0.0083647	0.0083647	0.0016687
26	27, 28	FL-11 flange	0.168276	14.197071	6.705622	6.705622	0.103201	0.103201	0.0083647	0.008364	0.001408
27	28, 29	Orifice XRO 87	0.076200	14.274171	6.705622	6.705622	0.076861	0.113843	0.0046398	0.010179	0.0004852
28	29, 30	FL-12 flange	0.244476	14.518647	6.705622	6.705622	0.257201	0.257201	0.051956	0.051956	0.012702
29	30, 31	Isolation valve CV-P-138	0.762002	15.280649	6.705622	6.705622	0.257176	0.757176	0.0519454	0.0519454	0.0837535
30	31, 32	QOBV CV-P-138-1	1.651005	16.931655	6.705622	6.705622	0.257201	0.273051	0.0519557	0.0519557	0.104984

Figure 16. (continued).

Piece Number	Node Number	Description	Length (Flow) C (m) Individual Piece	Refer to Exit	Elevation (m) Entry	Exit	Equivalent Diameter (m) Entry	Exit	Area (m^2) Entry	Exit	Volume (m^3)
Hot Leg											
31	32, 33	Expansion Joint	0.99063	17.922258	6.705622	6.705622	0.273051	0.298451	0.0585564	0.069957	0.097206
32	34, 35	Core barrel nozzle	0.350521	0.731522	6.705622	6.705622	0.292101	0.292101	0.067012	0.067012	0.023896
33	35, 36	Vessel nozzle	0.525782	1.271528	6.705622	6.705622	0.284176	0.284176	0.208089	0.20809	0.033645
34	36, 37	F1 - 14 SCH 160 LR 45° elbow	0.418933	1.681317	6.705622	6.705622	0.284176	0.284176	0.063426	0.063426	0.026571
35	37, 38, 50	F2 14 x 14 x 10 SCH 160 tee	0.558802	2.240119	6.705622	6.705622	0.284176	0.284176	0.063426	0.063426	0.040343
							Branch	0.215901	Branch	0.215901	
36	38, 39	P1-1, 14 SCH 160	0.694946	2.935065	6.705622	6.[illegible]622	0.284176	0.284176	0.063425	0.063425	0.044926
37	39, 40	FL-1 flange	0.449581	3.384696	6.705622	6.705622	0.284176	0.109551	0.063425	0.030924	0.005409
38	40, 41	Orifice plate XRO-88	0.076200	3.460847	6.705622	6.705622	0.113815	0.076861	0.010174	0.0046367	0.000481
39	41, 42	FL-2 flange	0.206376	3.667222	6.705622	6.705622	0.173051	0.173051	0.0235198	0.0235198	0.004854
40	42, 43	P4-1 8 SCH 160 straight	0.494032	4.161253	6.705622	6.705622	0.173051	0.173051	0.023520	0.023520	0.011619
41	43, 44	FL3 flange	0.206376	4.367629	6.705622	6.705622	0.173051	0.173051	0.0235198	0.0235198	0.004854
42	44, 45	Orifice plate XRO-86	0.076200	4.443830	6.705622	6.705622	0.173051	0.173051	0.023519	0.023519	0.001792
43	45, 46	FL-12 flange	0.244476	4.688305	6.705622	6.705622	0.257201	0.257201	0.051956	0.051956	0.012702
44	46, 47	Isolation valve CV-P-138	0.762002	5.450307	6.705[illegible]22	6.705622	0.257176	0.257176	0.0519454	0.0519454	0.0837535
45	47, 48	QOBV, CV-P-138	1.651005	7.101313	6.705622	6.705622	0.257201	0.273051	0.0519557	0.0519557	0.104984
46	48, 49	Expansion Joint	0.990603	8.091917	6.705622	6.705622	0.273051	0.298451	0.058556	0.069957	0.097206

Figure 16. (continued).

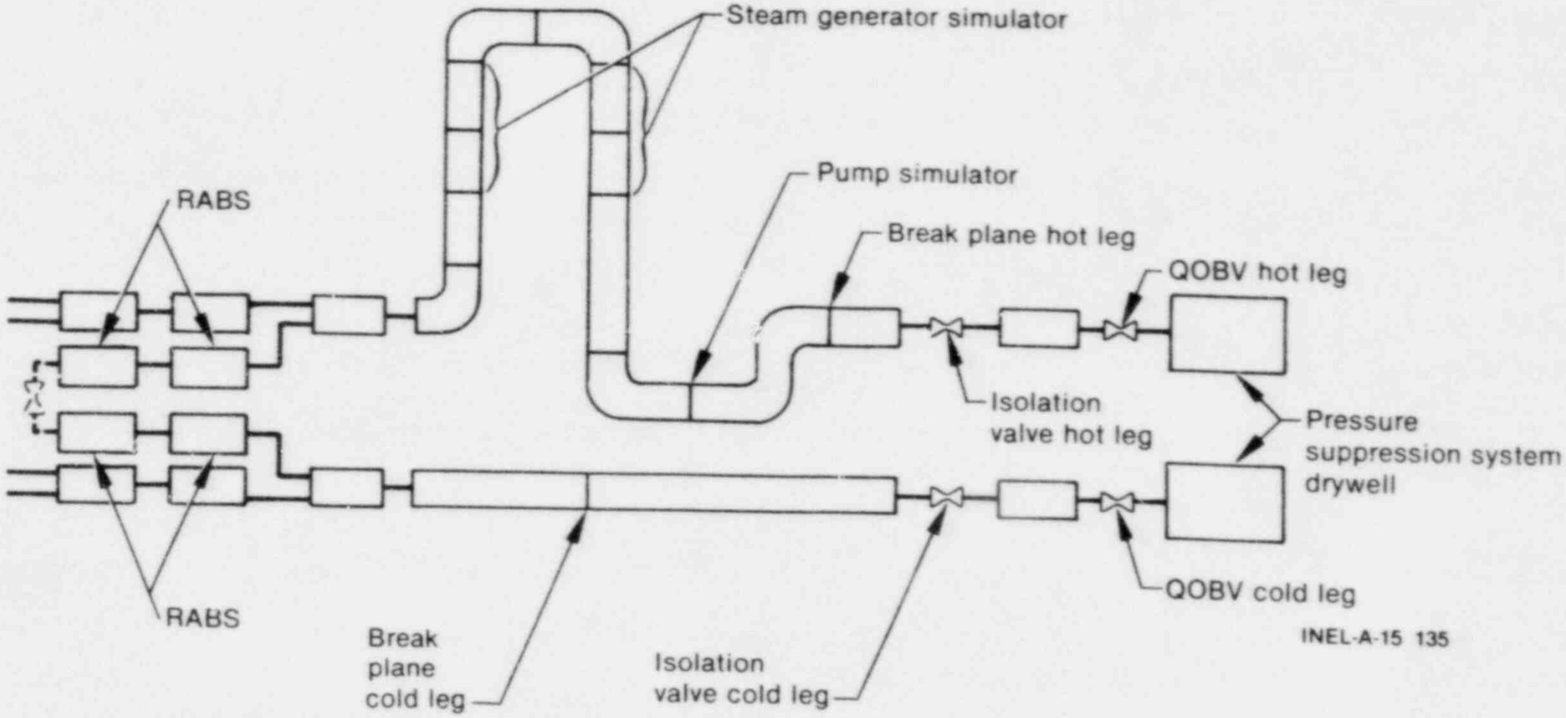
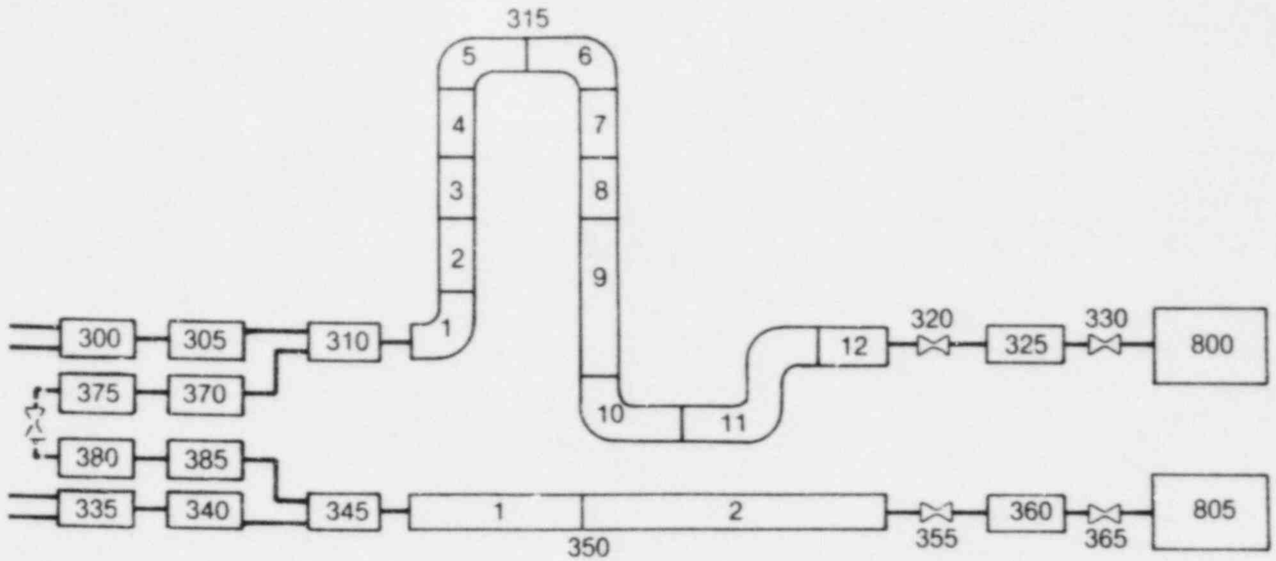


Figure 17a. Nodalization and description of components in the broken loop (identification).



INEL-A-15 135

Figure 17b. Nodalization and description of components in the broken loop (description and legend).

Component Number	Component Volume Number	Length (m)	Area (m²)	Volume (m³)	Hydraulic Diamter (m)	Elevation Change (m)	Elevation Outlet (m)	Component Type	Number of Junctions	Description	Volume Number (See Figure 9)
300	1	0.876	0.0634	0.0	0.0	0.0	0.0	Branch	3	Core barrel nozzle	32
										Vessel nozzle 3	33
305	1	0.698	0.0634	0.0	0.0	0.0	0.0	Branch	1	45 degree elbow	34
										Hlf of RABS tee hot leg	35
310	1	1.424	0.0	0.0668	0.0	0.0	0.0	Branch	2	Half of RABS tee hot leg	35
										Pipe section	36
										Flange 1	37
										Half of orifice XRO-85	
315	1	0.4054	0.00836	0.0	0.0	0.127	0.127	Pipe	11	Half of orifice XRO-85	
										Flange 11	26
										90 degree elbow	25
	2	0.5265	0.00836	0.0	0.0	0.488	0.615			Pipe section	24
										Flange 10	23
	3	0.362	0.108	0.0	0.0	0.362	0.977			Flange 9	22
	4	1.692	0.108	0.0	0.124	1.692	2.669			Flange 9	22
	5	0.8495	0.108	0.0	0.0	0.457	3.126			90 degree elbow	21
										Half of pipe section	20
	6	0.8495	0.108	0.0	0.0	-0.457	2.669			Half of pipe section	20
										90 degree elbow	19
	7	1.692	0.108	0.0	0.0	-1.692	0.977			Flange 8	18
	8	0.362	0.108	0.0	0.0	-0.362	0.615			Flange 8	18
	9	1.346	0.0	0.0162	0.0	-1.143	-0.528			Flange 7	17
										Pipe section	16
										Half of reducer	15
	10	1.325	0.0	0.0648	0.0	-0.686	-1.214			Half of reducer	15
										90 degree elbow	14
										Pump simulator	
										Flange 14	13
	11	1.842	0.00836	0.0	0.0	1.214	0.0		11	Flange 13	12
										90 degree elbow	11
										Pipe section	10
										90 degree elbow	9
										Flange 6	8
										Orifice XRO-81	
										Flange 4	43
	12	0.667	0.0525	0.0	0.0	0.0	0.0			Half of isolation valve	44

Figure 17b. (continued).

Component Number	Component Volume Number	Length (m)	Area (m^2)	Volume (m^3)	Hydraulic Diamter (m)	Elevation Change (m)	Elevation Outlet (m)	Component Type	Number of Junctions	Description	Volume Number (See Figure 9)
325	1	0.823	0.0525	0.0	0.0	0.0	0.0		0	Half of isolation valve Half of QOBV	44
335	1	0.7495	0.0634	0.0	0.0	0.0	0.0	Branch	3	Vessel filler Vessel Nozzle	1 2
340	1	0.698	0.0634	0.0	0.0	0.0	0.0	Branch	1	45 degree elbow Half of RABS tee cold leg	3 4
345	1	0.974	0.0634	0.0	0.0	0.0	0.0	Branch	2	Half of RABS tee cold leg Flow device	4 5
350	1 2	0.488 1.6085	0.0 0.0	0.00541 0.0777	0.0 0.0	0.0 0.0	0.0 0.0	Pipe	1	Flange 5 Orifice XRO-88 Flange 2 Pipe section Flange 3 Orifice XRO-86 Flange 12 Half of isolation valve cold leg	6 39 40 41 42 43 44
360	1	0.813	0.0525	0.0	0.0	0.0	0.0	Snglvol	0	Half of isolation valve cold leg Half of QOBV cold leg	44 45
370	1	2.203	0.0388	0.0	0.0	0.653	0.653	Branch	1	RABS hot leg single pipe	--
375	1	0.0	0.0776	0.0858	0.0	0.0	0.653	Snglvol	0	RABS hot leg parallel pipes	--
380	1	0.0	0.0776	0.0855	0.0	0.0	0.653	Snglvol	0	RABS cold leg parallel pipes	--
385	1	0.0	0.0388	0.118	0.0	-0.653	0.0	Branch	1	RABS cold leg single pipe	--

Figure 17b. (continued).

the current data. The orifice plates of the SG simulator are included in Volumes 315-4 and 315-7, the orifice plates for the pump simulator are in Volume 315-10. Figure 18 shows the outlet elevations of the volumes.

2.4.2 Junction-Related Components. Table 6 describes the necessary input data for the junction-related components. The loss coefficients for the SG simulator and the pump simulators are based on data by P. G. Prassinos (Reference 4). All other additional loss coefficients in the hot leg are adjusted to give the right pressure drops.

2.5 Pressurizer

The input data for the pressurizer are mainly based on Reeder (Reference 2). A detailed model for the pressurizer was necessary to simulate the behavior of the LOFT System during a LOCE with a break in the pressurizer relief valve.

2.5.1 Volume-Related Components. Figure 19a identifies the components of the pressurizer. Figure 19b describes the nodalization. This part of the system includes the pressurizer surge line, which is simulated by two volumes. The pressurizer relief valve is simulated by Component 425. The initial liquid level in the pressurizer is at the top of the third volume, e.g., Volumes 415-1, -2, -3 are full of liquid, and Volumes 415-4, -5, 420 are full of steam. To adjust the liquid level to other initial values, it is necessary to change the length of Volumes 415-3 and 415-4, whereas the sum of the lengths of these volumes has to be constant. The water level in the pressurizer is assumed to be 1.03 m above the bottom of the pressurizer. Figure 20 shows the outlet elevations of each volume.

2.5.2 Junction-Related Components. Table 7 shows the junction-related input data for the pressurizer. Component 410 simulates a

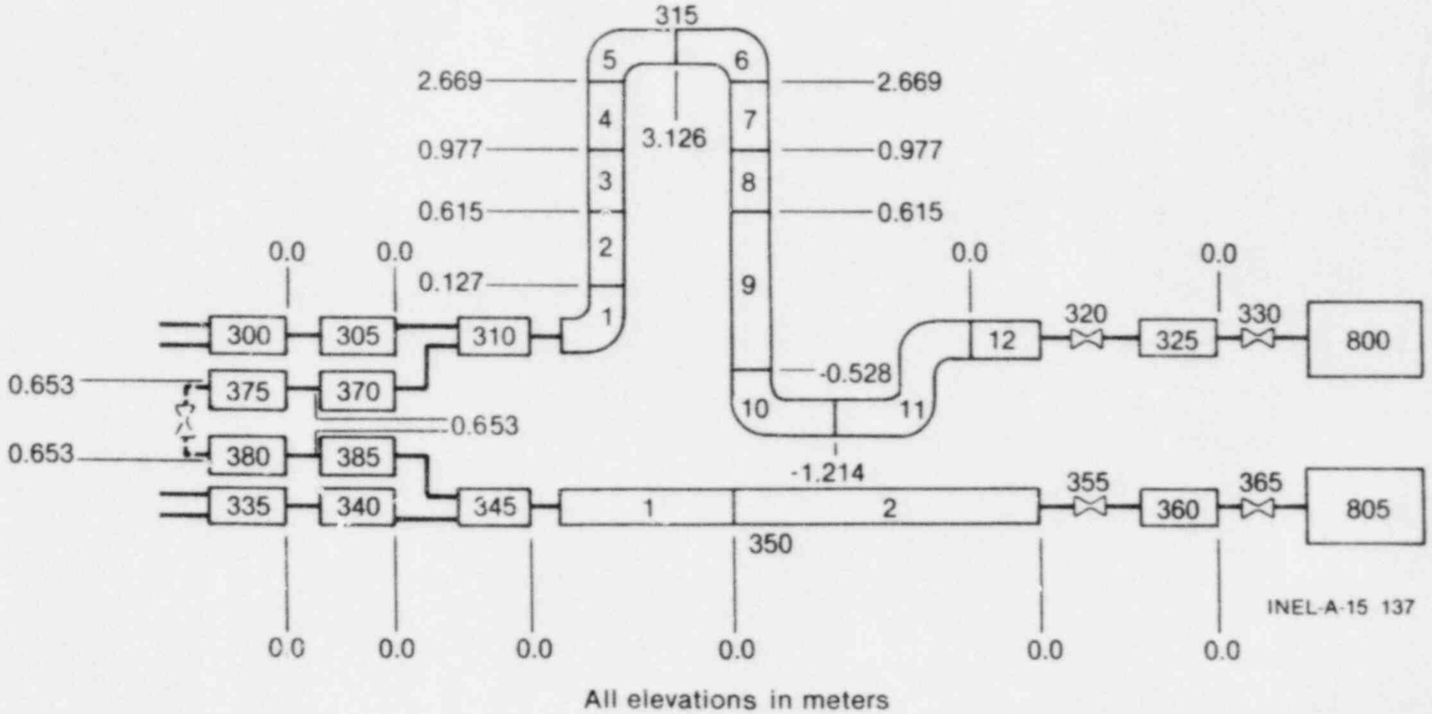


Figure 18. Volume outlet elevations in the broken loop.

TABLE 6. JUNCTION-RELATED DATA--BROKEN LOOP

Component Number	Junction Number	Volume Number From	Volume Number To	Area (m^2)	Junction Flag	Loss Coefficient Forward	Loss Coefficient Reverse	Description
300	1	2450101	3000100	0.0317	0100	0.0	0.0	Reactor vessel outlet
	2	3000101	3050100	0.0	0000	0.1	0.1	
	3	2500100	3000100	0.0317	0100	0.0	0.0	
305	1	3050101	3100100	0.0	0100	0.1	0.1	
310	1	3700101	3100100	0.0	0100	0.0	0.0	Reflood assist bypass junction
	2	3100101	3150100	0.0	0100	0.0	0.0	
315	1	3150101	3150200	0.0	0000	0.2	0.2	
	2	3150201	3150300	0.0	0100	0.0	0.0	
	3	3150301	3150400	0.0326	0100	93.9	93.9	SG. simulator
	4	3150401	3150500	0.0326	0100	93.9	93.9	SG. simulator
	5	3150501	3150600	0.108	0000	0.4	0.4	SG. simulator
	6	3150601	3150700	0.0326	0100	93.9	93.9	SG. simulator
	7	3150701	3150800	0.0326	0100	93.9	93.9	SG. simulator
	8	3150801	3150900	0.0	0000	0.0	0.0	
	9	3150901	3151000	0.0	0100	0.2	0.2	
	10	3151001	3151100	0.0081	0100	4.1	4.1	Pump simulator
	11	3151101	3151200	0.0	0100	0.4	0.4	

TABLE 6. (continued)

Component Number	Junction Number	Volume Number From	Volume Number To	Area (m^2)	Junction Flag	Loss Coefficient Forward	Loss Coefficient Reverse	Description
320		3151201	3250100	0.0	0100	0.0	0.0	Isolation valve
330		3250101	8000100	0.0466	0100	0.0	0.0	QOBV
335	1	2050100	3350100	0.0317	0100	1.0	1.0	
	2	3350101	3400100	0.0	0000	0.1	0.1	
	3	2000100	3350100	0.0317	0100	1.0	1.0	
340	1	3400101	3450100	0.0	0000	0.1	0.1	
345	1	3850101	3450100	0.0	0100	0.0	0.0	
	2	3450101	3500100	0.0	0100	0.0	0.0	
350	1	3500101	3500200	0.0	0100	0.0	0.0	Break plane
355		3500201	3600100	0.0	0100	0.0	0.0	
365		3600101	8050100	0.0466	0100	0.0	0.0	
370		3750101	3700100	0.0	0100	0.0	0.0	
385		3800101	3850100	0.0	0100	0.0	0.0	

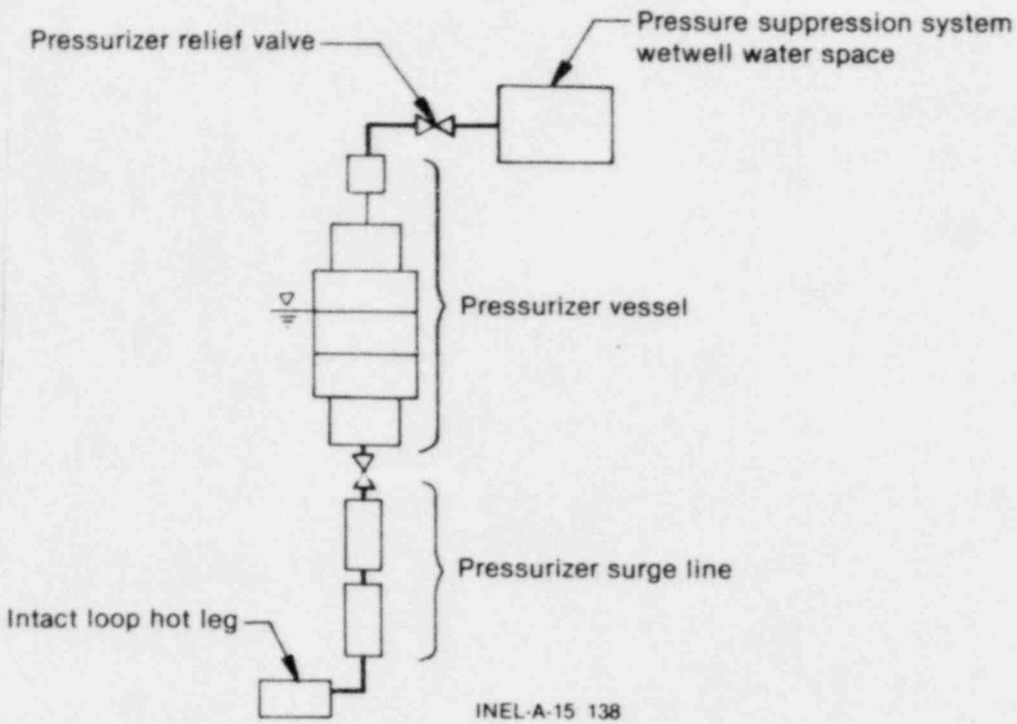


Figure 19a. Nodalization and description of components in the pressurizer (identification).

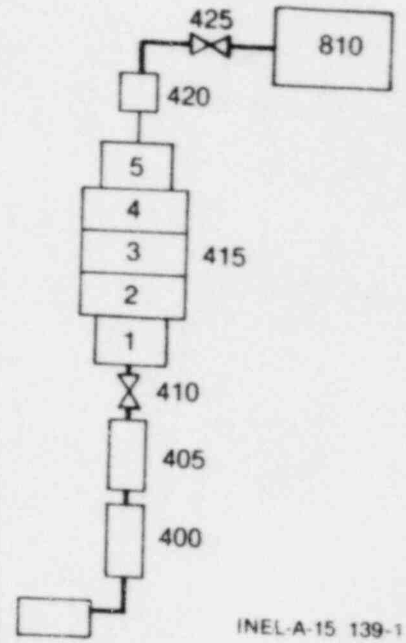


Figure 19b. Nodalization and description of components in the pressurizer (description and legend)

Component Number	Component Volume Number	Length (m)	Area (m^2)	Volume (m^3)	Hydraulic Diamter (m)	Elevation Change (m)	Elevation Outlet (m)	Component Type	Number of Junctions	Description
400	1	3.45	0.00145	0.0	0.0	0.54	0.54	Branch	2	Pressurizer surge line PCS side
405	1	3.45	0.00145	0.0	0.0	0.60	1.14	Snglvol	0	Pressurizer surge line pressurizer side
415	1	0.224	0.362	0.0	0.0	0.224	1.364	Pipe	4	Pressurizer inlet
	2	0.403	0.565	0.0	0.403	1.767				Pressurizer vessel water space
	3	0.403	0.565	0.0	0.0	0.403	2.17			Pressurizer vessel water space
	4	0.414	0.565	0.0	0.0	0.414	2.584			Pressurizer vessel steam space
	5	0.341	0.466	0.0	0.0	0.341	2.925			Pressurizer vessel steam space
420	1	0.236	0.13	0.0	0.0	0.236	3.161			Pressurizer outlet

Figure 19b. (continued).

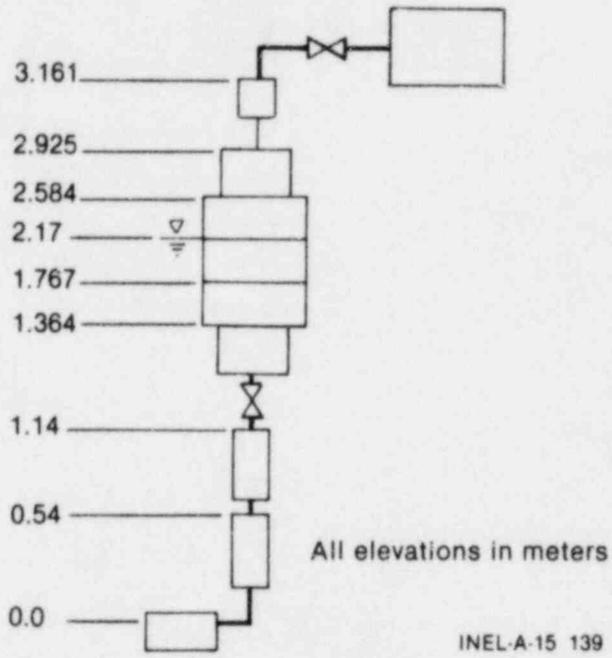


Figure 20. Volume outlet elevations in the pressurizer.

TABLE 7. JUNCTION-RELATED DATA--PRESSURIZER

Component Number	Junction Number	Volume Number From	Volume Number To	Area (m^2)	Junction Flag	Loss Coefficient Forward	Loss Coefficient Reverse	Description
400	1	1100100	4000100	0.0	0100	0.93	0.93	Connection surge line, hot leg
	2	4000101	4050100	0.0	0000	0.93	0.93	Half way surge line
410		4050101	4150100	0.0	0100	0.93	0.93	Inlet pressurizer
415	1	4150101	4150200	0.0	0100	0.0	0.0	Pressurizer
	2	4150201	4150300	0.0	0000	0.0	0.0	
	3	4150301	4150400	0.0	0000	0.0	0.0	
	4	4150401	4150500	0.0	0100	0.0	0.0	
420		4150501	4200100	0.0	0100	0.0	0.0	
425		4150601	8100100	9.0 E-5	0100	0.0	0.0	Pressurizer relief valve

valve in the pressurizer inlet, and Component 420, the Pressurizer Power Operated Relief Valve (PORV). The area of the PORV was chosen to give the right depressurization rate for Test L3-0.

The loss coefficients in the surge line are included to simulate the different bends in this pipe. The values are based on Prassinos (Reference 4). In the current input data no heat slabs are used for the simulation of the heater. Also the pressurizer spray system is not simulated.

2.6 Steam Generator Secondary

A detailed model for the steam generator secondary has been developed. Because the available information for this part is not as detailed as for the other parts of the LOFT System, the input data are based on drawings.

2.6.1 Volume-Related Data. Figure 21a identifies the components in the steam generator secondary. Figure 21b describes the nodalization scheme. The steam generator secondary consists of 12 components including the steam control valve and the feedwater valve. A total of 18 volumes and 16 junctions are used for the steam generator secondary. The length of Volume 515-4 to 515-7 is larger than the elevation change because the fluid has to flow around the baffles installed in the boiler section of the steam generator. Figure 22 shows the volume outlet elevations.

2.6.2 Junction-Related Data. The junction-related input data are shown in Table 8. The loss coefficients are adjusted to give the right steady-state circulation flow rate in the steam generator.

2.6.3 Heat Slabs. The heat slab input data for the steam generator secondary are included in Table 9. These heat slabs simulate the shroud separating the downcomer and boiler sections.

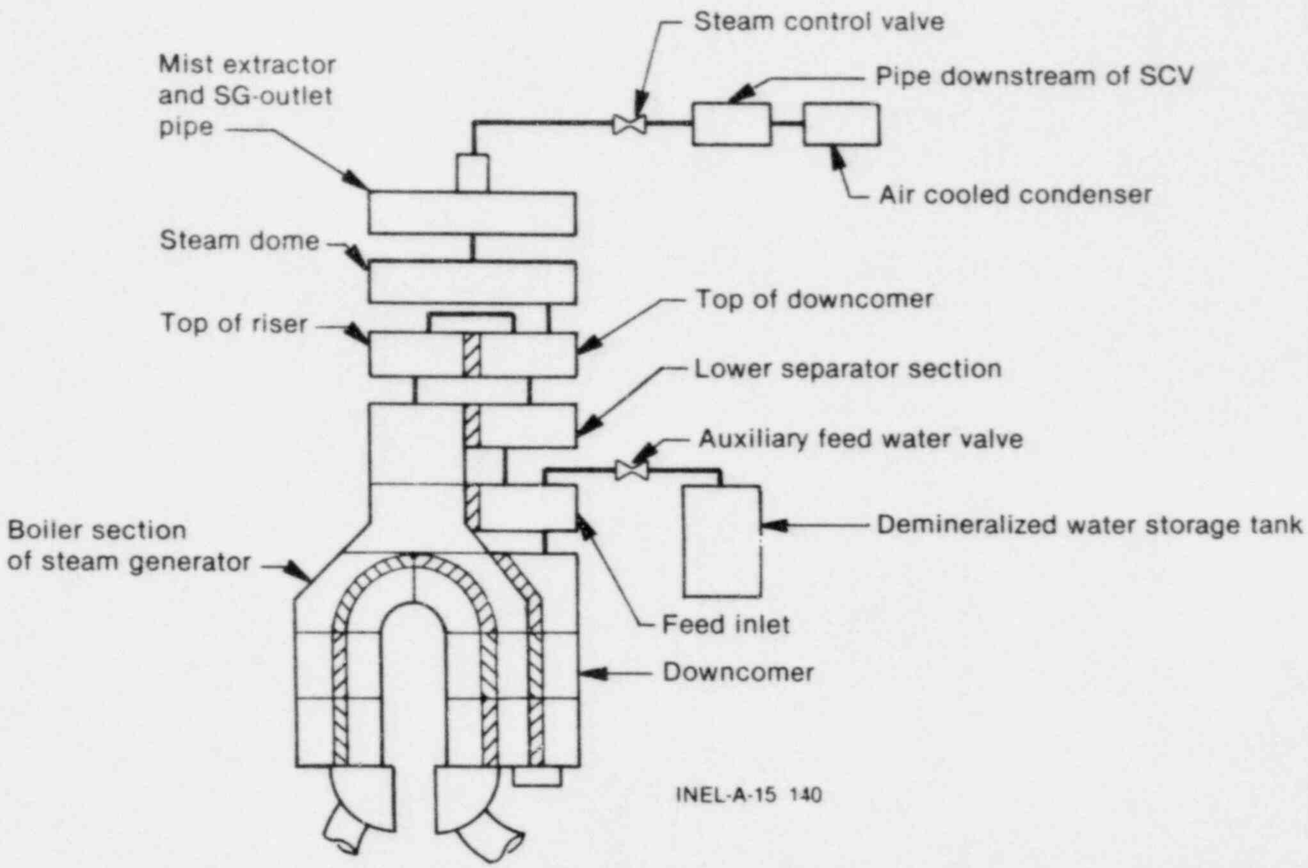


Figure 21a. Nodalization and description in the SG secondary (identification).

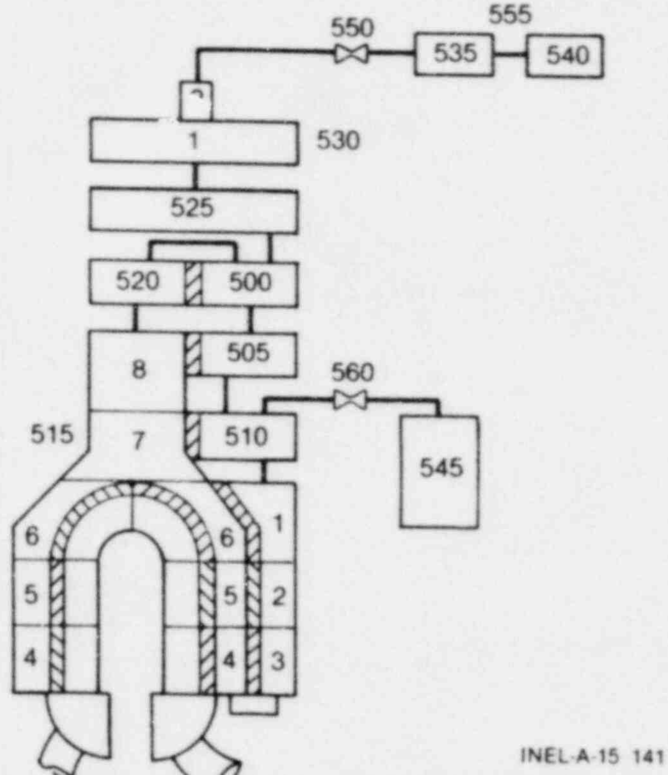


Figure 21b. Nodalization and description in the SG secondary (description and legend).

Component Number	Component Volume Number	Length (m)	Area (m^2)	Volume (m^3)	Hydraulic Diamter (m)	Elevation Change (m)	Elevation Outlet (m)	Component Type	Number of Junctions	Description
500	1	0.718	1.273	0.0	0.7874	-0.718	4.1256	Branch	3	Oulet of primary separator, top of volume is at top of shroud
505	1	0.718	1.273	0.0	0.7874	-0.718	3.4076	Snglvol	--	Volume between bottom of 500 top of feed ring
510	1	0.518	0.7525	0.0	0.10796	-0.518	2.8896	Branch	2	Top of volume is feed ring elevation Bottom of volume is at narrow portion of downcomer
515	1	0.7102	0.23226	0.0	0.10796	-0.7102	2.1794	Pipe	7	Narrow section of downcomer, volume between shroud and tubes, lower part of riser
	2	0.7102	0.23226	0.0	0.10796	-0.7102	1.4692			
	3	0.7102	0.23226	C.0	0.10796	-0.7102	0.759			
	4	1.85075	0.27871	0.0	0.0305	0.7102	1.4692			
	5	1.85075	0.27871	0.0	0.0305	0.7102	2.1794			
	6	1.85075	0.27871	0.0	0.0305	0.7102	2.8896			
	7	1.85075	0.27871	0.0	0 0305	0.518	3.40776			
		8	0.718	0.27871	0.0	0.0	0.718	4.1256		
520	1	0.718	0.27871	0.0	0.0	0.718	4.8434	Branch	1	Top of riser, inlet to primary separator
525	1	0.762	1.5886	0.0	0.0	0.762	5.6054	Branch	1	Bottom of steam dome between primary separator outlet and mist extractor inlet
530	1	0.762	1.2728	0.0	0.0	0.762	6.3674	Pipe	1	Top of steam dome between mist extractor and outlet pipe. Outlet pipe to steam flow control flow
	2	25.074	0.04635	0.0	0.0	0.0	6.3674			
535	1	54.44	0.06557	0.0	0.0	0.0	6.3674	Snglvol	--	Steam generator outlet pipe between steam flow control valve and air cooled condenser
540	1	17.67	0.21677	0.0	0.02	0.0	6.3674	Tmdpvol	--	Air cooled condenser
545	1	3.048	29.81	0.0	0.0	0.0	3.4076	Tmdpvol	--	Demineralized water storage tanks

Figure 21b. (continued).

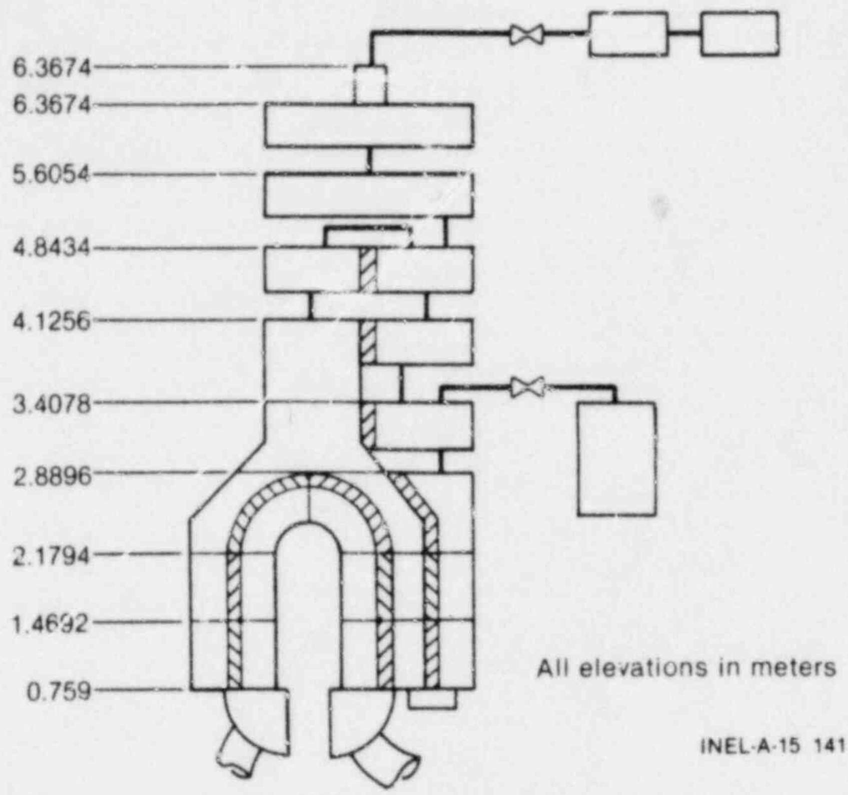


Figure 22. Volume outlet elevations in the SG secondary.

TABLE 8. JUNCTION-RELATED DATA--SG SECONDARY

Component Number	Junction Number	Volume Number		Area (m^2)	Junction Flag	Loss Coefficient		Description
		From	To			Forward	Reverse	
500	1	5000100	5250100	1.2728	0100	0.0	0.0	Separator to steam dome
	2	5000101	5050100	0.0	0100	0.0	0.0	Separator to downcomer
	3	5200101	5000100	0.196	0100	0.4	0.4	Riser to downcomer (separator)
510	1	5050101	5100100	0.0	0100	0.0	0.0	Downcomer
	2	5100101	5150100	0.0	0100	0.0	0.0	
515	1	5150101	5150200	0.0	0000	0.0	0.0	Downcomer
	2	5150201	5150300	0.0	0000	0.0	0.0	
	3	5150301	5150400	0.0	0100	17.5	17.5	Downcomer to boiler
	4	5150401	5150500	0.0	0000	4.2	4.2	Divider plate
	5	5150501	5150600	0.0	0000	8.8	8.8	Divider plate
	6	5150601	5150700	0.0	0000	4.2	4.2	Divider plate
	7	5150701	5150800	0.0	0000	0.0	0.0	Riser
520	1	5150801	5200100	0.0	0100	0.0	0.0	Riser
525	1	5250101	5300100	0.0	0100	0.8	0.8	Mist extractor
530	1	5300101	5300200	0.01365	0100	0.4	0.4	6" outlet pipe
550	1	5300201	5350100	0.002573	0100	0.0	0.0	Steam control valve
555	1	5350101	5400100	0.0	0100	0.0	0.0	Steam pipe to condenser
560	1	5450100	5100100	0.05	0100	0.0	0.0	Auxiliary main feed pump

TABLE 9. HEAT SLAB DATA--SG SECONDARY

Heat Structure Number	Geometry Type	Left Boundary Volume	Right Boundary Volume	Area/Length (m^2/m)	Interval Number	Components	Left Boundary (m)	Right Boundary (m)
1500-1	CYL	50001	52001	0.7725	1-3	C-STEEL	0.3048	0.314325
-2		50501	51508	0.7725	1-3	C-STEEL	0.3048	0.314325
-3		51001	51507	0.7725	1-3	C-STEEL	0.3048	0.314325

2.7 ECC System

The input data for the ECC System, similar to the steam generator secondary, were difficult to develop because little information is available. The input data are similar to those of RELAP4/MOD6 (Reference 5). Figure 23a identifies the components. The HPIS and the LPIS are simulated by time-dependent junctions.

2.7.1 Volume-Related Data. Figure 23b describes a nodalization schematic. This part of the LOFT System is simulated by eight components, including the ECC-valve and the accumulater check valve. Also, the ECC pipes to the intact loop cold leg are simulated by separate components. The ECC System is connected to Component 185 in the intact loop. The outlet elevations of the different volumes are shown in Figure 24.

2.7.2 Junction-Related Data. Table 10 shows the necessary junction-related input data for the ECC System.

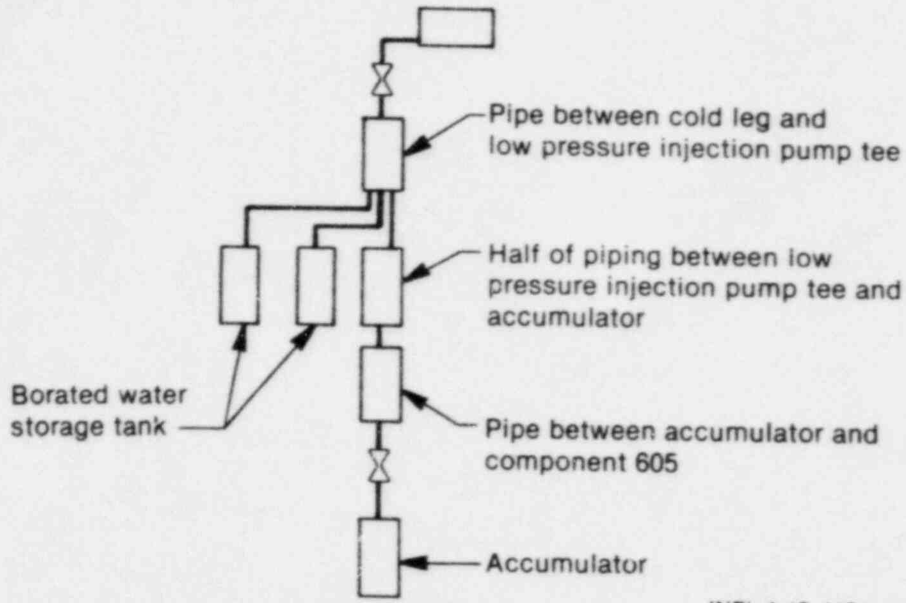
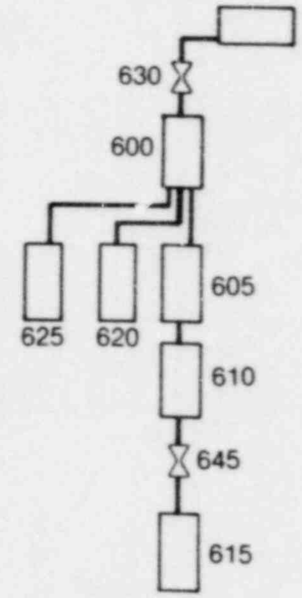


Figure 23a. Nodalization and description of components in the ECC system (identification).



INEL-A-15 143

Figure 23b. Nodalization and description of components in the ECC system (description and legend).

Component Number	Component Volume Number	Length (m)	Area (m^2)	Volume (m^3)	Hydraulic Diamter (m)	Elevation Change (m)	Component Type	Number of Junctions	Description
600	1	8.8776	0.009099	0.0	-3.20	0.0	Branch	--	Pipe between cold leg and low pressure injection pump tee
605	1	9.4891	0.014582	0.0	0.0	0.0	Branch	--	Half of piping between low pressure injection pump tee and accumulator
610	1	7.55998	0.018638	0.0	0.0	0.0	Snglvol	--	Pipe between accumulator outlet and Component 605
615	1	2.33	1.254	0.0	2.33	0.0	Snglvol	--	Accumulator
620	1	5.0	20.44	0.0	5.0	0.0	Snglvol	--	Borated water storage tank
625	1	5.0	20.44	0.0	5.0	0.0	Snglvol	--	Borated water storage tank

Figure 23b. (continued).

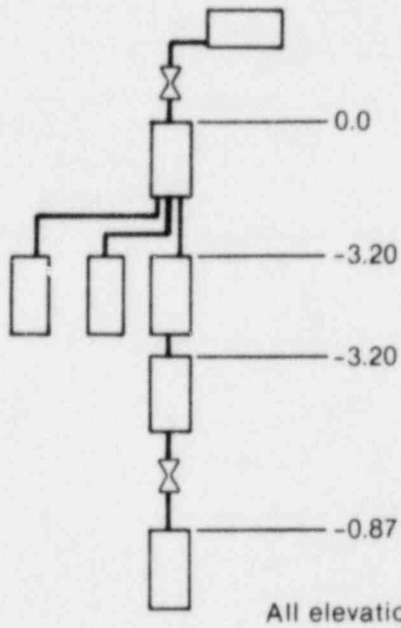


Figure 24. Volume outlet elevations in the ECC system.

TABLE 10. JUNCTION RELATED DATA--ECC SYSTEM

Component Number	Junction Number	Volume Number		Area (m^2)	Junction Flag	Loss Coefficient		Description
		From	To			Forward	Reverse	
605	1	6050101	6000100	0.014582	0100	0.8	0.8	
	2	6100101	6050100	0.014582	0100	0.7	0.7	
630		6000101	1850100	0.009099	0100	0.0	0.0	ECC valve
635		6200101	6000100	0.009099				TMDPJUN - LPIS
640		6250101	6000100	0.009099				TMDPJUN - HPIS
645		6150101	6100100	0.003167	0100	1.6	1.6	Accumulator valve

CONCLUSION

The LOFT input data set described for the computer code RELAP5/MOD0 represents the latest information available for the LOFT System. The data set can be used to simulate different LOFT-LOCEs and operational transients, minimizing the time required in the preparation of the basic input deck. To guarantee a frozen version of this input deck, changes are only possible by using updates. Several calculations using this data set have demonstrated the validity of the input deck.

REFERENCES

1. P. D. Bayless, letter to P. J. Schally, LOFT Volumes, April 1980.

2. D. L. Reeder, LOFT System and Test Description, NUREG/CR-0247, TREE-1208, July 1978.

3. V. H. Ransom et al., RELAP5/MOD0 Code Description, CDAP-TR 057 (Vol. 1-3), May 1979.

4. P. G. Prassinos, LOFT Acceptance Test Results, LTR 20-87, February 1979.

5. W. H. Grush, M. S. Shinko, Best Estimate Prediction for Nuclear Experiment L3-1, EG&G-LOFT-5033, November 1979.

APPENDIX A

LOFT L3-0 INPUT LISTING

```
*********************************************************
* MINOR EDIT VARIABLES                                  *
*********************************************************
* PRESSURES                                             *
*********************************************************
0000301   P        345010000        * PE-BL-1
0000302   P        310010000        * PE-BL-2
0000303   P        315110000        * PE-BL-3
0000304   P        350010000        * PE-BL-4
0000305   P        315090000        * PE-BL-6
0000306   P        350020000        * PE-BL-8
0000307   P        185010000        * PE-PC-1
0000308   P        100010000        * PE-PC-2
0000309   P        415050000        * PE-PC-4 / PT-139-5
0000310   P        110010000        * PT-139-2,3,4
0000311   P        245010000        * PE-1UP-1A,1B
0000312   P        215010000        * PE-1ST-1A,B/PE-2ST-1A,B
0000313   P        200010000        * PE-1ST-3A,3B
0000314   P        530020000        * PT-P4-10A
0000315   P        535010000        * PT-P4-85
*********************************************************
* TEMPERATURES                                          *
*********************************************************
0000321   TEMP     345010000        * TE-BL-1A,1B,1C
0000322   TEMP     310010000        * TE-BL-2A,2B,2C
0000323   TEMP     100010000        * TE-PC-2A,2B,2C
0000324   TEMP     185010000        * TE-PC-1
0000325   TEMP     115030000        * TE-SG-1
0000326   TEMP     115100000        * TE-SG-2
0000327   TEMP     515040000        * TE-SG-3
0000328   TEMP     415040000        * TE-139-19
0000329   TEMP     415030000        * TE-139-20
0000330   TEMP     205010000        * TE-1ST-1 / TE-2ST-1
0000331   TEMP     210010000        * TE-1ST-2 / TE-2ST-2
0000332   TEMP     210020000        * TE-1ST-4 / TE-2ST-4
0000333   TEMP     210030000        * TE-1ST-14 / TE-2ST-14
0000334   TEMP     210040000        * TE-3UP-2
0000335   TEMP     245010000        * TE-1UP-6
0000336   TEMP     246010000        * TE-2UP-4
0000337   TEMP     250010000        * TE-1UP-3
*********************************************************
* DENSITIES                                             *
*********************************************************
0000341   RHO      345010000        * DE-BL-1
0000342   RHO      310010000        * DE-BL-2
0000343   RHO      185010000        * DE-PC-1
0000344   RHO      100010000        * DE-PC-2
0000345   RHO      115120000        * DE-PC-3
*********************************************************
* VELOCITIES                                            *
*********************************************************
0000351   VELF     345010000        * FE-BL-1
0000352   VELF     310010000        * FE-BL-2
0000353   VELF     185010000        * FE-PC-1
0000354   VELF     100010000        * FE-PC-2
0000355   VELG     345010000        * FE-BL-1
0000356   VELG     310010000        * FE-BL-2
0000357   VELG     185010000        * FE-PC-1
0000358   VELG     100010000        * FE-PC-2
*********************************************************
* MASS FLOW RATES                                       *
*********************************************************
0000361   MFLOWJ   350010000        * BREAK PLANE BLCL
0000362   MFLOWJ   315110000        * BREAK PLANE BLHL
0000363   MFLOWJ   345020000        * DTT-RAKE BLCL
0000364   MFLOWJ   310020000        * DTT-RAKE BLHL
0000365   MFLOWJ   185020000        * DTT-RAKE ILCL
0000366   MFLOWJ   100020000        * DTT-RAKE ILHL
0000367   MFLOWJ   400010000        * PRES. SURGE LINE FLOW
0000368   MFLOWJ   425000000        * PRES. RELIEF VALVE FLOW
0000369   MFLOWJ   555000000        * FE-P4-12
0000370   MFLOWJ   560000000        * FE-P4-72-1
*********************************************************
* CLADDING TEMPERATURES CENTER MODULE                   *
*********************************************************
0000381   HTTEMP   230000110        * TE-5H5-015
0000382   HTTEMP   230000210        * TE-5H5-034
0000383   HTTEMP   230000210        * TE-5H5-049
```

```
************************************************************
************************************************************
********************** INTACT LOOP *************************
************************************************************
************************************************************
* REACTOR VESSEL NOZZLE INTACT LOOP HOT LEG                *
************************************************************
1000000   RVNILHL     BRANCH
1000001   3           1
1000101   0.0634      1.5372      0.0         0.0         0.0         0.0
1000102   4.0E-5      0.0         00
1000200   3           14.740E+6   558.0       0.0
1001101   245010000   100000000   0.0317      0.0         0.0         0100
1002101   100010000   105000000   0.0         0.05        0.05        0100
1003101   250000000   100000000   0.0317      0.0         0.0         0100
1001201   201.0       0.0         0.0
1002201   201.0       0.0         0.0
1003201   100.5       0.0         0.0
************************************************************
* PRESSURIZER CONNECTION TEE REACTOR VESSEL SIDE           *
************************************************************
1050000   PRCTRVS     BRANCH
1050001   1           1
1050101   0.0634      1.634       0.0         0.0         0.0         0.0
1050102   4.0E-5      0.0         00
1050200   3           14.740E+6   558.0       0.0
1051101   105010000   110000000   0.0         0.05        0.05        0100
1051201   201.0       0.0         0.0
************************************************************
* STEAM GENERATOR INLET PIPING                             *
************************************************************
1100000   SGINLP      BRANCH
1100001   1           1
1100101   0.0         1.1303      0.06204     0.0         0.0         0.0
1100102   4.0E-5      0.0         00
1100200   3           14.740E+6   558.0       0.0
1101101   110010000   115000000   0.0         0.1         0.1         0100
1101201   201.0       0.0         0.0
************************************************************
* STEAM GENERATOR PLUS PIPING                              *
************************************************************
1150000   SGAPS       PIPE
1150001   13
1150101   0.0         3
1150102   0.151       9
1150103   0.0         12
1150104   0.0634      13
1150201   0.0         1
1150202   0.0512      2
1150203   0.0         9
1150204   0.0512      10
1150205   0.0         12
1150301   0.93124     1
1150302   0.708       2
1150303   0.63        3
1150304   1.067       5
1150305   0.45        7
1150306   1.067       9
1150307   0.63        10
1150308   0.547       11
1150309   0.689       12
1150310   0.855       13
1150401   0.05826     1
1150402   0.057       2
1150403   0.223       3
1150404   0.0         9
1150405   0.223       10
1150406   0.0437      11
1150407   0.0462      12
1150408   0.0         13
1150501   0.0         13
1150601   0.0         1
1150602   90.0        6
1150603   -90.0       13
```

```
1150701   0.0         1
1150702   0.246       2
1150703   0.513       3
1150704   1.067       5
1150705   0.2865      5
1150706   -0.2865     7
1150707   -1.067      9
1150708   -0.513      10
1150709   -0.498      11
1150710   -0.669      12
1150711   -0.355      13
1150801   4.0E-5      0.0         2
1150802   4.0E-5      0.0102      3
1150803   1.0E-5      0.0103      9
1150804   4.0E-5      0.0102      10
1150805   4.0E-5      0.0         13
1150901   0.15        0.15        1
1150902   0.05        0.05        2
1150903   0.0         0.0         4
1150904   0.1         0.1         5
1150905   0.2         0.2         6
1150906   0.1         0.1         7
1150907   0.0         0.0         9
1150908   0.05        0.05        11
1150909   0.1         0.1         12
1151001   00          13
1151101   0100        3
1151102   0000        8
1151103   0100        12
1151201   3           14.740E+6  558.0       0.0         13
1151300   1
1151301   201.0       0.0         0.0         12
*******************************************************************
* PUMP SUCTION TEE                                                *
*******************************************************************
1200000   PSTEE       BRANCH
1200001   3           1
1200101   0.0634      0.76        0.0         0.0         0.0         0.0
1200102   4.0E-5      0.0         00
1200200   3           14.740E+6  558.0       0.0
1201101   115010000  120000000  0.0         0.1         0.1         0000
1202101   120010000  125000000  0.0317      0.2         0.2         0100
1203101   120010000  155000000  0.0317      0.2         0.2         0100
1201201   201.0       0.0         0.0
1202201   100.5       0.0         0.0
1203201   100.5       0.0         0.0
*******************************************************************
* PUMP1 SUCTION TEE OUTLET                                        *
*******************************************************************
1250000   P1STOL      BRANCH
1250001   2           1
1250101   0.0         1.003       0.0613      0.0         90.0        0.521
1250102   4.0E-5      0.0         00
1250200   3           14.740E+6  558.0       0.0
1251101   125010000  130000000  0.0         0.1         0.1         0100
1252101   125000000  155000000  0.0         0.0         0.0         0100
1251201   100.5       0.0         0.0
1252201   0.0         0.0         0.0
*******************************************************************
* PUMP 1 INLET                                                    *
*******************************************************************
1300000   P1INL       SNGLVOL
1300101   0.0         0.457       0.0189      0.0         90.0        0.457
1300102   4.0E-5      0.0         00
1300200   3           14.740E+6  558.0       0.0
*******************************************************************
* PRIMARY COOLANT PUMP 1                                          *
*******************************************************************
1350000   PCP1        PUMP
1350101   0.0365      0.0         0.099       0.0         90.0        0.319
1350102   0
1350108   130010000  0.0         0.0         0.0         0100
1350109   140000000  0.0         0.05        0.05        0100
1350200   3           14.740E+6  558.0       0.0
1350201   1           100.5       0.0         0.0
1350202   1           100.5       0.0         0.0
1350301   0     0     0     -1    -1    501   0
1350302   369.0       0.35771     0.3155      46.0        500.6       1.431
1350303   613.6       0.0         153.0       0.003       14.455      0.0
1350310   0.0         0.0         0.0
```

```
*****************************************************************************
* PUMP 1 OUTLET PUMP SIDE
*                                                                           *
*****************************************************************************
1400000    P1OTLPS    SNGLVOL
1400101    0.0366     0.502      0.0        0.0        0.0        0.0
1400102    4.0E-5     0.0        00
1400200    3          14.740E+6  558.0      0.0
*****************************************************************************
* PUMP1 OUTLET PIPE TEE SIDE
*                                                                           *
*****************************************************************************
1450000    POPTS      BRANCH
1450001    2          1
1450101    0.0        1.4064     0.0633     0.0        0.0        0.0
1450102    4.0E-5     0.0        00
1450200    3          14.740E+6  558.0      0.0
1451101    140010000  145000000  0.0        0.1        0.1        0100
1452101    145010000  150000000  0.0        0.0        0.0        0100
1451201    100.5      0.0        0.0
1452201    100.5      0.0        0.0
*****************************************************************************
* PUMP OUTLET TEE
*                                                                           *
*****************************************************************************
1500000    POTLTEE    BRANCH
1500001    2          1
1500101    0.0634     0.4966     0.0        0.0        0.0        0.0
1500102    4.0E-5     0.0        00
1500200    3          14.740E+6  558.0      0.0
1501101    170010000  150000000  0.0183     0.2        0.2        0100
1502101    150010000  175000000  0.0        0.1        0.1        0100
1501201    100.5      0.0        0.0
1502201    201.0      0.0        0.0
*****************************************************************************
* PUMP 2 SUCTION TEE OUTLET
*                                                                           *
*****************************************************************************
1550000    P2STOL     BRANCH
1550001    1          1
1550101    0.0        1.003      0.0613     0.0        90.0       0.521
1550102    4.0E-5     0.0        00
1550200    3          14.740E+6  558.0      0.0
1551101    155010000  160000000  0.0        0.1        0.1        0100
1551201    100.5      0.0        0.0
*****************************************************************************
* PUMP 2 INLET PIPE
*                                                                           *
*****************************************************************************
1600000    P2INL      SNGLVOL
1600101    0.0        0.457      0.0189     0.0        90.0       0.457
1600102    4.0E-5     0.0        00
1600200    3          14.740E+6  558.0      0.0
*****************************************************************************
* PRIMARY COOLANT PUMP 2
*                                                                           *
*****************************************************************************
1650000    PCP2       PUMP
1650101    0.0366     0.0        0.099      0.0        90.0       0.319
1650102    0
1650108    160010000  0.0        0.0        0.0        0100
1650109    170000000  0.0        0.1        0.1        0100
1650200    3          14.740E+6  558.0      0.0
1650201    1          100.5      0.0        0.0
1650202    1          100.5      0.0        0.0
1650301    135  135   135   -1   -1    501  0
1650302    369.0      0.35771    0.3155     96.0       500.6      1.431
1650303    613.6      0.0        153.0      0.003      14.455     0.0
1650310    0.0        0.0        0.0
*****************************************************************************
* PUMP 2 OUTLET
*                                                                           *
*****************************************************************************
1700000    P2OUTL     BRANCH
1700001    1          1
1700101    0.0366     0.514      0.0        0.0        0.0        0.0
1700102    4.0E-5     0.0        00
1700200    3          14.740E+6  558.0      0.0
1701101    145010000  170010000  0.0183     0.2        0.2        0100
1701201    0.0        0.0        0.0
```

```
****************************************************************************
* COLD LEG PIPE TO ECC  CONNECTION TEE                                     *
****************************************************************************
1750000    PTECT       PIPE
1750001    2
1750101    0.0634      2
1750201    0.0         1
1750301    0.559       1
1750302    0.613       2
1750401    0.0         2
1750501    0.0         2
1750601    0.0         2
1750701    0.0         2
1750801    4.0E-5      0.0         2
1750901    0.15        0.15        1
1751001    00          2
1751101    0100        1
1751201    3           14.740E+6 558.0       0.0         2
1751300    1
1751301    201.0       0.0         0.0         1
****************************************************************************
* ECC CONNECTION TEE PUMP SIDE                                             *
****************************************************************************
1800000    ECTPS       BRANCH
1800001    1           1
1800101    0.0634      1.152       0.0         0.0         0.0         0.0
1800102    4.0E-5      0.0         00
1800200    3           14.740E+6   558.0       0.0
1801101    175010000   180000000   0.0         0.05        0.05        0100
1801201    201.0       0.0         0.0
****************************************************************************
* COLD LEG PIPE FROM ECC CONNECTION TO REACTOR VESSEL                      *
****************************************************************************
1850000    CLPRVS      BRANCH
1850001    3           1
1850101    0.0634      1.01        0.0         0.0         0.0         0.0
1850102    4.0E-5      0.0         00
1850200    3           14.740E+6   558.0       0.0
1851101    185010000   205000000   0.0317      1.0         1.0         0100
1852101    180010000   135000000   0.0         0.0         0.0         0100
1853101    185010000   200000000   0.0317      1.0         1.0         0100
1851201    201.0       0.0            0.0
1852201    201.0       0.0            0.0
1853201    100.5       0.0            0.0
```

```
**********************************************************************
**********************************************************************
****************** REACTOR VESSEL ************************************
**********************************************************************
**********************************************************************
**********************************************************************
* INLET ANNULUS TOP VOLUME                                           *
**********************************************************************
2000000   IANLTVOL   BRANCH
2000001   2          1
2000101   0.0        0.33       0.0655    0.0       90.0      0.33
2000102   4.0E-5     0.178      00
2000200   3          14.740E6   558.0     0.0
2001101   200000000  205000000  0.0       0.0
2002101   200000000  245010000  0.001     0.0       0.0       0100
2001201   100.5      0.0        0.0                 0.0       0100
2002201   0.0        0.0        0.0
**********************************************************************
* INLET ANNULUS LOWER VOLUME                                         *
**********************************************************************
2050000   IANLVOL    BRANCH
2050001   1          1
2050101   0.0        0.424      0.11      0.0       -90.0     -0.424
2050102   4.0E-5     0.172      00
2050200   3          14.740E6   558.0     0.0
2051101   205010000  210000000  0.0       0.0       0.0       0100
2051201   201.0      0.0        0.0
**********************************************************************
* DOWNCOMER                                                          *
**********************************************************************
2100000   DWNCOMR    PIPE
2100001   4
2100101   0.142      4
2100201   0.0        3
2100301   0.958      4
2100401   0.0        4
2100501   0.0        4
2100601   -90.0      4
2100801   4.0E-5     0.102      4
2100901   0.0        0.0        3
2101001   00         4
2101101   0000       3
2101201   3          14.740E6   558.0     0.0       1
2101202   3          14.740E6   558.0     0.0       2
2101203   3          14.740E6   558.0     0.0       3
2101204   3          14.740E6   558.0     0.0       4
2101300   1
2101301   201.       0.0        0.0       3
**********************************************************************
* LOWER PLENUM UPPER VOLUME                                          *
**********************************************************************
2150000   LPUPVOL    BRANCH
2150001   3          1
2150101   0.740      0.360      0.0       0.0       -90.0     -0.360
2150102   4.0E-5     0.0        00
2150200   3          14.740E6   558.0     0.0
2151101   210010000  215000000  0.0       0.0       0.0       0100
2152101   215010000  220000000  0.0       0.0       0.0       0100
2153101   215000000  225000000  0.15      0.0       0.0       0100
2151201   201.0      0.0        0.0
2152201   0.0        0.0        0.0
2153201   201.0      0.0        0.0
**********************************************************************
* LOWER PLENUM LOWER VOLUME                                          *
**********************************************************************
2200000   LPLOVOL    SNGLVOL
2200101   0.790      0.370      0.0       0.0       -90.0     -0.370
2200102   4.0E-5     0.0        00
2200200   3          14.740E6   558.0     0.0
**********************************************************************
* LOWER CORE SUPPORT STRUCTURE                                       *
**********************************************************************
2250000   LCOSUST    BRANCH
2250001   2          1
2250101   0.25       0.52       0.0       0.0       90.0      0.52
2250102   4.0E-5     0.095      00
2250200   3          14.740E6   558.0     0.0
2251101   225010000  230000000  0.0975    0.3       0.3       0100
2252101   225010000  235000000  0.0       0.0       0.0       0100
2251201   194.2      0.0        0.0
2252201   6.6        0.0        0.0
```

```
**************************************************************
* ACTIVE CORE                                                *
**************************************************************
2300000   CORE       PIPE
2300001   3
2300101   0.1705     3
2300201   0.1440     2
2300301   0.559      2
2300302   0.657      3
2300401   0.0        3
2300501   0.0        3
2300601   90.0       3
2300801   4.0E-5     0.012      3
2300901   0.5        0.5        2
2301001   00         3
2301101   0100       2
2301201   3          14.740E6   558.0      0.0        1
2301202   3          14.740E6   558.0      0.0        2
2301203   3          14.740E6   558.0      0.0        3
2301300   1
2301301   194.2      0.0        0.0        2
**************************************************************
* BYPASS VOLUME                                              *
**************************************************************
2350000   BYPVOL     PIPE
2350001   3
2350101   0.015      3
2350201   0.0        2
2350301   0.559      2
2350302   0.657      3
2350401   0.0        3
2350501   0.0        3
2350601   90.0       3
2350801   4.0E-5     0.003      3
2350901   0.0        0.0        2
2351001   00         3
2351101   0000       2
2351201   3          14.740E6   558.0      0.0        1
2351202   3          14.740E6   558.0      0.0        2
2351203   3          14.740E6   558.0      0.0        3
2351300   1
2351301   6.6        0.0        0.0        2
**************************************************************
* UPPER CORE SUPPORT  STRUCTURE                              *
**************************************************************
2400000   UCCSST     BRANCH
2400001   2          1
2400101   0.297      1.118      0.0        0.0        90.0       1.118
2400102   4.0E-5     0.145      00
2400200   3          14.740E6   558.0      0.0
2401101   230010000  240000000  0.12       0.30       0.30       0100
2402101   235010000  240000000  0.0        0.0        0.0        0100
2401201   194.2      0.0        0.0
2402201   6.8        0.0        0.0
**************************************************************
* UPPER  FLOW SKIRT REGION                                   *
**************************************************************
2450000   UFOSRE     BRANCH
2450001   1          1
2450101   0.114      0.843      0.0        0.0        90.0       0.843
2450102   4.0E-5     0.131      00
2450200   3          14.740E6   558.0      0.0
2451101   240010000  245000000  0.0        0.0        0.0        0100
2451201   201.0      0.0        0.0
**************************************************************
* DEAD END OF FUEL MODULES                                   *
**************************************************************
2460000   FUMODL     BRANCH
2460001   1          1
2460101   0.163      0.700      0.0        0.0        90.0       0.700
2460102   4.0E-5     0.214      00
2460200   3          14.740E6   558.0      0.0
2461101   240010000  246000000  0.0        0.0        0.0        0100
2461201   0.0        0.0        0.0
```

```
**********************************************************************
* UPPER PLENUM LOWER VOLUME                                          *
**********************************************************************
2500000   UPLLVOL     BRANCH
2500001   2           1
2500101   0.288       0.854       0.0       0.0       90.0      0.854
2500102   4.0E-5      0.0         00
2500200   3           14.740E6    559.0     0.0
2501101   245010000   250000000   0.0       0.0       0.0       0100
2502101   250010000   255000000   0.0       0.0       0.0       0100
2501201   100.5       0.0         0.0
2502201   0.0         0.0         0.0
**********************************************************************
* UPPER PLENUM UPPER VOLUME                                          *
**********************************************************************
2550000   UPLUVOL     SNGLVOL
2550101   0.244       0.712       0.0       0.0       90.0      0.712
2550102   4.0E-5      0.0         00
2550200   3           14.740E6    556.0     0.0
```

```
**************************************************************
**************************************************************
******************** BROKEN LOOP *****************************
**************************************************************
**************************************************************
* REACTOR VESSEL BROKEN LOOP HOT LEG                         *
**************************************************************
3000000    RVBLHL       BRANCH
3000001    3            1
3000101    0.0634       0.876        0.0      0.0      0.0      0.0
3000102    4.0E-5       0.0          00
3000200    3            14.740E+6    558.0    0.0
3001101    245010000    300000000    0.0317   0.0      0.0      0100
3002101    300010000    305000000    0.0      0.1      0.1      0000
3003101    250000000    300000000    0.0317   0.0      0.0      0100
3001201    0.0          0.0          0.0
3002201    0.0          0.0          0.0
3003201    0.0          0.0          0.0
**************************************************************
* HOT LEG PIPE TO REFLOOD ASSIST BYPASS TEE                  *
**************************************************************
3050000    HLPRAS       BRANCH
3050001    1            1
3050101    0.0634       0.698        0.0      0.0      0.0      0.0
3050102    4.0E-5       0.0          00
3050200    3            14.740E+6    558.0    0.0
3051101    305010000    310000000    0.0      0.1      0.1      0100
3051201    0.0          0.0          0.0
**************************************************************
* STEAM GENERATOR SIMULATOR INLET                            *
**************************************************************
3100000    SGSII        BRANCH
3100001    2            1
3100101    0.0          1.424        0.0666   0.0      0.0      0.0
3100102    4.0E-5       0.0          00
3100200    3            14.740E+6    558.5    0.0
3101101    370010000    310000000    0.0      0.0      0.0      0100
3102101    310010000    315000000    0.0      0.0      0.0      0100
3101201    0.0          0.0          0.0
3102201    0.0          0.0          0.0
**************************************************************
* STEAM GENERATOR AND PUMP SIMULATION                        *
**************************************************************
3150000    SGPSI        PIPE
3150001    12
3150101    0.00836      2
3150102    0.108        8
3150103    0.0          10
3150104    0.00836      11
3150105    0.0525       12
3150201    0.0          2
3150202    0.0326       4
3150203    0.108        5
3150204    0.0326       7
3150205    0.0          8
3150206    0.0          9
3150207    0.0081       10
3150208    0.0          11
3150301    0.4054       1
3150302    0.5265       2
3150303    0.362        3
3150304    1.692        4
3150305    0.8455       6
3150306    1.692        7
3150307    0.362        8
3150308    1.346        9
3150309    1.325        10
3150310    1.842        11
3150311    0.667        12
3150401    0.0          9
3150402    0.0162       9
3150403    0.0646       10
3150404    0.0          12
3150601    90.0         5
3150602    -90.0        10
3150603    90.0         11
3150604    0.0          12
```

```
3150701   0.127       1
3150702   0.486       2
3150703   0.362       3
3150704   1.692       4
3150705   0.457       5
3150706   -0.457      6
3150707   -1.692      7
3150708   -0.362      8
3150709   -1.143      9
3150710   -0.686      10
3150711   1.214       11
3150712   0.0         12
3150801   4.0E-5      0.0         3
3150802   4.0E-5      0.124       4
3150803   4.0E-5      0.0         6
3150804   4.0E-5      0.124       7
3150805   4.0E-5      0.0         12
3150901   0.2         0.2         1
3150902   0.0         0.0         2
3150903   93.9        93.9        4
3150904   0.4         0.4         5
3150905   93.9        93.9        7
3150906   0.0         0.0         8
3150907   0.2         0.2         9
3150908   4.1         4.1         10
3150909   0.4         0.4         11
3151001   00          12
3151101   0000        1
3151102   0100        4
3151103   0000        5
3151104   0100        11
3151201   3           14.740E+6   558.0       0.0         1
3151202   3           14.740E+6   558.0       0.0         2
3151203   3           14.740E+6   558.0       0.0         3
3151204   3           14.740E+6   558.0       0.0         4
3151205   3           14.740E+6   558.0       0.0         5
3151206   3           14.740E+6   558.0       0.0         6
3151207   3           14.740E+6   558.0       0.0         7
3151208   3           14.740E+6   558.0       0.0         8
3151209   3           14.740E+6   558.0       0.0         9
3151210   3           14.740E+6   558.0       0.0         12
3151300   1
3151301   0.0         0.0         0.0         11
****************************************************************
* ISOLATION VALVE HOT LEG                                      *
****************************************************************
3200000   ISVHL       VALVE                                     0.0         0100
3200101   315010000   325000000   0.0         0.0
3200201   1           0.0         0.0         0.0
3200301   TRPVLV      504
****************************************************************
* PIPE SECTION BETWEEN ISOLATION VALVE AND QOBV                *
****************************************************************
3250000   VVOLHL      SNGLVOL
3250101   0.0525      0.823       0.0         0.0         0.0         0.0
3250102   4.0E-5      0.0         00
3250200   3           14.740E+6   558.0       0.0
****************************************************************
* QUICK OPENING BLOWDOWN VALVE HOT LEG                         *
****************************************************************
3300000   QOBVHL      VALVE                                     0.0         0100
3300101   325010000   800000000   0.0466      0.0
3300201   1           0.0         0.0         0.0
3300301   TRPVLV      506
```

```
*********************************************************************
* BROKEN LOOP COLD LEG REACTOR VESSEL NOZZLE                        *
*********************************************************************
3350000   AVNBL      BRANCH
3350001   3          1
3350101   0.0634     0.7495     0.0        0.0        0.0        0.0
3350102   4.0E-5     0.0        00
3350200   3          14.740E+6  558.0      0.0
3351101   205000000  335000000  0.0317     1.0        1.0        0100
3352101   335010000  340000000  0.0        0.1        0.1        0000
3353101   200000000  335000000  0.0317     1.0        1.0        0100
3351201   0.0        0.0        0.0
3352201   0.0        0.0        0.0
3353201   0.0        0.0        0.0
*********************************************************************
* CONNECTION TEE OF THE BYPASS ASSIST SYSTEM REACTOR VESSEL SIDE*
*********************************************************************
3400000   CTPAPV     BRANCH
3400001   1          1
3400101   0.0624     0.698      0.0        0.0        0.0        0.0
3400102   4.0E-5     0.0        00
3400200   3          14.740E+6  558.0      0.0
3401101   340010000  345000000  0.0        0.1        0.1        0000
3401201   0.0        0.0        0.0
*********************************************************************
* BYPASS ASSIST OUTLET ECC TEE COLD LEG                             *
*********************************************************************
3450000   BACET      BRANCH
3450001   2          1
3450101   0.0634     0.974      0.0        0.0        0.0        0.0
3450102   4.0E-5     0.0        00
3450200   3          14.740E+6  558.0      0.0
3451101   335010000  345000000  0.0        0.0        0.0        0100
3452101   345010000  350000000  0.0        0.0        0.0        0100
3451201   0.0        0.0        0.0
3452201   0.0        0.0        0.0
*********************************************************************
* ECC TEE ISOLATION VALVE COLD LEG                                  *
*********************************************************************
3500000   ETIVCL     PIPE
3500001   2
3500101   0.0        2
3500201   0.0        1          * BREAK PLANE
3500301   0.488      1
3500302   1.6065     2
3500401   0.00541    1
3500402   0.07770    2
3500601   0.0        2
3500801   4.0E-5     0.0        1
3500802   4.0E-5     0.0        2
3500901   0.0        0.0        1
3501001   00         2
3501101   0100       1
3501201   3          14.740E+6  558.0      0.0        2
3501300   1
3501301   0.0        0.0        0.0        1
*********************************************************************
* ISOLATION VALVE COLD LEG                                          *
*********************************************************************
3550000   ISVCL      VALVE
3550101   350010000  360000000  0.0        0.0        0.0        0100
3550201   1          0.0        0.0        0.0
3550301   TRPVLV     505
*********************************************************************
* PIPE SECTION BETWEEN ISOLATION VALVE AND CUBV COLD LEG            *
*********************************************************************
3600000   VVCLCL     SNGLVOL
3600101   0.0525     0.813      0.0        0.0        0.0        0.0
3600102   4.0E-5     0.0        00
3600200   3          14.740E+6  558.0      0.0
```

```
**********************************************************************
* QUICK OPENING BLOWDOWN VALVE COLD LEG                              *
**********************************************************************
3650000  QOBVCL     VALVE
3650101  360010000  605000000  0.0466     0.0        0.0        0100
3650201  1          0.0        0.0        0.0
3650301  TRPVLV     507
**********************************************************************
* REFLOOD ASSIST BYPASS SINGLE PIPE HOT LEG SIDE                     *
**********************************************************************
3700000  RABSPHL    BRANCH
3700001  1          1
3700101  0.0388     2.203      0.0        0.0        90.0       0.653
3700102  4.0E-5     0.0        00
3700200  3          14.740E+6  558.0      0.0
3701101  375010000  370000000  0.0        0.0        0.0        0100
3701201  0.0        0.0        0.0
**********************************************************************
* REFLOOD ASSIST BYPASS PARALLEL PIPES HOT LEG SIDE                  *
**********************************************************************
3750000  RABPPHL    SNGLVOL
3750101  0.0776     0.0        0.0858     0.0        0.0        0.0
3750102  4.0E-5     0.0        00
3750200  3          14.740E+6  558.0      0.0
**********************************************************************
* REFLOOD ASSIST BYPASS PARALLEL PIPES COLD LEG SIDE                 *
**********************************************************************
3800000  RABPPCL    SNGLVOL
3800101  0.0776     0.0        0.0855     0.0        0.0        0.0
3800102  4.0E-5     0.0        00
3800200  3          14.740E+6  558.0      0.0
**********************************************************************
* REFLOOD ASSIST BYPASS SINGLE PIPE COLD LEG SIDE                    *
**********************************************************************
3850000  RABSPCL    BRANCH
3850001  1          1
3850101  0.0388     0.0        0.11803    0.0        90.0       0.653
3850102  4.0E-5     0.0        00
3850200  3          14.740E+6  558.0      0.0
3851101  380010000  385000000  0.0        0.0        0.0        0100
3851201  0.0        0.0        0.0
```

```
****************************************************************
****************************************************************
****************** PRESSURIZER *********************************
****************************************************************
****************************************************************
* SURGE LINE PCS SIDE                                          *
****************************************************************
4000000   SLPCS       BRANCH
4000001   2           1
4000101   0.00145     3.45        0.0        0.0        90.0       0.54
4000102   4.0E-5      0.0         00
4000200   3           14.740E+6   558.0      0.0
4001101   110000000   400000000   0.0        0.93       0.93       0100
4002101   400010000   405000000   0.0        0.93       0.93       0000
4001201   0.0         0.0         0.0
4002201   0.0         0.0         0.0
****************************************************************
* SURGE LINE PRESSURIZER VESSEL                                *
****************************************************************
4050000   SLPRV       SNGLVOL
4050101   0.00145     3.45        0.0        0.0        90.0       0.60
4050102   4.0E-5      0.0         00
4050200   3           14.740E+6   558.0      0.0
****************************************************************
* PRESSURIZER SURGE LINE VALVE                                 *
****************************************************************
4100000   SLVALV      VALVE
4100101   405010000   415000000   0.0        0.93       0.93       0100
4100201   1           0.0         0.0        0.0
4100301   TRPVLV      508
****************************************************************
* PRESSURIZER VESSEL                                           *
****************************************************************
4150000   PRESSV      PIPE
4150001   5
4150101   0.362       1
4150102   0.565       4
4150103   0.466       5
4150201   0.0         4
4150301   0.224       1
4150302   0.403       3
4150303   0.414       4
4150304   0.341       5
4150401   0.0         5
4150501   0.0         5
4150601   90.0        5
4150801   4.0E-5      0.0         5
4151001   00          5
4151101   0100        1
4151102   0000        3
4151103   0100        4
4151201   2           14.740E+6   0.0        0.0        3
4151202   2           14.740E+6   1.0        0.0        5
4151300   1
4151301   0.0         0.0         0.0        4
****************************************************************
* TOP VOLUME PRESSURIZER                                       *
****************************************************************
4200000   TOPPRE      BRANCH
4200001   1
4200101   0.13        0.236       0.0        0.0        90.0       0.236
4200102   4.0E-5      0.0         00
4200200   2           14.740E6    1.0        0.0
4201101   415010000   420000000   0.0        0.0        0.0        0100
4201201   0.0         0.0         0.0
****************************************************************
* PORV                                                         *
****************************************************************
4250000   PORV        VALVE
4250101   420010000   610000000   9.0E-5     0.0        0.0        0100
4250201   1           0.0         0.0        0.0
4250301   TRPVLV      509
```

```
*****************************************************************
*****************************************************************
**********STEAM GENERATOR SECONDARY SIDE ************************
*****************************************************************
*****************************************************************
* TOP OF DOWNCOMER (OUTLET OF PRIMARY SEPARATOR)                *
*****************************************************************
5000000    "SEPAR OUT"             BRANCH
5000001    3            1
5000101    1.273        0.718      0.0        0.0        -90.0     -0.718
5000102    4.E-5        0.7874     00
5000200    2            6.80E06    1.0        0
5001101    500000000    525000000  1.2728     0.0        0.0       0100
5002101    500010000    505000000  0.0        0.0        0.0       0100
5003101    520010000    500000000  0.196      0.4        0.4       0100
5001201    0.0          0.0        0.0
5002201    0.0          0.0        0.0
5003201    0.0          0.0        0.0
*****************************************************************
* LOWER SEPARATOR SECTION                                       *
*****************************************************************
5050000    "LWR SEP" SNGLVOL
5050101    1.273        0.718      0.0        0.0        -90.0     -0.718
5050102    4.E-5        0.7874     00
5050200    2            6.80E06    1.0        0
*****************************************************************
* FEED INLET VOLUME                                             *
*****************************************************************
5100000    "FEED INLET"            BRANCH
5100001    2
5100101    0.7525       0.518      0.0        0.0        -90.0     -0.518
5100102    4.E-5        0.10796    00
5100200    2            6.80E06    1.0        0
5101101    505010000    510000000  0.0        0.0        0.0       0100
5102101    510010000    515000000  0.0        0.0        0.0       0100
5101201    0.0          0.0        0.0
5102201    0.0          0.0        0.0
*****************************************************************
* STEAM GENERATOR DOWNCOMER                                     *
*****************************************************************
5150000    "DWNCMR"                PIPE
5150001    8
5150101    0.23226      3
5150102    0.27571      5
5150201    0.0          7
5150301    0.7102       3
5150302    1.65075      7
5150303    0.718        8
5150401    0.0          8
5150601    -90.0        3
5150602    21.0         6
5150603    16.0         7
5150604    90.0         8
5150701    -0.7102      3
5150702    0.7102       6
5150703    0.518        7
5150704    0.718        8
5150801    4.E-5        0.10796    3
5150802    4.E-5        0.0305     7
5150803    4.E-5        0.0        8
5150901    0.0          0.0        2
5150902    17.5         17.5       3
5150903    4.2          4.2        4
5150904    8.8          8.8        5
5150905    4.2          4.2        6
5150906    0.0          0.0        7
5151001    00           8
5151101    0000         2
5151102    0100         3
5151103    0000         7
5151201    2            6.80E06    0.0        0.0        3
5151202    2            6.80E06    0.0        0.0        6
5151203    2            6.80E06    1.0        0.0        8
5151300    1
5151301    0.0          0.0        0.0        7
```

```
*************************************************************************
* TOP OF RISER (INSIDE SHROUD, ABOVE TUBES)                             *
*************************************************************************
5200000   "SEPAR IN"               BRANCH
5200001   1           1
5200101   0.27671     0.718        0.0          0.0          90.0         0.718
5200102   4.E-5       0.0          00
5200200   2           6.80E06      1.0          0.0
5201101   515010000   520000000    0.0          0.0          0.0          0100
5201201   0.0         0.0          0.0
*************************************************************************
* BELOW MIST EXTRACTOR, ABOVE TOP OF SHROUD IN STEAM DOME               *
*************************************************************************
5250000   "BOT STM DM"             BRANCH
5250001   1           1
5250101   1.5866      0.762        0.0          0.0          90.0         0.762
5250102   4.E-5       0.0          00
5250200   2           6.80E06      1.0          0
5251101   525010000   530000000    0.0          0.0          0.0          0100
5251201   0.0         0.0          0.0
*************************************************************************
* MIST EXTRACTOR AND STEAM GEN OUTLET PIPE TO SCV                       *
*************************************************************************
5300000   "STMDM/PIPE"             PIPE
5300001   2
5300101   1.2728      1
5300102   0.04635     2
5300201   0.01365     1
5300301   0.762       1
5300302   25.074      2
5300401   0.0         2
5300601   90.0        1
5300602   0.0         2
5300801   4.E-5       0.0          2
5300901   0.4         0.4          1
5301001   00          2
5301101   0100        1
5301201   2           6.80E06      1.0          0.0          2
5301300   1
5301301   0.0         0.0          0.0          1
*************************************************************************
* PIPE DOWNSTREAM OF SCV                                                *
*************************************************************************
5350000   "COND INLET"             SNGLVOL
5350101   0.06557     54.44        0.0          0.0          0.0          0.0
5350102   4.E-5       0.0          00
5350200   2           2.00E06      1.0          0.0
*************************************************************************
* AIR COOLED CONDENSER                                                  *
*************************************************************************
5400000   "CONDENSER"              TMDPVOL
5400101   0.21677     17.67        0.0          0.0          0.0          0.0
5400102   4.E-5       0.02         00
5400200   2
5400207   0.0         2.00E06      1.0
*************************************************************************
* MAKE UP FEED STORAGE TANK                                             *
*************************************************************************
5450000   "FEED TANK"              TMDPVOL
5450101   29.81       3.048        0.0          0.0          0.0          0.0
5450102   4.E-5       0.0          00
5450200   2
5450201   0.0         1.00E05      0.0
*************************************************************************
* STEAM CONTROL VALVE                                                   *
*************************************************************************
5500000   STCDVA      VALVE
5500101   530010000   535000000    0.002573     0.0          0.0          0100
5500201   1           0.0          0.0          0.0
5500301   TRPVLV      510
```

```
***********************************************************************
* FLOW PATH TO THE AIR COOLED CONDENSER
***********************************************************************
5550000    COACCO    SNGLJUN
5550101    535010000 540000000 0.0        0.0        0.0        0100
5550201    1         0.0       0.0        0.0
***********************************************************************
* AUXILLARY FEED WATER VALVE                                          *
***********************************************************************
5600000    AUFWVA    TMDPJUN
5600101    545000000 510000000 0.05
5600200    1
5600201    0.0       0.0       0.0        0.0
5600202    10000.    0.0       0.0        0.0
```

```
************************************************************
********************** ECC SYSTEM **************************
************************************************************
************************************************************
* PIPING PCS HPIS INJECTION POINT                          *
************************************************************
6000000   PPCHP       BRANCH
6000001   0           1
6000101   0.009059    8.8776      0.0        0.0        -90.0      -3.2
6000102   4.0E-5      0.0         00
6000200   3           4.370E+6    304.0      0.0
************************************************************
* PIPING ACCUMULATOR                                       *
************************************************************
6050000   PIAC1       BRANCH
6050001   2           1
6050101   0.014582    9.4691      0.0        0.0        0.0        0.0
6050102   4.0E-5      0.0         00
6050200   3           4.370E+6    304.0      0.0
6051101   605010000   600000000   0.0        0.8        0.8        0100
6052101   610010000   605000000   0.0        0.7        0.7        0100
6051201   0.0         0.0         0.0
6052201   0.0         0.0         0.0
************************************************************
* PIPING ACCUMULATOR                                       *
************************************************************
6100000   PIAC2       SNGLVOL
6100101   0.018638    7.55998     0.0        0.0        0.0        0.0
6100102   4.0E-5      0.0         00
6100200   3           4.370E+6    304.0      0.0
************************************************************
* ACCUMULATOR VESSEL                                       *
************************************************************
6150000   ACCU        SNGLVOL
6150101   1.254       2.33        0.0        0.0        90.0       2.33
6150102   4.0E-5      0.0         00
6150200   3           4.370E+6    304.0      0.0
************************************************************
* BWST LPIS                                                *
************************************************************
6200000   BWTLPI      SNGLVOL
6200101   20.44       5.0         0.0        0.0        90.0       5.0
6200102   4.0E-5      0.0         00
6200200   3           1.0E+5      300.0      0.0
************************************************************
* BWST HPIS                                                *
************************************************************
6250000   BWTHPI      SNGLVOL
6250101   20.44       5.0         0.0        0.0        90.0       5.0
6250102   4.0E-5      0.0         00
6250200   3           1.0E+5      300.0      0.0
************************************************************
* ECC SYSTEM VALVE                                         *
************************************************************
6300000   ECVLV       VALVE
6300101   600010000   1P5000000   0.0        0.0        0.0        0100
6300201   1           0.0         0.0        0.0
6300301   TRPVLV      502
************************************************************
* LOW PRESSURE INJECTION SYSTEM                            *
************************************************************
6350000   LPIS        TMDPJUN
6350101   620010000   600000000   0.0
6350200   1           512
6350201   0.0         0.0         0.0        0.0
************************************************************
* HIGH PRESSURE INJECTION SYSTEM                           *
************************************************************
6400000   HPIS        TMDPJUN
6400101   625010000   600000000   0.0
6400200   1           513
6400201   0.0         0.0         0.0        0.0
************************************************************
* ACCUMULATOR VALVE                                        *
************************************************************
6450000   ACCVLV      VALVE
6450101   615010000   610000000   0.003167   1.6        1.6        0100
6450201   1           0.0         0.0        0.0
6450301   TRPVLV      503
```

```
************************************************************************
************************************************************************
******************** CONTAINMENT ***************************************
************************************************************************
************************************************************************
* CONTAINMENT BROKEN LOOP HOT LEG                                      *
************************************************************************
8000000    CBLHL      TMDPVOL
8000101    0.0        1.0        0.1        0.0        0.0        0.0
8000102    0.0        0.0        00
8000200    2
8000201    0.0        1.0E+5     1.0
8000202    10000.0    1.0E+5     1.0
************************************************************************
* CONTAINMENT BROKEN LOOP COLD LEG                                     *
************************************************************************
8050000    C605       TMDPVOL
8050101    0.0        1.0        0.1        0.0        0.0        0.0
8050102    0.0        0.0        00
8050200    2
8050201    0.0        1.0E+5     1.0
8050202    10000.0    1.0E+5     1.0
************************************************************************
* CONTAINMENT POWER OPERATED RELIEF VALVE                              *
************************************************************************
8100000    C910       TMDPVOL
8100101    0.0        1.0        0.1        0.0        0.0        0.0
8100102    0.0        0.0        00
8100200    2
8100201    0.0        1.0E+5     1.0
8100202    10000.0    1.0E+5     1.0
************************************************************************
* BOUNDARY VALVE INTACT LOOP HOT LEG                                   *
************************************************************************
9000000    BVALV      VALVE
9000101    110010000 905000000 0.0         0.0        0.0        0100
9000201    1          0.0        0.0        0.0
9000301    TRPVLV     511
************************************************************************
* BOUNDARY VOLUME INTACT LOOP HOT LEG                                  *
************************************************************************
9050000    BVOLLP     TMDPVOL
9050101    0.0        1.0        0.1        0.0        0.0        0.0
9050102    0.0        0.0        00
9050200    3
9050201    0.0        14.7456    558.0
9050202    10000.0    14.7456    558.0
```

```
*****************************************************************************
*****************************************************************************
************** HEAT STRUCTURE INPUT DATA ************************************
*****************************************************************************
*****************************************************************************
* REACTOR VESSEL HEAT STRUCTURES                                            *
*****************************************************************************
* FILLER BLOCKS INLET ANNULUS TOP VOLUME                                    *
*****************************************************************************
12000000  1            5          2          1          0.503
12000100  0            1
12000101  4            0.773
12000201  4            4
12000301  0.0          4
12000401  558.0        5
12000501  200010000    0          1          1          0.33       1
12000601  0            0          0          1          0.33       1
12000701  0            0.0        0.0        0.0        1
12000801  0            1.16       0.0        0.33       1
*****************************************************************************
* FILLER BLOCKS INLET ANNULUS LOWER VOLUME                                  *
*****************************************************************************
12050000  1            5          2          1          0.501
12050100  0            1
12050101  4            0.766
12050201  4            4
12050301  0.0          4
12050401  558.0        5
12050501  205010000    0          1          1          0.424      1
12050601  0            0          0          1          0.424      1
12050701  0            0.0        0.0        0.0        1
12050801  0            1.02       0.0        0.424      1
*****************************************************************************
* FILLER BLOCKS DOWNCOMER AND LOWER PLENUM                                  *
*****************************************************************************
12100000  6            5          2          1          0.47
12100100  0            1
12100101  4            0.735
12100201  4            4
12100301  0.0          4
12100401  558.0        5
12100501  210010000    0          1          1          0.958      1
12100503  210030000    0          1          1          0.958      3
12100504  210040000    0          1          1          0.958      4
12100505  215010000    0          1          1          0.36       5
12100506  220010000    0          1          1          0.37       6
12100601  0            0          0          1          0.958      4
12100602  0            0          0          1          0.36       5
12100603  0            0          0          1          0.37       6
12100701  0            0.0        0.0        0.0        6
12100801  0            0.94       0.0        0.958      4
12100802  0            0.94       0.0        0.36       5
12100803  0            0.94       0.0        0.37       6
*****************************************************************************
* CORE SUPPORT BARREL                                                       *
*****************************************************************************
12010000  6            5          2          1          0.419
12010100  0            1
12010101  4            0.459
12010201  4            4
12010301  0.0          4
12010401  558.0        5
12010501  200010000    0          1          1          0.33       1
12010502  205010000    0          1          1          0.424      2
12010503  210010000    0          1          1          0.958      3
12010504  210020000    0          1          1          0.958      4
12010505  210030000    0          1          1          0.958      5
12010506  210040000    0          1          1          0.958      6
12010601  0            0          0          1          0.33       1
12010602  0            0          0          1          0.424      2
12010603  0            0          0          1          0.958      3
12010604  0            0          0          1          0.958      4
12010605  0            0          0          1          0.958      5
12010606  0            0          0          1          0.958      6
12010701  0            0.0        0.0        0.0        6
12010801  0            0.84       0.0        0.33       1
12010802  0            0.84       0.0        0.424      2
12010803  0            0.84       0.0        0.958      6
```

```
*****************************************************************
* FLOW SKIRT - CORE FILLER ASSEMBLY                             *
*****************************************************************
12250000  7          5          2          1          0.3
12250100  0          1
12250101  4          0.30
12250201  4          4
12250301  0.0        4
12250401  558.0      5
12250501  225010000  0          1          1          0.52       1
12250502  230010000  0          1          1          0.559      2
12250503  230020000  0          1          1          0.559      3
12250504  230030000  0          1          1          0.657      4
12250505  240010000  0          1          1          1.118      5
12250506  245010000  0          1          1          0.42       6
12250507  246010000  0          1          1          0.35       7
12250601  0          0          0          1          0.52       1
12250602  0          0          0          1          0.559      2
12250603  0          0          0          1          0.559      3
12250604  0          0          0          1          0.657      4
12250605  0          0          0          1          1.118      5
12250606  0          0          0          1          0.42       6
12250607  0          0          0          1          0.35       7
12250701  0          0.0        0.0        0.0        7
12250801  0          0.6        0.0        0.52       1
12250802  0          0.6        0.0        0.559      3
12250803  0          0.6        0.0        0.657      4
12250804  0          0.6        0.0        1.118      5
12250805  0          0.6        0.0        0.42       6
12250806  0          0.6        0.0        0.35       7
*****************************************************************
* ACTIVE CORE                                                   *
*****************************************************************
12300000  3          10         2          1          0.0
12300100  0          1
12300101  5          4.6475-3
12300102  1          4.7425-3
12300103  3          5.3505-3
12300201  1          5
12300202  2          6
12300203  3          9
12300301  1.0        5
12300302  0.0        9
12300401  558.0      10
12300501  0          0          0          1          725.1      3
12300601  230010000  0          1          1          725.1      1
12300602  230020000  0          1          1          725.1      2
12300603  230030000  0          1          1          725.1      3
12300701  900        0.40979    0.0        0.0        1
12300702  900        0.44484    0.0        0.0        2
12300703  900        0.14173    0.0        0.0        3
12300901  0          0.02144    0.0        0.559      3
*****************************************************************
* FUEL MODULES                                                  *
*****************************************************************
12   0000  1          5          1          1          0.0
12460100  0          1
12460101  4          0.01
12460201  4          4
12460301  0.0        4
12460401  558.0      5
12460501  245010000  0          1          1          1.8        1
12460601  246010000  0          1          1          1.8        1
12460701  0          0.0        0.0        1.8        1
12460801  0          0.0        0.0        1.8        1
12460901  0          0.0        0.0        1.8        1
*****************************************************************
* REACTOR VESSEL BOTTOM                                         *
*****************************************************************
12200000  1          5          1          1          0.0
12200100  0          1
12200101  4          0.092
12200201  4          4
12200301  0.0        4
12200401  558.0      5
12200501  0          0          0          0          1.68       1
12200601  220010000  0          0          0          1.68       1
12200701  0          0.0        0.0        0.0        1
12200901  0          0.0        0.0        0.52       1
```

```
****************************************************************
* LOWER CORE SUPPORT STRUCTURE                                 *
****************************************************************
12260000   1           5           2           1           0.282
12260100   0           1
12260101   4           0.3
12260201   4           4
12260301   0.0         4
12260401   558.0       5
12260501   225010000   0           1           1           0.52        1
12260601   0           0           0           1           0.52        1
12260701   0           0.0         0.0         0.0         1
12260801   0           0.56        0.0         0.52        1
****************************************************************
* UPPER CORE SUPPORT STRUCTURE                                 *
****************************************************************
12400000   1           5           2           1           0.282
12400100   0           1
12400101   4           0.31
12400201   4           4
12400301   0.0         4
12400401   558.0       5
12400501   240010000   0           1           1           1.118       1
12400601   0           0           0           1           1.118       1
12400701   0           0.0         0.0         0.0         1
12400801   0           0.56        0.0         1.118       1
****************************************************************
* UPPER HEAD TOP PLATE                                         *
****************************************************************
12550000   1           5           1           1           0.0
12550100   0           1
12550101   4           0.474
12550201   4           4
12550301   0.0         4
12550401   558.0       5
12550501   255010000   0           1           1           0.712       1
12550601   0           0           0           1           0.712       1
12550701   0           0.0         0.0         0.0         1
12550801   0           0.0         0.0         0.712       1
****************************************************************
* CORE SUPPORT BARREL UPPER PLENUM LOWER VOLUME                *
****************************************************************
12500000   1           5           2           1           0.381
12500100   0           1
12500101   4           0.419
12500201   4           4
12500301   0.0         4
12500401   558.0       5
12500501   250010000   0           1           1           0.854       1
12500601   0           0           0           1           0.854       1
12500701   0           0.0         0.0         0.0         1
12500801   0           0.762       0.0         0.854       1
****************************************************************
* CORE SUPPORT BARREL UPPER PLENUM TOP VOLUME                  *
****************************************************************
12520000   1           5           2           1           0.381
12520100   0           1
12520101   4           0.728
12520201   4           4
12520301   0.0         4
12520401   558.0       5
12520501   255010000   0           1           1           0.712       1
12520601   0           0           0           1           0.712       1
12520701   0           0.0         0.0         0.0         1
12520801   0           0.762       0.0         0.712       1
```

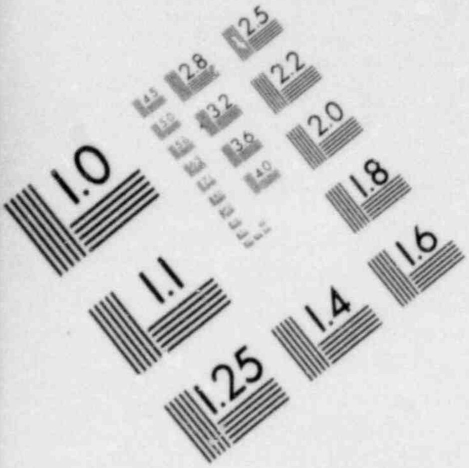
```
*************************************************************************
* INTERNALS UPPER PLENUM                                                *
*************************************************************************
12510000  2          5          1          1          0.0
12510100  0          1
12510101  4          0.005
12510201  4          4
12510301  0.0        4
12510401  558.0      5
12510501  250010000  0          1          1          1.0        1
12510502  255010000  0          1          1          1.0        2
12510601  0          0          0          1          1.0        1
12510602  0          0          0          1          1.0        2
12510701  0          0.0        0.0        0.0        2
12510801  0          0.0        0.0        1.0        1
12510802  0          0.0        0.0        1.0        2
*************************************************************************
* STEAM GENERATOR HEAT STRUCTURES                                       *
*************************************************************************
* STEAM GENERATOR TUBING                                                *
*************************************************************************
10060000  6          6          2          1          0.0051054
10060100  0          1
10060101  7          0.00634854
10060201  6          7
10060301  0.0        7
10060401  540.0      6
10060501  115040000  10000      1          1          1397.324   6
10060601  515040000  10000      1          1          1397.324   3
10060602  515060000  -10000     1          1          1397.324   6
10060701  0          0          0          0          6
10060801  0          0          0          0          6
10060901  0          0          0          0          6
*************************************************************************
* SHROUD SECONDARY SIDE STEAM GENERATOR                                 *
*************************************************************************
15000000  3          4          2          1          0.3048
15000100  0          1
15000101  3          0.314325
15000201  5          3
15000301  0.0        3
15000401  540.0      4
15000501  500010000  0          1          1          0.7725     1
15000502  505010000  0          1          1          0.7725     2
15000503  510010000  0          1          1          0.152      3
15000601  520010000  0          1          1          0.7725     1
15000602  515060000  0          1          1          0.7725     2
15000603  515070000  0          1          1          0.152      3
15000701  0          0          0          0          3
15000801  0          0.0        0.0        0.0        3
15000901  0          0.0        0.0        0.0        3
15150000  4          4          2          1          0.6445
15150100  0          1
15150101  3          0.6572
15150201  5          3
15150301  0.0        3
15150401  540.0      4
15150501  510010000  0          1          1          0.152      1
15150502  515010000  10000      1          1          0.7113     4
15150601  515070000  0          1          1          0.152      1
15150602  515060000  -10000     1          1          0.7113     4
15150701  0          0          0          0          4
15150801  0          0.0        0.0        0.0        4
15150901  0          0.0        0.0        0.0        4
```

```
*******************************************************************
* HEAT STRUCTURE THERMAL PROPERTY DATA                            *
*******************************************************************
20100100  UO2
20100200  TBL/FCTN  1          1    * GAP
20100300  ZR
20100400  S-STEEL
20100500  C-STEEL
20100600  TBL/FCTN  1          1    * INCONEL 600
*******************************************************************
* THERMAL CONDUCTIVITY GAP                                        *
*******************************************************************
20100201  273.15     0.14
20100202  590.0      0.24
20100203  810.0      0.29
20100204  1090.0     0.36
20100205  1370.0     0.42
20100206  3260.0     0.75
*******************************************************************
* THERMAL CONDUCTIVITY INCONEL 600                                *
*******************************************************************
20100601  366.5      13.65
20100602  477.6      15.92
20100603  588.7      18.17
20100604  700.0      20.42
20100605  810.9      22.50
20100606  922.0      24.92
20100607  1033.2     26.83
20100608  1144.3     29.42
20100609  1477.6     36.06
*******************************************************************
* VOLUMETRIC HEAT CAPACITY GAP                                    *
*******************************************************************
20100251  273.15     5.4
20100252  3260.0     5.4
*******************************************************************
* VOLUMETRIC HEAT CAPACITY INCONEL 600                            *
*******************************************************************
20100651  366.5      3.906E5
20100652  477.6      4.084E5
20100653  588.7      4.260E5
20100654  700.0      4.436E5
20100656  810.9      4.665E5
20100657  922.0      4.929E5
20100658  1033.2     5.105E5
20100659  1477.6     5.727E5
*******************************************************************
* POWER                                                           *
*******************************************************************
20290000  POWER
20290001  0.0        0.0
20290002  1000.0     0.0
. END OF INPUT
```

```
*****************************************************************
*****************************************************************
******************** PUMP DATA **********************************
*****************************************************************
*****************************************************************
* SINGLE PHASE HEAD CURVES                                      *
*****************************************************************
* HEAD CURVE NO. 1                                              *
*****************************************************************
1351100     1                         1
1351101     0.000000E+00              1.403600E+00
1351102     1.906100E-01              1.363600E+00
1351103     3.896300E-01              1.318600E+00
1351104     5.939600E-01              1.232600E+00
1351105     7.902000E-01              1.133600E+00
1351106     1.000000E+00              1.000000E+00
*****************************************************************
* HEAD CURVE NO. 2                                              *
*****************************************************************
1351200     1                         2
1351201     0.000000E+00              -6.700000E-01
1351202     2.000000E-01              -5.000000E-01
1351203     4.000000E-01              -2.500000E-01
1351204     5.755400E-01              0.000000E+00
1351205     7.443200E-01              2.563000E-01
1351206     7.734800E-01              3.776000E-01
1351207     8.631300E-01              6.326000E-01
1351208     1.000000E+00              1.000000E+00
*****************************************************************
* HEAD CURVE NO. 3                                              *
*****************************************************************
1351300     1                         3
1351301     -1.000000E+00             2.472200E+00
1351302     -8.057400E-01             2.047400E+00
1351303     -6.069000E-01             1.831000E+00
1351304     -4.068300E-01             1.624000E+00
1351305     -2.001710E-01             1.470500E+00
1351306     0.000000E+00              1.403600E+00
*****************************************************************
* HEAD CURVE NO. 4                                              *
*****************************************************************
1351400     1                         4
1351401     -1.000000E+00             2.472200E+00
1351402     -8.229700E-01             1.996800E+00
1351403     -6.333200E-01             1.569700E+00
1351404     -4.553400E-01             1.327900E+00
1351405     -2.710900E-01             1.194900E+00
1351406     -1.771600E-01             1.060500E+00
1351407     -9.073000E-02             1.015600E+00
1351408     0.000000E+00              9.342790E-01
*****************************************************************
* HEAD CURVE NO. 5                                              *
*****************************************************************
1351500     1                         5
1351501     0.000000E+00              2.500000E-01
1351502     2.000000E-01              2.800000E-01
1351503     4.000000E-01              3.400000E-01
1351504     4.118000E-01              2.768000E-01
1351505     5.976300E-01              4.584000E-01
1351506     7.934670E-01              6.992000E-01
1351507     1.000000E+00              1.000000E+00
*****************************************************************
* HEAD CURVE NO. 6                                              *
*****************************************************************
1351600     1                         6
1351601     0.000000E+00              9.342790E-01
1351602     9.109900E-02              9.229000E-01
1351603     1.865090E-01              8.963000E-01
1351604     2.717620E-01              8.750000E-01
1351605     4.558720E-01              8.433000E-01
1351606     5.744060E-01              8.385000E-01
1351607     7.405760E-01              8.466000E-01
1351608     7.666190E-01              8.469000E-01
1351609     8.714710E-01              8.836000E-01
1351610     1.000000E+00              1.000000E+00
```

```
**************************************************************************
* HEAD CURVE NO. 7                                                       *
**************************************************************************
1351700    1                       7
1351701    -1.000000E+00           -1.000000E+00
1351702    -8.000000E-01           -6.300000E-01
1351703    -6.000000E-01           -3.000000E-01
1351704    -4.000000E-01           -5.000000E-02
1351705    -2.000000E-01           1.500000E-01
1351706    0.000000E+00            2.500000E-01
**************************************************************************
* HEAD CURVE NO. 8                                                       *
**************************************************************************
1351800    1                       8
1351801    -1.000000E+00           -1.000000E+00
1351802    -8.000000E-01           -9.700000E-01
1351803    -6.000000E-01           -9.500000E-01
1351804    -4.000000E-01           -8.600000E-01
1351805    -2.000000E-01           -8.000000E-01
1351806    0.000000E+00            -6.700000E-01
**************************************************************************
* SINGLE PHASE TORQUE DATA                                               *
**************************************************************************
* TORQUE CURVE NO. 1                                                     *
**************************************************************************
1351900    2                       1
1351901    0.000000E+00            6.032000E-01
1351902    1.930000E-01            6.325000E-01
1351903    3.930000E-01            7.369000E-01
1351904    5.955200E-01            8.331000E-01
1351905    7.978200E-01            9.229000E-01
1351906    1.000000E+00            1.000000E+00
**************************************************************************
* TORQUE CURVE NO. 2                                                     *
**************************************************************************
1352000    2                       2
1352001    0.000000E+00            -6.700000E-01
1352002    4.000000E-01            -2.500000E-01
1352003    5.000000E-01            1.500000E-01
1352004    7.372550E-01            5.265160E-01
1352005    7.680490E-01            6.065940E-01
1352006    8.672300E-01            7.436600E-01
1352007    1.000000E+00            1.000000E+00
**************************************************************************
* TORQUE CURVE NO. 3                                                     *
**************************************************************************
1352100    2                       3
1352101    -1.000000E+00           1.984300E+00
1352102    -8.069600E-01           1.394000E+00
1352103    -6.063800E-01           1.097500E+00
1352104    -4.068600E-01           8.220000E-01
1352105    -1.992600E-01           6.646000E-01
1352106    0.000000E+00            6.032000E-01
**************************************************************************
* TORQUE CURVE NO. 4                                                     *
**************************************************************************
1352200    2                       4
1352201    -1.000000E+00           1.984300E+00
1352202    -8.223400E-01           1.830800E+00
1352203    -6.337100E-01           1.682400E+00
1352204    -4.553300E-01           1.557000E+00
1352205    -2.670230E-01           1.436200E+00
1352206    -1.761070E-01           1.387900E+00
1352207    -8.931000E-02           1.348100E+00
1352208    0.000000E+00            1.233610E+00
**************************************************************************
* TORQUE CURVE NO. 5                                                     *
**************************************************************************
1352300    2                       5
1352301    0.000000E+00            -4.500000E-01
1352302    4.000000E-01            -2.500000E-01
1352303    5.000000E-01            0.000000E+[illegible]
1352304    1.000000E+00            3.569000E-01
```

```
*****************************************************************
* TORQUE CURVE NO. 6                                            *
*****************************************************************
1352400    2                            6
1352401    0.000000E+00                 1.233610E+00
1352402    9.664300E-02                 1.196500E+00
1352403    1.885690E-01                 1.105600E+00
1352404    2.734700E-01                 1.041600E+00
1352405    4.566900E-01                 9.580000E-01
1352406    5.744800E-01                 7.807000E-01
1352407    7.381600E-01                 6.134000E-01
1352408    7.685200E-01                 5.849000E-01
1352409    8.700570E-01                 4.677000E-01
1352410    1.000000E+00                 3.569000E-01
*****************************************************************
* TORQUE CURVE NO. 7                                            *
*****************************************************************
1352500    2                            7
1352501    -1.000000E+00                -1.000000E+00
1352502    -3.000000E-01                -9.000000E-01
1352503    -1.000000E-01                -5.000000E-01
1352504    0.000000E+00                 -4.500000E-01
*****************************************************************
* FOR TORQUE CURVE NO. 8                                        *
*****************************************************************
1352600    2                            8
1352601    -1.000000E+00                -1.000000E+00
1352602    -2.500000E-01                -9.000000E-01
1352603    -6.000000E-02                -8.000000E-01
1352604    0.000000E+00                 -6.700000E-01
*****************************************************************
* TWO - PHASE MULTIPLIER DATA                                   *
*****************************************************************
* HEAD CURVE                                                    *
*****************************************************************
1353000    0
1353001    0.000000E+00                 0.000000E+00
1353002    2.000000E-02                 2.000000E-02
1353003    5.000000E-02                 5.000000E-02
1353004    1.000000E-01                 1.000000E-01
1353005    2.000000E-01                 4.600000E-01
1353006    2.400000E-01                 8.000000E-01
1353007    3.000000E-01                 9.600000E-01
1353008    4.000000E-01                 9.800000E-01
1353009    6.000000E-01                 9.700000E-01
1353010    8.000000E-01                 9.000000E-01
1353011    9.000000E-01                 8.000000E-01
1353012    9.600000E-01                 5.000000E-01
1353013    1.000000E+00                 0.000000E+00
*****************************************************************
* TORQUE CURVE                                                  *
*****************************************************************
1353100    0
1353101    0.000000E+00                 0.000000E+00
1353102    1.250000E-01                 7.000000E-02
1353103    1.650000E-01                 1.250000E-01
1353104    2.400000E-01                 6.000000E-01
1353105    8.000000E-01                 5.600000E-01
1353106    9.600000E-01                 4.500000E-01
1353107    1.000000E+00                 0.000000E+00
*****************************************************************
* PUMP 2-PHASE DIFFERENCE DATA                                  *
*****************************************************************
* HEAD CURVE NO. 1                                              *
*****************************************************************
1354100    1                            1
1354101    0.000000E+00                 0.000000E+00
1354102    1.000000E-01                 8.300000E-01
1354103    2.000000E-01                 1.090000E+00
1354104    5.000000E-01                 1.020000E+00
1354105    7.000000E-01                 1.010000E+00
1354106    9.000000E-01                 9.400000E-01
1354107    1.000000E+00                 1.000000E+00
```



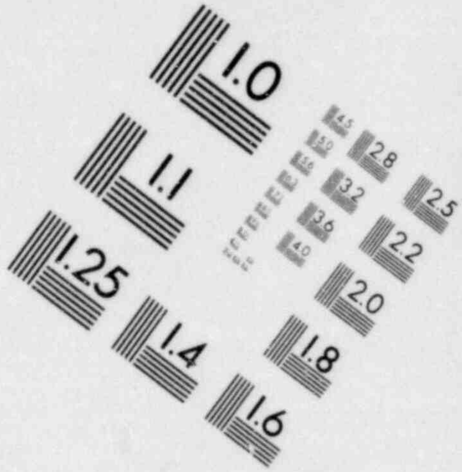
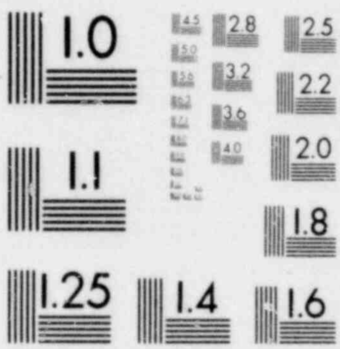
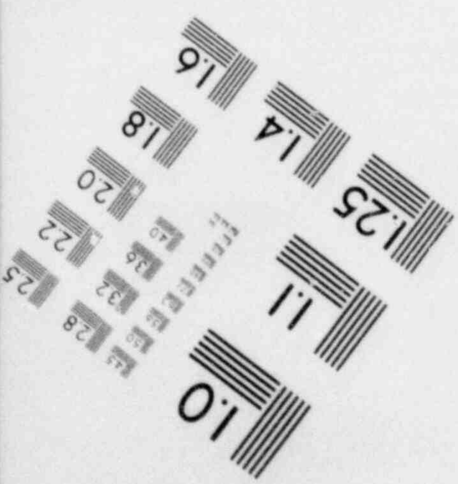


IMAGE EVALUATION TEST TARGET (MT-3)



6"



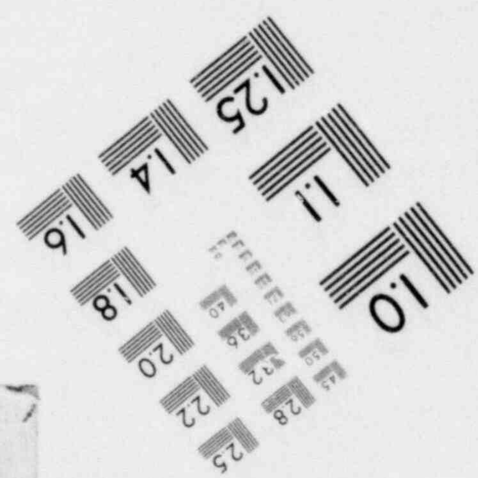


IMAGE EVALUATION TEST TARGET (MT-3)

6"

```
*************************************************************************
* HEAD CURVE NO. 2                                                      *
*************************************************************************
1354200    1                     2
1354201    0.000000E+00          0.000000E+00
1354202    1.000000E-01          -4.000000E-02
1354203    2.000000E-01          0.000000E+00
1354204    3.000000E-01          1.000000E-01
1354205    4.000000E-01          2.100000E-01
1354206    8.000000E-01          6.700000E-01
1354207    9.000000E-01          8.000000E-01
1354208    1.000000E+00          1.000000E+00
*************************************************************************
* HEAD CURVE NO. 3                                                      *
*************************************************************************
1354300    1                     3
1354301    -1.000000E+00         -1.160000E+00
1354302    -9.000000E-01         -1.240000E+00
1354303    -8.000000E-01         -1.770000E+00
1354304    -7.000000E-01         -2.360000E+00
1354305    -6.000000E-01         -2.790000E+00
1354306    -5.000000E-01         -2.910000E+00
1354307    -4.000000E-01         -2.670000E+00
1354308    -2.500000E-01         -1.690000E+00
1354309    -1.000000E-01         -5.000000E-01
1354310    0.000000E+00          0.000000E+00
*************************************************************************
* HEAD CURVE NO. 4                                                      *
*************************************************************************
1354400    1                     4
1354401    -1.000000E+00         -1.160000E+00
1354402    -9.000000E-01         -7.800000E-01
1354403    -8.000000E-01         -5.000000E-01
1354404    -7.000000E-01         -3.100000E-01
1354405    -6.000000E-01         -1.700000E-01
1354406    -5.000000E-01         -8.000000E-02
1354407    -3.500000E-01         0.000000E+00
1354408    -2.000000E-01         5.000000E-02
1354409    -1.000000E-01         8.000000E-02
1354410    0.000000E+00          1.100000E-01
*************************************************************************
* HEAD CURVE NO. 5                                                      *
*************************************************************************
1354500    1                     5
1354501    0.000000E+00          0.000000E+00
1354502    2.000000E-01          -3.400000E-01
1354503    4.000000E-01          -6.500000E-01
1354504    6.000000E-01          -9.300000E-01
1354505    8.000000E-01          -1.190000E+00
1354506    1.000000E+00          -1.470000E+00
*************************************************************************
* HEAD CURVE NO. 6                                                      *
*************************************************************************
1354600    1                     6
1354601    0.000000E+00          1.100000E-01
1354602    1.000000E-01          1.300000E-01
1354603    2.500000E-01          1.500000E-01
1354604    4.000000E-01          1.300000E-01
1354605    5.000000E-01          7.000000E-02
1354606    6.000000E-01          -4.000000E-02
1354607    7.000000E-01          -2.300000E-01
1354608    8.000000E-01          -5.100000E-01
1354609    9.000000E-01          -9.100000E-01
1354610    1.000000E+00          -1.470000E+00
*************************************************************************
* HEAD CURVE NO. 7                                                      *
*************************************************************************
1354700    1                     7
1354701    -1.000000E+00         0.000000E+00
1354702    0.000000E+00          0.000000E+00
*************************************************************************
* HEAD CURVE NO. 8                                                      *
*************************************************************************
1354800    1                     8
1354801    -1.000000E+00         0.000000E+00
1354802    0.000000E+00          0.000000E+00
```

```
****************************************************************
* TORQUE CURVE NO. 1                                           *
****************************************************************
1354900    2                      1
1354901    0.000000E+00           6.032000E-01
1354902    1.930000E-01           6.325000E-01
1354903    3.930000E-01           7.369000E-01
1354904    5.955200E-01           8.331000E-01
1354905    7.976200E-01           9.228000E-01
1354906    1.000000E+00           1.000000E+00
****************************************************************
* TORQUE CURVE NO. 2                                           *
****************************************************************
1355000    2                      2
1355001    0.000000E+00           -6.700000E-01
1355002    4.000000E-01           -2.500000E-01
1355003    5.000000E-01           1.500000E-01
1355004    7.372550E-01           5.265860E-01
1355005    7.680490E-01           6.065940E-01
1355006    8.672300E-01           7.436600E-01
1355007    1.000000E+00           1.000000E+00
****************************************************************
* TORQUE CURVE NO. 3                                           *
****************************************************************
1355100    2                      3
1355101    -1.000000E+00          1.984300E+00
1355102    -8.009600E-01          1.394000E+00
1355103    -6.063800E-01          1.097500E+00
1355104    -4.068600E-01          8.220000E-01
1355105    -1.992600E-01          6.648000E-01
1355106    0.000000E+00           6.032000E-01
****************************************************************
* TORQUE CURVE NO. 4                                           *
****************************************************************
1355200    2                      4
1355201    -1.000000E+00          1.964300E+00
1355202    -8.223400E-01          1.830600E+00
1355203    -6.337100E-01          1.682400E+00
1355204    -4.553000E-01          1.557000E+00
1355205    -2.670230E-01          1.436200E+00
1355206    -1.761070E-01          1.387900E+00
1355207    -9.931000E-02          1.348100E+00
1355208    0.000000E+00           1.233610E+00
****************************************************************
* TORQUE CURVE NO. 5                                           *
****************************************************************
1355300    2                      5
1355301    0.000000E+00           -4.500000E-01
1355302    4.000000E-01           -2.500000E-01
1355303    5.000000E-01           0.000000E+00
1355304    1.000000E+00           3.569000E-01
****************************************************************
* TORQUE CURVE NO. 6                                           *
****************************************************************
1355400    2                      6
1355401    0.000000E+00           1.233610E+00
1355402    9.064300E-02           1.196500E+00
1355403    1.885690E-01           1.109600E+00
1355404    2.734700E-01           1.041600E+00
1355405    4.586690E-01           8.956000E-01
1355406    5.744300E-01           7.807000E-01
1355407    7.381600E-01           6.134000E-01
1355408    7.685200E-01           5.849000E-01
1355409    8.700570E-01           4.877000E-01
1355410    1.000000E+00           3.569000E-01
****************************************************************
* TORQUE CURVE NO. 7                                           *
****************************************************************
1355500    2                      7
1355501    -1.000000E+00          -1.000000E+00
1355502    -3.000000E-01          -9.000000E-01
1355503    -1.000000E-01          -5.000000E-01
1355504    0.000000E+00           -4.500000E-01
****************************************************************
* TORQUE CURVE NO. 8                                           *
****************************************************************
1355600    2                      8
1355601    -1.000000E+00          -1.000000E+00
1355602    -2.500000E-01          -9.000000E-01
1355603    -6.000000E-02          -8.000000E-01
1355604    0.000000E+00           -6.700000E-01
```