NORTHEAST UTILITIES

THE CONNECTICUT LIGHT AND POWER COMPANY
WESTERN MASSACHUSETTS ELECTRIC COMPANY
HOLYOKE WATER POWER COMPANY
NORTHEAST UTILITIES SERVICE COMPANY
NORTHEAST NUCLEAR ENERGY COMPANY

General Offices • Selden Street, Berlin, Connecticut

P.O. BOX 270
HARTFORD, CONNECTICUT 06141-0270
(203) 666-6911

June 20, 1984

Docket No. 50-423
B11238

Director of Nuclear Reactor Regulation
Mr. B. J. Youngblood, Chief
Licensing Branch No. 1
Division of Licensing
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Youngblood:

Millstone Nuclear Power Station, Unit No. 3
Millstone 3 Site Visit by Auxiliary Systems Branch Reviewer, June 13, 1984

Attached is the additional information concerning (1) protection against postulated pipe breaks outside containment and (2) hydrogen recombiner building post accident exhaust system. The above information was requested by your Mr. R. Goel, Auxiliary Systems Branch during his Millstone 3 site visit of June 13, 1984. As noted in the attachment, a copy for each of the following FSAR figures were provided to your R. Goel on June 13, 1984.

Figure 9.4-1 sheets 1, 2, 3, 4 and 5
Figure 9.4-2 sheets 1, 2, 3 and 5
Figure 9.4-3 sheets 1, 2 and 3
Figure 9.4-4 sheets 1 and 2
Figure 9.4-9 sheet 1

The attached information should fully resolve the above concerns. If there are any questions, please contact our licensing representative directly.

Very truly yours,

NORTHEAST NUCLEAR ENERGY COMPANY
et. al.

BY NORTHEAST NUCLEAR ENERGY COMPANY
Their Agent

W. G. Counsil

W. G. Counsil
Senior Vice President

B001
1/1

STATE OF CONNECTICUT)
) ss. Berlin
COUNTY OF HARTFORD)

Then personally appeared before me W. G. Counsil, who being duly sworn, did state that he is Senior Vice President of Northeast Nuclear Energy Company, an Applicant herein, that he is authorized to execute and file the foregoing information in the name and on behalf of the Applicants herein and that the statements contained in said information are true and correct to the best of his knowledge and belief.

Lorraine J. D'Amico
Notary Public

My Commission Expires March 31, 1988

OPEN ITEMS

AUXILIARY SYSTEMS BRANCH

ASB-22 PRESSURE AND TEMPERATURE PROFILES FOR PIPE BREAKS OUTSIDE CONTAINMENT

Provide the following information to perform an independent calculation for verifying environmental conditions in a compartment (e.g. Main Steam Valve Building) after a high energy line break.

1. With respect to the pipe to be broken, we need to know the:

   a. Type of fluid (water or steam);
   b. Temperature;
   c. Pressure;
   d. Source of fluid;
   e. Flow rate (or assumed flow rate) versus time; and
   f. Enthalpy versus time

2. With respect to the compartments being analyzed:
   a. Number of compartment analyzed;
   b. For each compartment:
      i. initial temperature
      ii. initial pressure
      iii. initial humidity
      iv. floor area including floor space taken by equipment (square feet)
      v. number of vents and vent areas (square feet) for each vent; and
      vi. compartment wall height (feet) and
   c. Simple compartment and interconnection diagram.

3. All assumptions used, including but not limited to the:

   a. Orifice coefficient;
   b. Fluid expansion factor; and
   c. Heat transfer coefficient for heat through the walls

4. Utilities analysis results:

   a. Temperature versus time curve (peak temperature specified);
   b. Pressure versus time curve (peak pressure specified); and
   c. Humidity versus time curve (peak humidity specified)

Response (6/84):

The attachment ASB22-1 provides the above-requested information for the Main Steam Valve Building.

ATTACHMENT ASB22-1

High Energy Line Break Environmental Analysis
Main Steam Valve Building

1. Method of Analysis
2. Mass and Energy Release
3. Building Model
   a. Volume and vent path data
   b. Heat sinks
   c. Initial conditions
4. Results

1. Method of Analysis

The pressure, temperature, and humidity transients following a high energy line break (HELB) in the main steam valve building (MSVB) were determined with the Stone & Webster Engineering Corporation's THREED computer program. The building was modelled as six control volumes, or nodes, with vent paths connecting the nodes to each other and to the outside atmosphere. Blow-out panels are used in the MSVB to provide pressure relief to atmosphere following a HELB. Building ventilation systems were not considered in the analysis.

The postulated HELB was a 1.0 square foot rupture in a main steam line. The MSVB is a break exclusion zone for the main steam piping, so a 1.0 square foot rupture was postulated consistent with Branch Technical Position ASB 3-1.

2. Mass and Energy Release

Parameters used to calculate the mass and energy release are given in Table 1. The mass and energy release data is given in Table 2.

A constant flow was assumed from the time of rupture up to steam generator dry-out, which is the time the affected steam generator empties. The flow was based on the frictionless Moody model at the initial steam line conditions. Dry-out time was determined by a mass balance on the affected steam generator, and included all available water sources: the initial steam generator inventory including the feedwater line up to the isolation valve, steam in the main steam piping, and auxiliary feedwater added to the steam generator.

Failure of the main steam isolation valve (MSIV) in the ruptured line was assumed. Closure of the MSIVs in the other three main steam lines prevent the three intact steam generators from feeding the break. This is the limiting single failure for pressure and temperature in the MSVB.

3. Building Model

The MSVB is modelled by six interconnected nodes as shown in Figure 1. A sketch showing the location of the nodes is given in Figure 2. Input data for the thermal-hydraulic calculations are described below.

a. Volume and Vent Path Data

The nodal volumes and vent path data used in the THREED computer program are given in Tables 3 and 4. The vent paths areas in Table 3 denoted by an asterisk are blow-out panel areas. These panel flow areas are initially assumed to be zero until their maximum rated pressure is reached. At that time, the vent area instantaneously increases to the net through area of the blow-out panel assemblies.

Forward and reverse loss coefficients, K-factors, are given in both Tables 3 and 4. Table 3 gives the total forward and reverse K-factors, and Table 4 gives the constituent parts of the total values.

The geometric inertia parameters or "Inertas" are given in Table 3. The Inerta represents a summation of length over area (L/A) terms between connected node pairs.

b. Heat Sinks

The passive heat sink data is given in Table 5. The slab thicknesses shown in Table 5 are numerically representative of an area-averaged thickness. The slab thicknesses are averaged to account for adjacent node pairs that share a common wall, floor or ceiling.

Condensation heat transfer to the heat sinks on the inside surface is determined by the Vchida correlation including a fixed 8 percent partial revaporization correlation. Heat transfer from the outer surface is by natural convection at a constant value of 2 Btu/hr-ft^2-^{o}F to a constant environment temperature of 120^{o}F. The conduction heat transfer model and, in general, the heat sink routines in THREED are based on the routines in CONTEMPT-LT/026.

c. Initial Conditions

The initial conditions used in the analysis are:

Initial Temperature	120^{o}F
Initial Pressure	14.696 psia
Humidity	100 percent

The use of the above initial conditions yields the limiting HELB pressure and temperature transients for the MSVB.

4. Results

The peak calculated pressure and temperature in the MSVB was 15.82 psia and 292.4^{o}F, respectively. Complete pressure and temperature transients for each node of the building are given in Figures 3, 4 and 5. The relative humidity is 100% for the duration of the transient.

Table 1

Parameters for Mass and Energy Release Calculations
Main Steam Valve Building Analysis

Postulated rupture	Main steam line
Rupture size	1.0 ft^2
Power level	Hot standby
Main steam pressure	1106 psia
Main steam enthalpy	1188.82 Btu/lbm
Flow prior to SG dryout	
Flow model	Frictionless Moody
Flow rate (assumed constant)	2306 lbm/sec
SG dryout time	100.8 sec
Flow after SG dryout (equal to auxiliary feedwater flow)	44.27 lbm/sec
Auxiliary feedwater isolation time	30 minutes

Table 2

Mass and Energy Release Data
1.0 SQ FT Main Steam Line Rupture
Main Steam Valve Building Analysis

Time (sec)	Mass Flow Rate (lbm/sec)	Energy Flow Rate (Btu/sec)
0.0	2306.0	2741419.0
100.8	2306.0	2741419.0
100.81	44.27	52629.0
1800.0	44.27	52629.0
1800.01	0.0	0.0

TABLE 3

THREED INPUT FOR ANALYSIS OF MAIN STEAM VALVE BUILDING

Node No.	Node Vol. (ft^3)	Vent Path No.	Vent Path Area (ft^2)	Vent Path Connecting Node From	To	Forward K-Factor (f L/D)	Reverse K-Factor (f L/D)	Inerta (ft^{-1})
1	30494	1	90.0	1	2	2.462	2.462	0.043
		2	85.3*	1	3	2.39	2.42	0.055
2	30494	3	85.3*	1	3	2.39	2.42	0.055
		4	19.6*	1	3	2.46	2.47	0.134
3	29640	5	19.6*	1	3	2.46	2.47	0.134
		6	40.0	1	5	2.45	2.45	0.09
4	29640	7	85.3*	2	4	2.39	2.42	0.055
		8	85.3*	2	4	2.39	2.42	0.055
5	9671	9	19.6*	2	4	2.46	2.47	0.134
		10	19.6*	2	4	2.46	2.47	0.134
6	12741	11	12.8	2	6	2.145	2.169	0.26
		12	375.8	3	7	1.604	1.7	0.045
7	10E20	13	375.8	4	7	1.604	1.7	0.045
		14	42.0	1	2	2.56	2.56	0.068
		15	78.0	1	2	2.49	2.49	0.046

*Area available after blow out panel vacates vent path
Blow out panels release at:

0.54 psid for the 85.3 ft^2 vent paths
0.65 psid for the 19.6 ft^2 vent paths

TABLE 4

Vent Path Flow Coefficients

MAIN STEAM VALVE BUILDING ANALYSIS

Forward K Factors

Vent Path No.	Total Kf	Contraction	Expansion	Vena Contraction	Vent Friction	Wall Friction	Momentum Loss
1	2.46	0.46	0.86	1.07	0.005	0.06	0.0
2	2.39	0.46	0.82	1.04	0.004	0.06	0.004
3	2.39	0.46	0.82	1.04	0.004	0.06	0.004
4	2.46	0.49	0.96	0.94	0.009	0.06	0.0
5	2.46	0.49	0.96	0.94	0.009	0.06	0.0
6	2.45	0.47	0.89	1.01	0.008	0.06	0.0
7	2.39	0.46	0.82	1.04	0.004	0.06	0.004
8	2.39	0.46	0.82	1.04	0.004	0.06	0.004
9	2.46	0.49	0.96	0.94	0.009	0.06	0.0
10	2.46	0.49	0.96	0.94	0.009	0.06	0.0
11	2.145	0.49	0.94	0.44	0.016	*0.26	0.0
12	1.604	0.15	1.0	0.70	0.002	*0.23	-0.483
13	1.604	0.15	1.0	0.70	0.002	*0.23	-0.483
14	2.56	0.48	0.93	1.09	0.006	0.06	0.0
15	2.49	0.47	0.88	1.08	0.005	0.06	0.0

Reverse K Factors

Vent Path No.	Total KR	Contraction	Expansion	Vena Contraction	Vent Friction	Wall Friction	Momentum Loss
1	2.46	0.46	0.86	1.07	0.005	0.06	0.0
2	2.42	0.45	0.86	1.06	0.004	0.06	-0.004
3	2.42	0.45	0.86	1.06	0.004	0.06	-0.004
4	2.47	0.49	0.97	0.94	0.009	0.06	0.0
5	2.47	0.49	0.97	0.94	0.009	0.06	0.0
6	2.45	0.47	0.89	1.01	0.008	0.06	0.0
7	2.42	0.45	0.86	1.06	0.004	0.06	-0.004
8	2.42	0.45	0.86	1.06	0.004	0.06	-0.004
9	2.47	0.49	0.97	0.94	0.009	0.06	0.0
10	2.47	0.49	0.97	0.94	0.009	0.06	0.0
11	2.169	0.48	0.97	0.44	0.016	*0.26	0.0
12	1.7	0.5	0.09	0.39	0.003	*0.23	0.483
13	1.7	0.5	0.09	0.39	0.003	*0.23	0.483
14	2.56	0.48	0.93	1.09	0.006	0.06	0.0
15	2.49	0.47	0.88	1.08	0.005	0.06	0.0

*These coefficients include a grating loss (K = 0.2).

TABLE 5

MAIN STEAM VALVE BUILDING
PASSIVE HEAT SINKS

Node No.	Area (ft^2)	Slab Thickness (ft)	Description Material
1	5879.2	1.5833	Concrete
2	5913.0	1.5833	Concrete
3	5836.0	1.5833	Concrete
4	5836.0	1.5833	Concrete
5	4375.2	1.5833	Concrete
6	3964.4	1.5833	Concrete

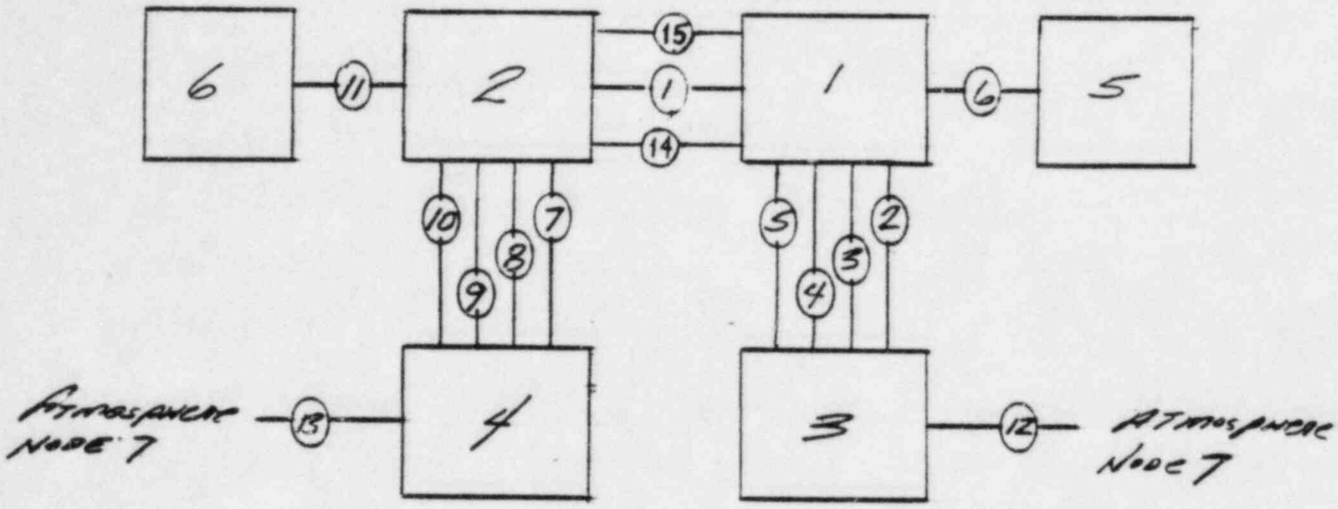
Data common to all heat sinks:

1. Thermal Conductivity (BTU/hr-ft-^{o}F) = 0.79
2. Volumetric Heat Capacity (BTU/cu-ft-^{o}F) = 24.93
3. Uchida heat transfer correlation with a fixed 8 percent partial revaporization (inside boundary).
4. Natural convection coefficient of 2 BTU/hr-ft^2-^{o}F (outside boundary).
5. Constant outside temperature of 120^{o}F.

Figure 1

Main Steam Valve Building

Nodal Diagram



BLOW OUT PANELS, JUNCTIONS
2, 3, 4, 5, 7, 8, 9 & 10

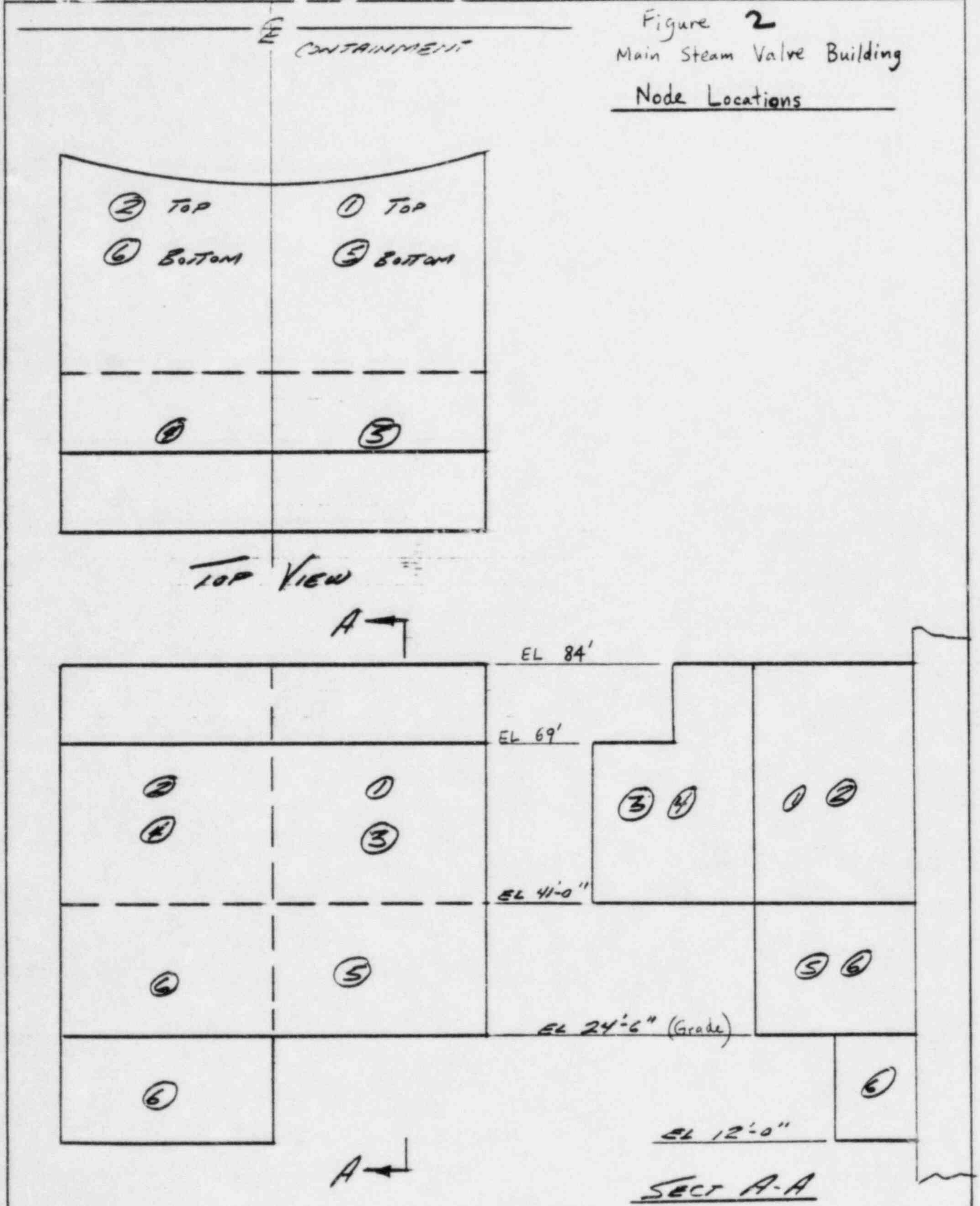
STONE & WEBSTER ENGINEERING CORPORATION

CALCULATION SHEET

5010.65

CALCULATION IDENTIFICATION NUMBER				PAGE __
J.O. OR W.O. NO.	DIVISION & GROUP	CALCULATION NO.	OPTIONAL TASK CODE	

Figure 2
Main Steam Valve Building
Node Locations



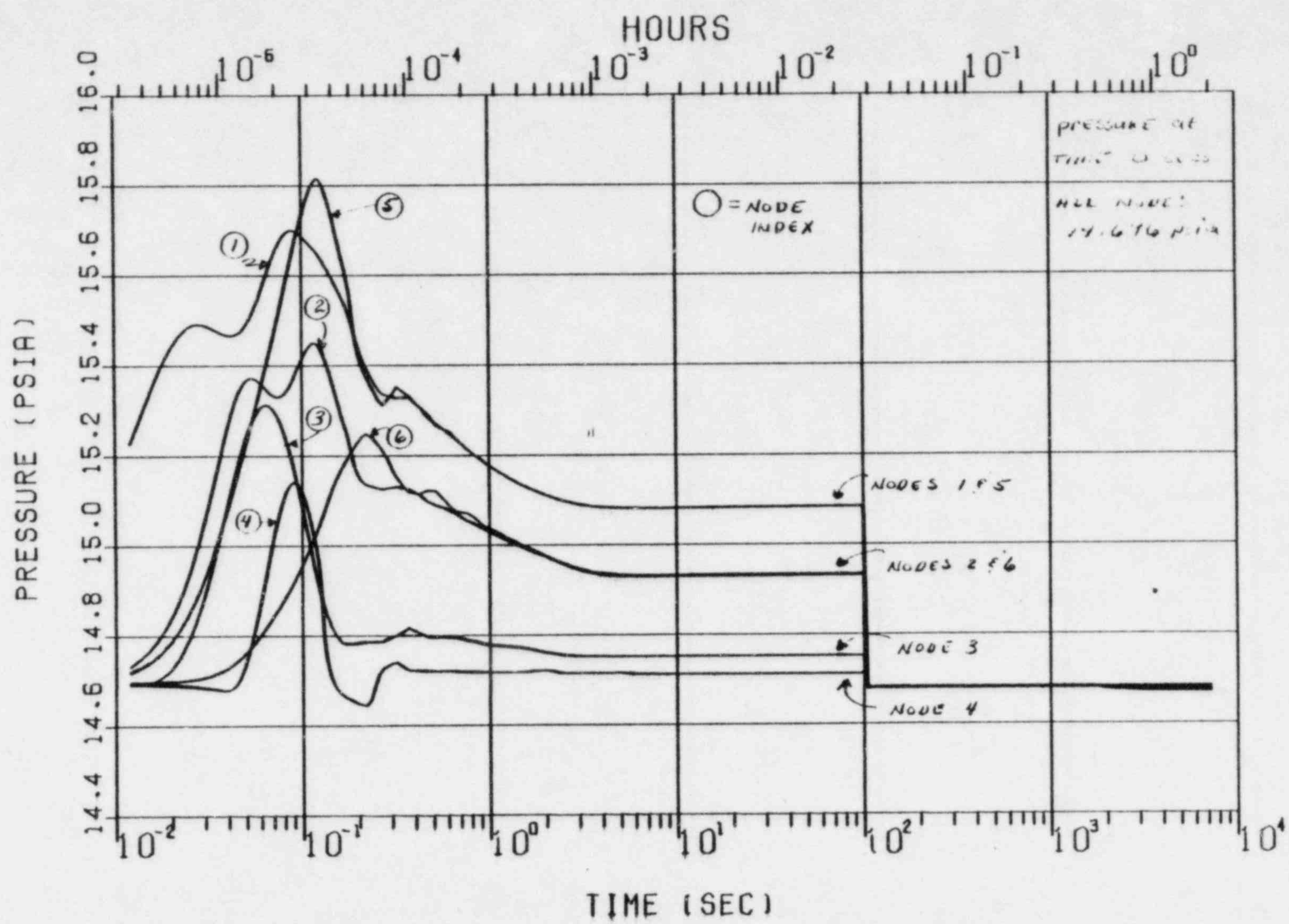


FIGURE 3
MILLSTONE 3 MSVH 1.0SQFT.MSLB IN NODE 1
PRESSURE VS. TIME
PROFILE NODES 1 THRU 6

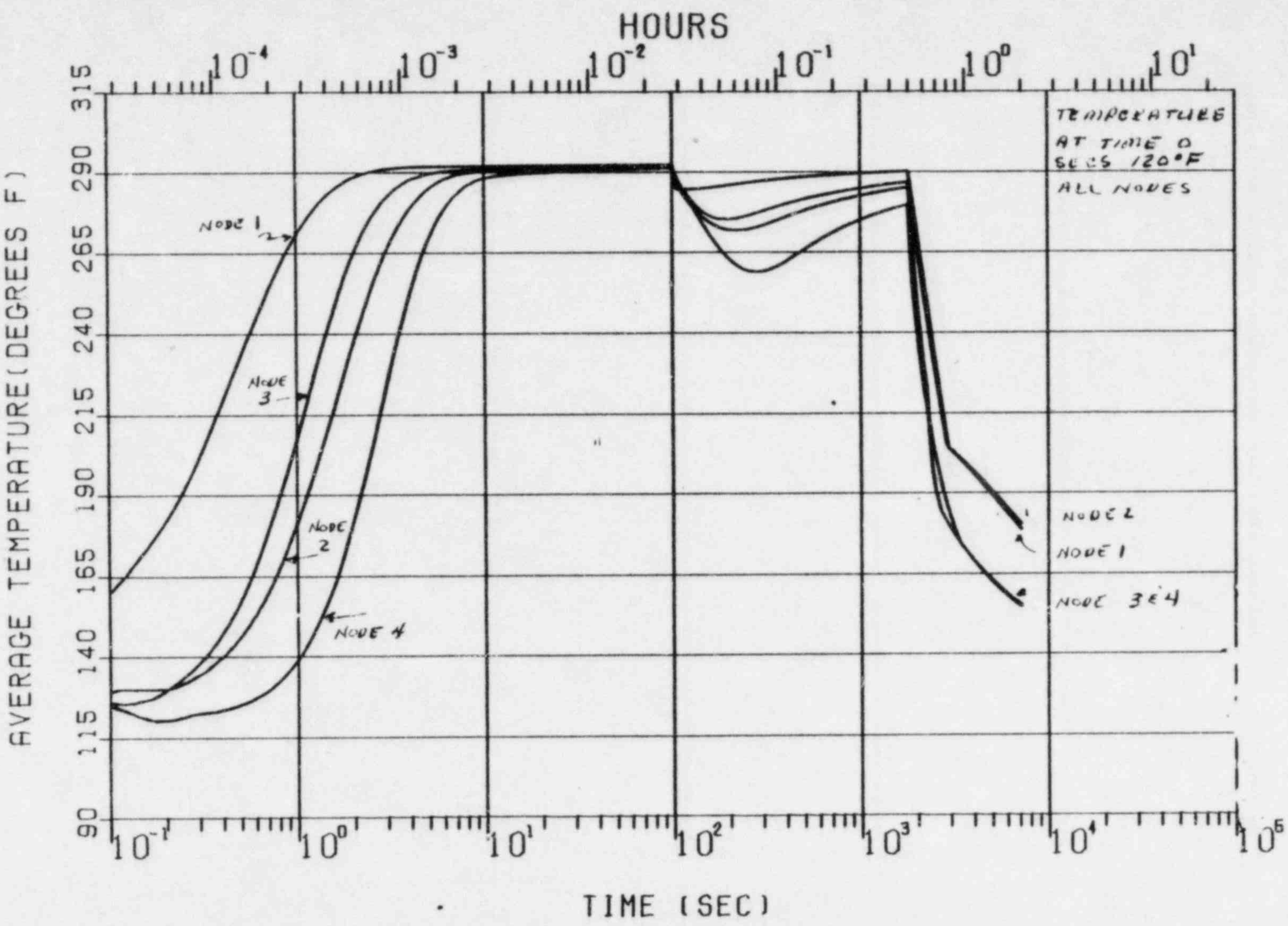


FIGURE 4
MILLSTONE 3 MSVH 1.0SQFT.MSLB IN NODE 1
AVERAGE TEMPERATURE VS TIME
PROFILE FOR NODES 1 THRU 4

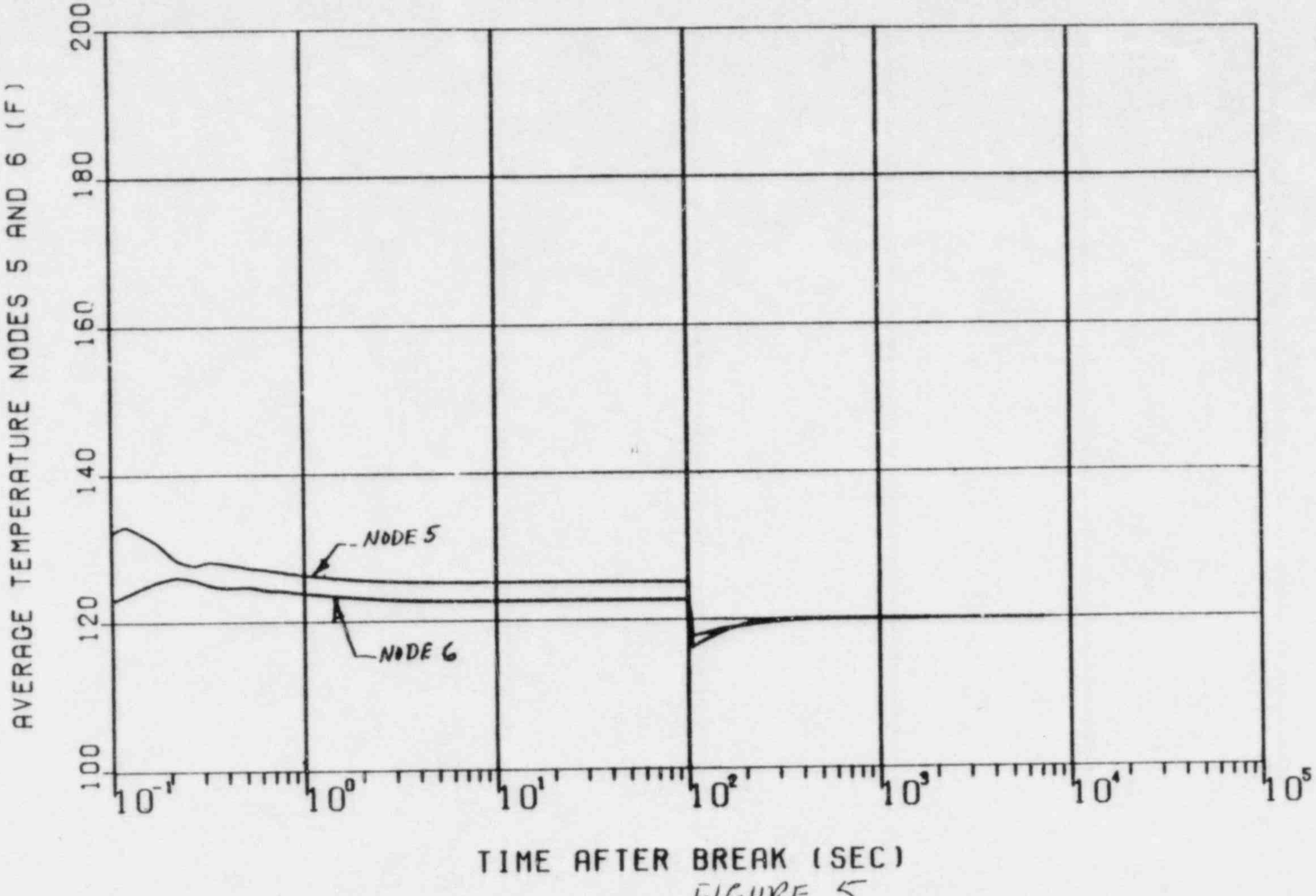


FIGURE 5

MAIN STEAM LINE BREAK 1.0SQFT
AVERAGE TEMPERATURE VS TIME

Open Items

AUXILIARY SYSTEMS BRANCH
ASB-23 HYDROGEN RECOMBINER BUILDING VENTILATION SYSTEM

Information in the FSAR is inadequate to review this system. Additional information about hydrogen recombiner building post accident exhaust system and figures are required.

Response (6/84):

Refer to the revised FSAR Section 9.4.11. A copy for each of the following FSAR figures was provided directly to your Mr. R. Goel, Auxiliary Systems Branch during his site visit of June 13, 1984.

Figure 9.4-1 sheets 1, 2, 3, 4 and 5
Figure 9.4-2 sheets 1, 2, 3, and 5
Figure 9.4-3 sheets, 1, 2, and 3
Figure 9.4-4 sheets, 1 and 2
Figure 9.4-9 sheet 1

missiles and internally generated missiles, pipe whip, and jet impingement forces associated with a pipe break.

7. The QA and Seismic Category I portion of the HVAC system is in accordance with the requirements of General Design Criterion 5 for shared systems and components important to safety.

8. The QA and Seismic Category I portion of the HVAC system is in accordance with the requirements of IEEE-323-1974 for qualifying Class IE electrical equipment (Section 3.11B).

9. The QA and Seismic Category I portion of the HVAC system is in accordance with the requirements of Regulatory Guide 1.26, for the quality group classification of systems components (Section 3.2).

10. The QA and Seismic Category I portion of the HVAC system is in accordance with the requirements of Regulatory Guide 1.29, for the seismic design classification of system components (Section 3.2).

11. All ventilation intakes and exhaust outlets are provided with concrete missile protected hoods.

9.4.11.2 System Description

The hydrogen recombiner building HVAC system is shown on Figure 9.4-2. The system is comprised of the following subsystems:

1. Hydrogen recombiner ventilation
2. Control room air conditioning
3. HVAC equipment room air conditioning
4. Hydrogen recombiner building heating
5. Hydrogen recombiner building post-accident exhaust system

   a. The hydrogen recombiner ventilation system is nuclear safety related and consists of two redundant supply and exhaust duct networks with safety related fans, radiation monitors, and isolation dampers powered from the Class IE power supply. During normal plant operation, the two redundant hydrogen recombiners are nonoperational and, consequently, require no ventilation.

   Electro-hydraulic operated dampers (MOD's) on the supply and exhaust lines are normally closed. After a postulated accident one of the two redundant hydrogen recombiners will operate and require ventilation. The MOD's on the supply and exhaust duct lines are manually activated to open or close and will activate limit switches to start or stop the fan located on the

the dampers close. A disposable type filter with a differential pressure indicator is located on the supply duct to minimize dust buildup in the HVAC equipment room.

d. The heating system in the hydrogen recombiner building is non-nuclear safety related. It consists of electric unit heaters and is located in all areas of the building to provide a minimum design temperature of 50°F d.b., with the exception of the HRB control room which has a minimum design temperature of 75°F d.b. The heaters have built-in thermostats with adjustable control knobs mounted on the face of the units for automatic temperature control.

e. The hydrogen recombiner building post accident exhaust system serving the post accident sampling module units (Section 9.3.2.6) is connected to the supplementary leak collection and release system (SLCRS) (Section 6.2.3). Whenever a sample is required, one of the SLCRS fans (Figure 9.4-2) is started and a manual damper opened to provide filtered exhaust from the module unit hood.

9.4.11.3 Safety Evaluation

The hydrogen recombiner ventilation system is required to operate after one hour of a postulated accident. This system and the hydrogen recombiner building post accident exhaust system are QA and Seismic Category I. The ventilation systems are located within a Seismic Category I structure, which is designed for missile, earthquake, tornado, and flood protection. The hydrogen recombiner ventilation and hydrogen recombiner building post accident exhaust systems are also seismically supported.

To preclude post-accident containment leakage into the hydrogen recombiner building, the boundary of the SLCRS (Section 6.2.3) extends to the annular space between the containment and the hydrogen recombiner building. This area has been provided with air tight seals to allow proper functioning of the SLCRS.

The electrical components (electro-hydraulic dampers, fans, and radiation elements) of the hydrogen recombiner ventilation system are powered from the Class IE power supply to maintain the function of the system during a postulated accident. In the event of a loss of electrical power, the electro-hydraulic operated dampers are additionally designed to fail close. A manual control switch with position indicating lights is provided on the ventilation panel (VP-1) for each train of these dampers allowing manual operation for building isolation from the main control room.

Redundancy is designed into the system (separate ventilation loops for each of the redundant hydrogen recombiners) to assure that no single failure results in the loss of function of the hydrogen recombiners. Three-hour rated fire dampers are located where