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February 28, 1986
Fort St. Vrain
Unit No. 1
P-86120

Director of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Attn: Mr. H.N. Berkow, Project Director
Standardization and Special
Projects Directorate

Docket No. 50-267

SUBJECT: Fort St. Vrain
Environmental Qualification
Program

REFERENCES: 1) NRC Letter Dated 11/05/85, Butcher to Lee, (G-85452)

2) PSC Letter Dated 12/27/85, Walker to Berkow, (P-85499)

Dear Mr. Berkow:

Reference 1 submitted requests for additional information needed by the NRC Staff in their review of the Fort St. Vrain (FSV) Environmental Qualification (EQ) Program. The PSC responses were submitted by reference 2 except for the information requested to permit the staff to perform independent calculations of the temperature profiles. This additional information is provided in the enclosure of this letter.

In reference 2, PSC stated that the staff would receive information for two line break scenarios in the Reactor Building, the one yielding the highest peak temperature and the one yielding the highest temperature at one hour. Subsequent conversations with the staff have expanded the request to include information for one line break scenario in the Turbine Building. Enclosed with this letter is the requested information for the following scenarios: 1) HRH-1, the offset rupture in the Turbine Building which yields the highest peak temperature, 2) HRH-2, the offset rupture in the Reactor Building which yields the highest peak temperature, and 3) CRH-19, a typical

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small break in the Reactor Building (resulting in a blowdown rate which is 10% of the offset rupture blowdown rate). CRH-19 is not the scenario yielding the highest temperature at one hour in the Reactor Building. It appears that breaks smaller than 10% will result in higher temperatures at one hour. However, at this time, the 10% break size temperature profile is the smallest break which has been finalized and independently reviewed. Smaller break temperature profiles are being recalculated at this time based upon recent changes in the Steam Line Rupture Detection/Isolation System setpoints.

The information enclosed for the three scenarios will allow an independent verification of the temperature profiles obtained from GA Technologies using their FLASH/GA and CONTEMPT-G computer programs. If you have any questions, please contact Mr. M.H. Holmes at (303) 480-6960.

Very truly yours,

D. W. Warembourg

D.W. Warembourg, Manager
Nuclear Engineering Division

DWW/FWT:pa

Enclosure

TABLE 1

PRESSURE AND TEMPERATURE PROFILES FOR PIPE BREAK OUTSIDE CONTAINMENT

The following information is required for each pipe break analysis performed by the applicants.

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 the 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)

TABLE 2

Data/Case	HRH-1	HRH-2	CRH-19
1. Broken pipe data			
a. Type of fluid	Steam	Steam	Steam
b. Temperature (°F)	1000.	1000.	740.
c. Pressure (Psia)	566.4	584.6	895
d. Source of the fluid	S.G. & pipes	S.G. & pipes	S.G. pipes & auxiliary steam
e. Flow rate versus time	Table 3	Table 4	Table 5
f. Enthalpy rate versus time	Table 3	Table 4	Table 5
2. Compartment data			
a. Number of compartments	1	1	1
b,i Initial temp	90°F	90°F	90°F
b,ii Initial pressure	12.3 psi	12.3 psi	12.3 psi
b,iii Initial humidity	70%	70%	70%
b,iv Floor area	Table 6	Table 7	Table 7
b,v Number of vents & vent areas	*	*	*
b,vi Wall height	Table 6	Table 7	Table 7
c. Simple compartment diagram	Figs. 1, 2, 3	Figs. 1, 4, 5	Figs. 1, 4, 5
3. Assumptions used:			
a. Orifice coefficient	1	1	1
b. Fluid expansion factor	∞	∞	∞
c. Heat transfer coefficent for walls	Table 6	Table 7	Table 7
4. Utility analysis results			
a. Temperature versus time	Figure 6	Figure 7	Figure 8
b. Pressure versus time	*	*	*
c. Humidity versus time	Figure 9	Figure 10	Figure 11

*An "open building" calculation was performed, meaning that the building pressure was held constant (12.3 psia) and, at each time step, an appropriate mass of mixed air and steam exchange with the environment was calculated to maintain that pressure.

TABLE 3
HRH-1 FLOW AND ENERGY RELEASE VERSUS TIME

Description: Hot Reneat Steam Leak in T.3
Reference Input: Run ST9629, 9/4/85 at 13:57:34 (Flash/GA)

Time		Flow Rate	Enthalpy Rate
(S)	(Hr)	(Lb/Hr)	(Btu/Hr)
0	0	0	0
0.1	2.7778×10^{5}	18.845×10^{6}	27.514×10^{9}
0.210	5.5833×10^{-5}	10.928×10^{6}	15.443×10^{9}
0.381	1.0583×10^{-4}	6.599×10^{6}	9.471×10^{9}
0.560999	1.5583×10^{-4}	5.676×10^{6}	8.345×10^{9}
0.920997	2.5583×10^{-4}	4.729×10^{6}	7.087×10^{9}
1.46099	4.0583×10^{-4}	4.040×10^{6}	6.115×10^{9}
2.40229	6.6730×10^{-4}	3.488×10^{6}	5.307×10^{9}
4.00038	1.1112×10^{-3}	2.901×10^{6}	4.446×10^{9}
8.00057	2.2224×10^{-3}	2.427×10^{6}	3.723×10^{9}
10.0012	2.7781×10^{-3}	2.323×10^{6}	3.565×10^{9}
11.0012	3.0559×10^{-3}	1.909×10^{6}	2.940×10^{9}
12.0008	3.3335×10^{-3}	843.0×10^{3}	1.294×10^{9}
13.0	3.6111×10^{-3}	391.1×10^{3}	606.4×10^{6}
14.0017	3.8894×10^{-3}	188.3×10^{3}	289.8×10^{6}
15.0012	4.1670×10^{-3}	142.8×10^{3}	218.0×10^{6}
16.0187	4.4496×10^{-3}	0	0
	∞	0	0

TABLE 4
HRH-2 FLOW AND ENERGY RELEASE VERSUS TIME

Description: Hot Reheat Steam Leak in R 8
Reference Input: Run ST8680, 9/4/85 at 19:24:57 (Flash/GA run)

Time		Flow Rate	Enthalpy Rate
(S)	(Hr)	(Lb/Hr)	(Btu/Hr)
0	0	0	0
0.1	2.7778×10^{5}	10.020×10^{6}	14.853×10^{9}
0.12	3.3333×10^{-5}	10.244×10^{6}	15.087×10^{9}
0.201	5.5833×10^{-5}	9.081×10^{6}	13.332×10^{9}
0.381	1.0583×10^{-4}	6.739×10^{6}	9.817×10^{9}
0.560999	1.5583×10^{-4}	5.487×10^{6}	8.062×10^{9}
0.920997	2.5583×10^{-4}	4.320×10^{6}	6.432×10^{9}
1.46099	4.0583×10^{-4}	3.548×10^{6}	5.317×10^{9}
2.40184	6.6718×10^{-4}	3.093×10^{6}	4.660×10^{9}
4.00008	1.1111×10^{-3}	2.906×10^{6}	4.403×10^{9}
8.00052	2.2224×10^{-3}	2.433×10^{6}	3.715×10^{9}
10.0016	2.7782×10^{-3}	1.144×10^{6}	1.762×10^{9}
11.0008	3.0558×10^{-3}	348.8×10^{3}	547.8×10^{6}
12.0016	3.3338×10^{-3}	131.3×10^{3}	202.6×10^{6}
13.0049	3.6125×10^{-3}	22.47×10^{3}	34.05×10^{6}
13.2170	3.6714×10^{-3}	0	0
	∞	0	0

TABLE 5
CRH-19 FLOW AND ENERGY RELEASE VERSUS TIME

Description: Cold Reheat Steam Leak in Reactor Building through 10% Leak Area
Reference Input: Run ST6965, (Flash/GA)

Time (Sec)	Flow Rate (Lb/Hr)	Enthalpy Rate (Btu/Hr)
0.00000	0.00000	0.00000
4.31952-02	6.76724+05	9.19545+08
8.80165-02	1.61093+06	2.19180+09
.13349	1.99831+06	2.70948+09
.17932	2.00681+06	2.72152+09
.38290	2.00069+06	2.71502+09
.96548	1.96029+06	2.65647+09
1.5455	1.92229+06	2.60334+09
2.1238	1.88949+06	2.55776+09
2.7011	1.85917+06	2.51666+09
3.3001	1.83479+06	2.48449+09
3.8767	1.81768+06	2.46315+09
4.4532	1.80464+06	2.44811+09
5.0300	1.79510+06	2.43856+09
5.6257	1.78525+06	2.42817+09
6.0904	1.77845+06	2.41940+09
6.4904	1.76862+06	2.40478+09
6.8904	1.74870+06	2.37501+09
7.2904	1.71957+06	2.33178+09
7.6904	1.68288+06	2.27819+09
8.0904	1.64815+06	2.22895+09
8.4904	1.61247+06	2.17977+09
8.8904	1.57663+06	2.13143+09
9.2904	1.54341+06	2.08798+09
9.6904	1.50897+06	2.04338+09

TABLE 5 (Contd.)

Time (Sec)	Flow Rate (Lb/Hr)	Enthalpy Rate (Btu/Hr)
10.390	1.44849+06	1.96533+09
11.390	1.37015+06	1.86566+09
12.390	1.30115+06	1.77778+09
13.390	1.24720+06	1.71168+09
14.390	1.19969+06	1.65181+09
15.390	1.16019+06	1.59658+09
16.390	1.12334+06	1.53799+09
17.390	1.08396+06	1.47114+09
18.390	1.04987+06	1.40969+09
19.390	1.02313+06	1.35618+09
20.890	9.91221+05	1.28767+09
22.890	9.49254+05	1.20903+09
24.890	9.03217+05	1.13975+09
26.890	8.53657+05	1.07511+09
27.060	8.49296+05	1.06967+09
38.7	5.814+05	7.3227+08
67.0	0	0
∞	0	0

TABLE 6
TURBINE BUILDING

Total Floor Area = 15,830 ft^2
Volume = 750,000 ft^3

	Heat Sink Surface	Wall hick (in.)	Area (Sq Ft)	Film Heat Transfer Coefficient Outside* (Btu/h-ft^2-°F)
1.	Concrete Floor Etc.	36	30,400	0
2.	Concrete Structures	21	5,810	0
3.	Concrete Partition Walls & Floors	12	44,600	2
4.	Piping	0.375	80,540	0
5.	Composite Steel Wall	5.25	7,930	6
6.	Steel Decking	0.0936	12,300	0
7.	Structural Steel and Equipment	0.375	62,710	0
8.	Electrical Conduits and Cable Trays	0.0312	52,700	0

	Time (Min)	Film Inside Heat Transfer Coefficient* (Btu/h-ft^2-°F)
HRH-1	0	5
	0.267	6.6
	0.2682	5
	120	5

Linear interpolation
Concrete thermal conductivity: 1 Btu/h-ft-°F
Steel thermal conductivity : 27 Btu/h-ft-°F
Heat sinks are as modeled in GA-A12045 (1972)

*Locations that signify the inside and outside heat transfer coefficients are illustrated in Fig. 1.

TABLE 7
REACTOR BUILDING

Total Floor Area = 4900 ft^2
Volume = 534,730 ft^3

Heat Sink Surface	Wall Thick (in.)	Area (Sq Ft)	$\frac{BTU}{h-ft^2-°F}$ Heat Transfer Coefficient Outside *
1. Concrete Walls and Floor, PCRV	36	42,230	0
2. PCRV Support Ring	21	9,870	0
3. Concrete Partition Walls and Floors	12	9,710	0
4. Thin Steel Wall	0.06	16,090	2
5. Composite Steel Wall	5.25	19,810	6
6. Steel Decking	0.0936	43,140	0
7. Structural Steel	0.375	28,800	0
8. Ducting, Electrical Conduits Cable Trays	0.0312	63,700	0
9. Piping	0.375	49,200	0

	Time (Min)	Inside Heat Transfer Coefficient* BTU/ft^2-h-°F
CRH-19	0	5
	0.8334	32
	1.1166	32
	1.14	5
	120	5
HRH-2	0	5
	0.22026	7.64
	0.22146	5
	120	5

Heat sinks are as modeled in GA-A12045 (1972)

*Locations that signify the inside and outside heat transfer coefficients are illustrated in Fig. 1.

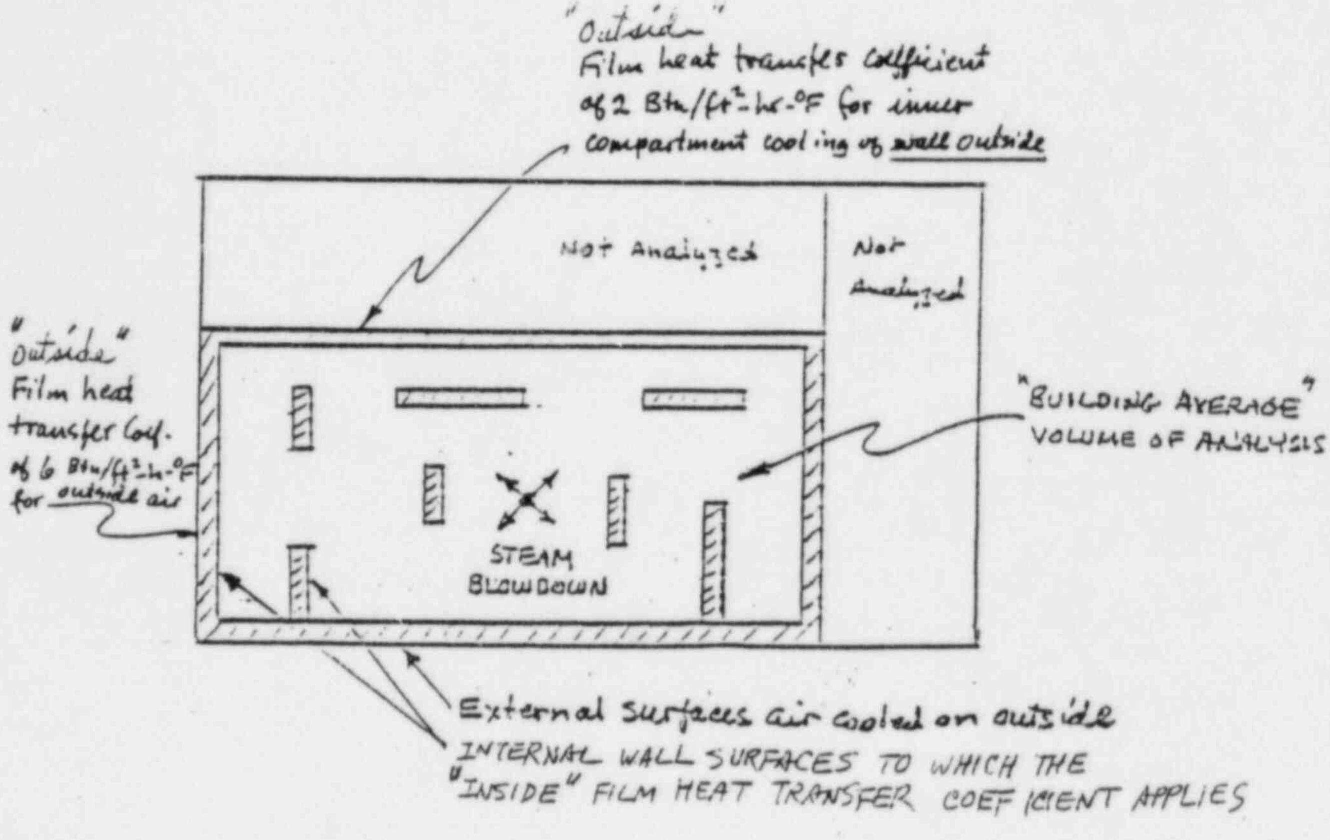

FIGURE 1. ILLUSTRATION OF CONTEMPT-G BUILDING MODELS APPLICABLE TO BOTH REACTOR AND TURBINE BUILDINGS

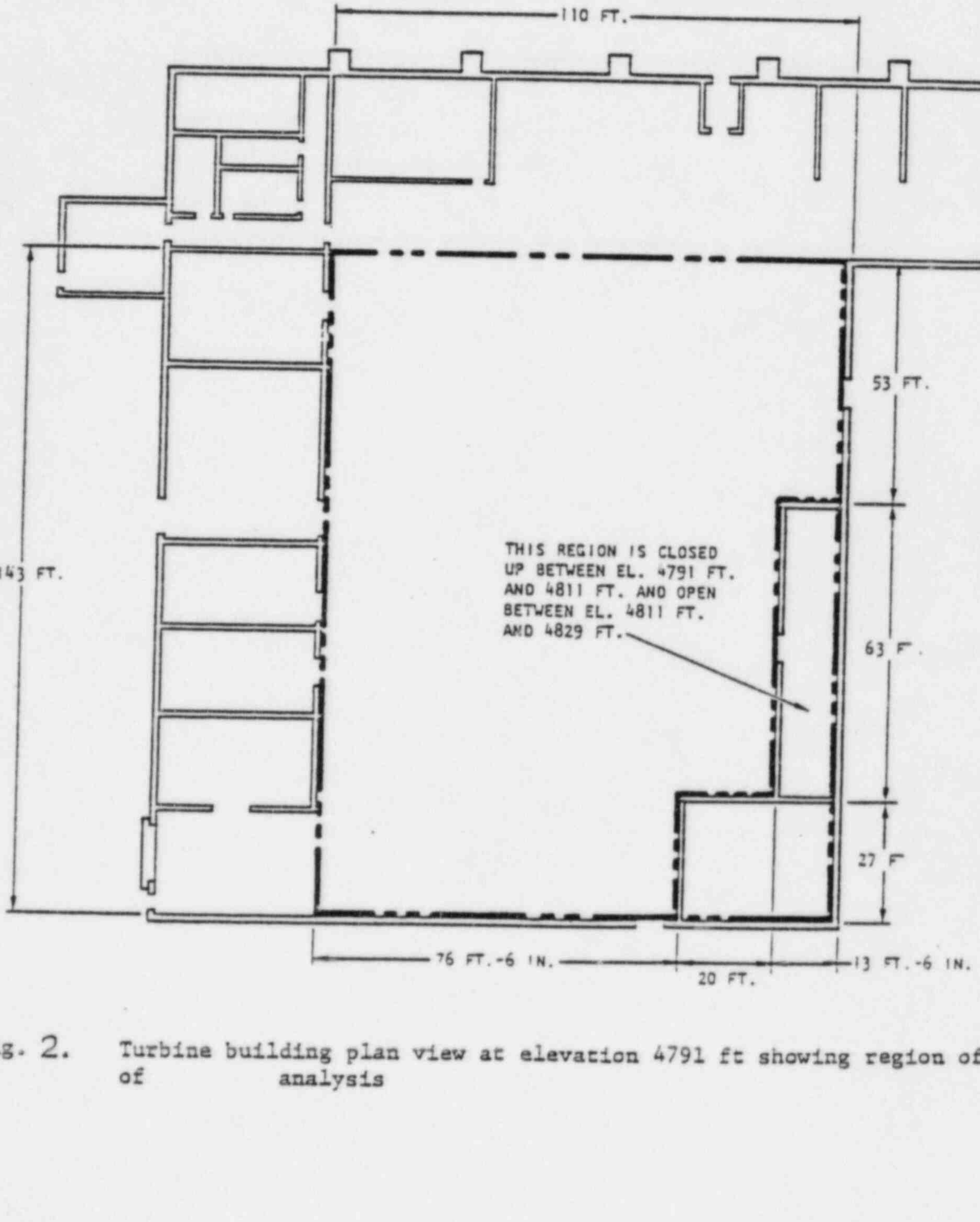

Fig. 2. Turbine building plan view at elevation 4791 ft showing region of of analysis

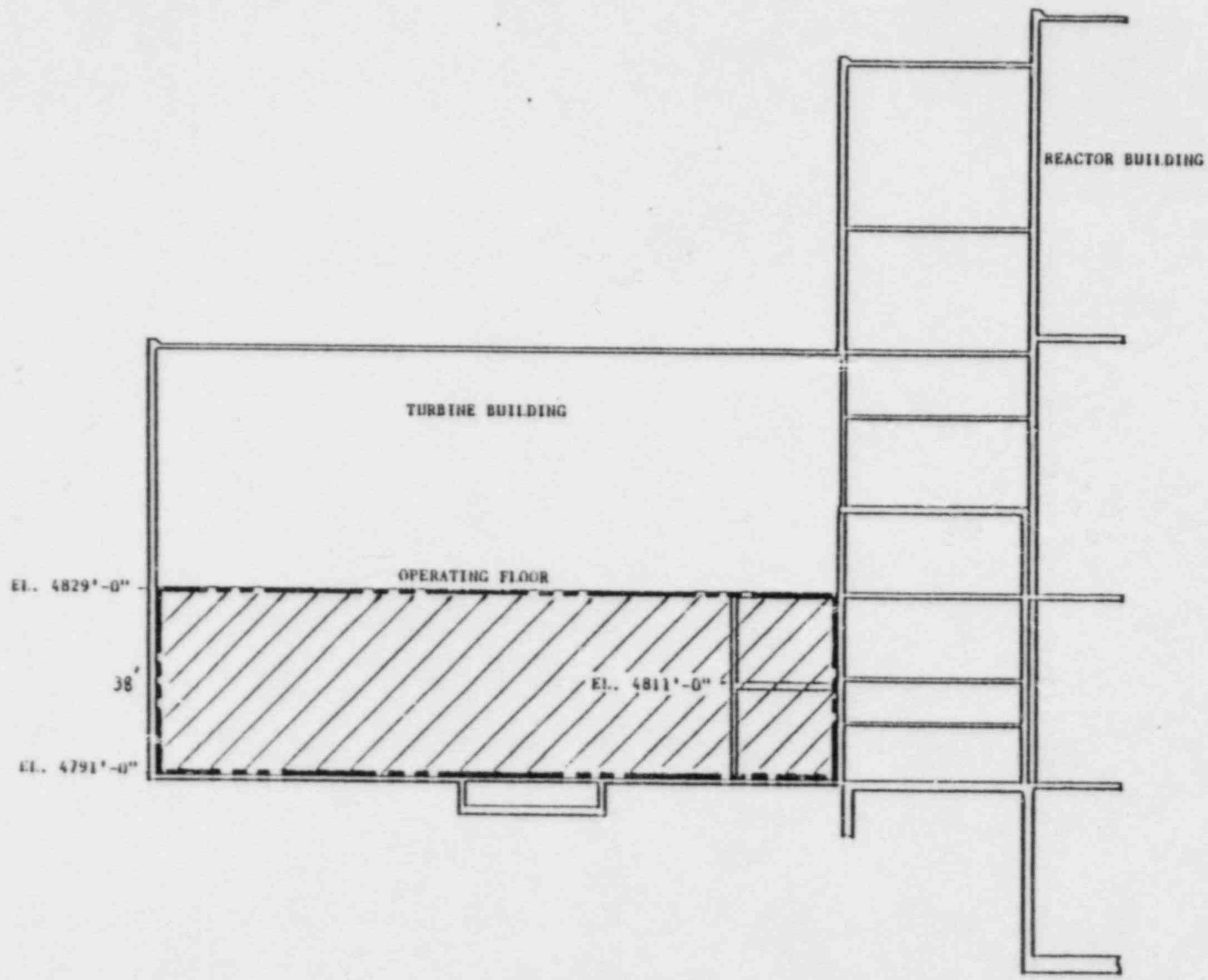

Fig. 3. Turbine building elevation showing region that was analyzed

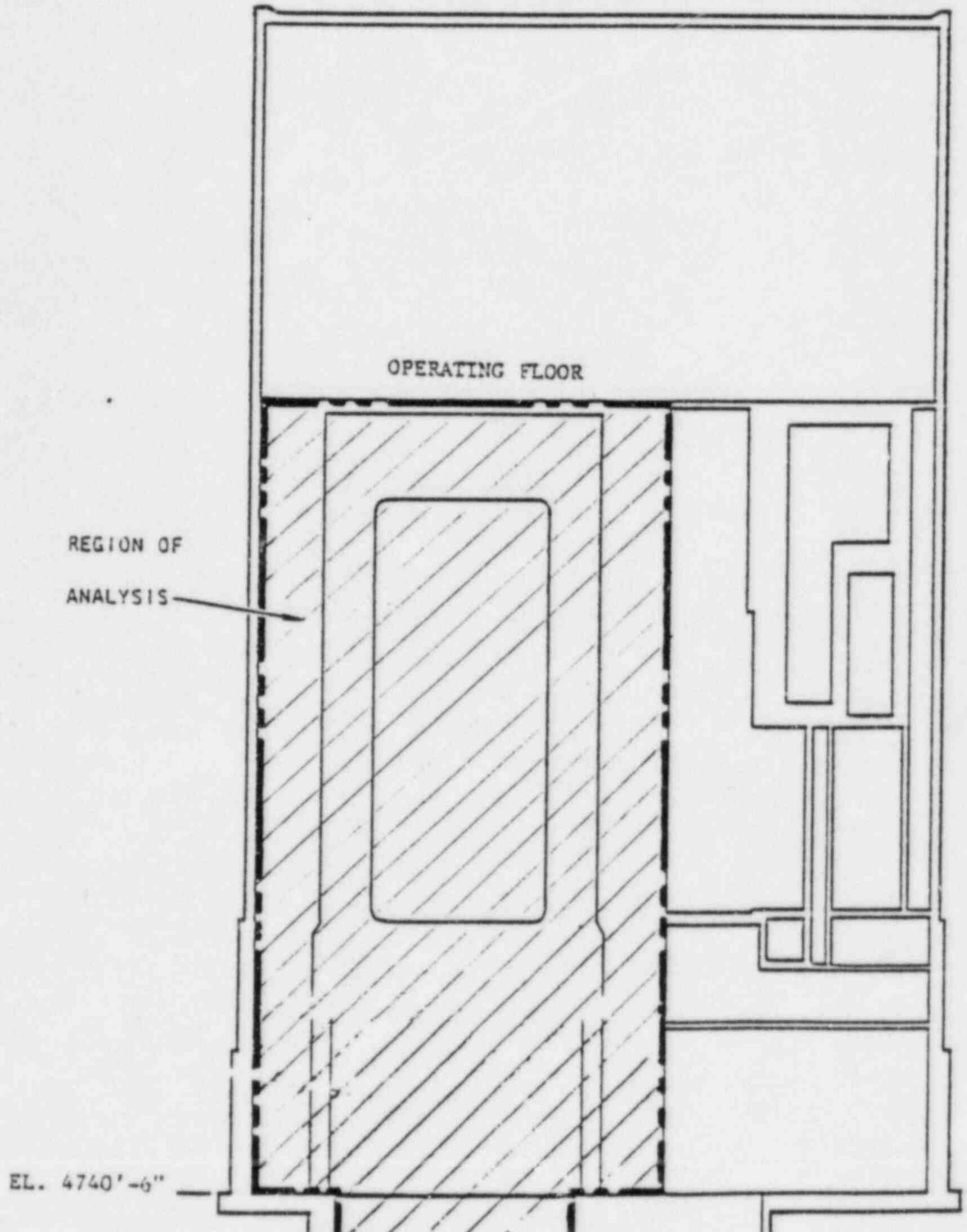

Fig. 4. Reactor building elevation showing region that was analyzed

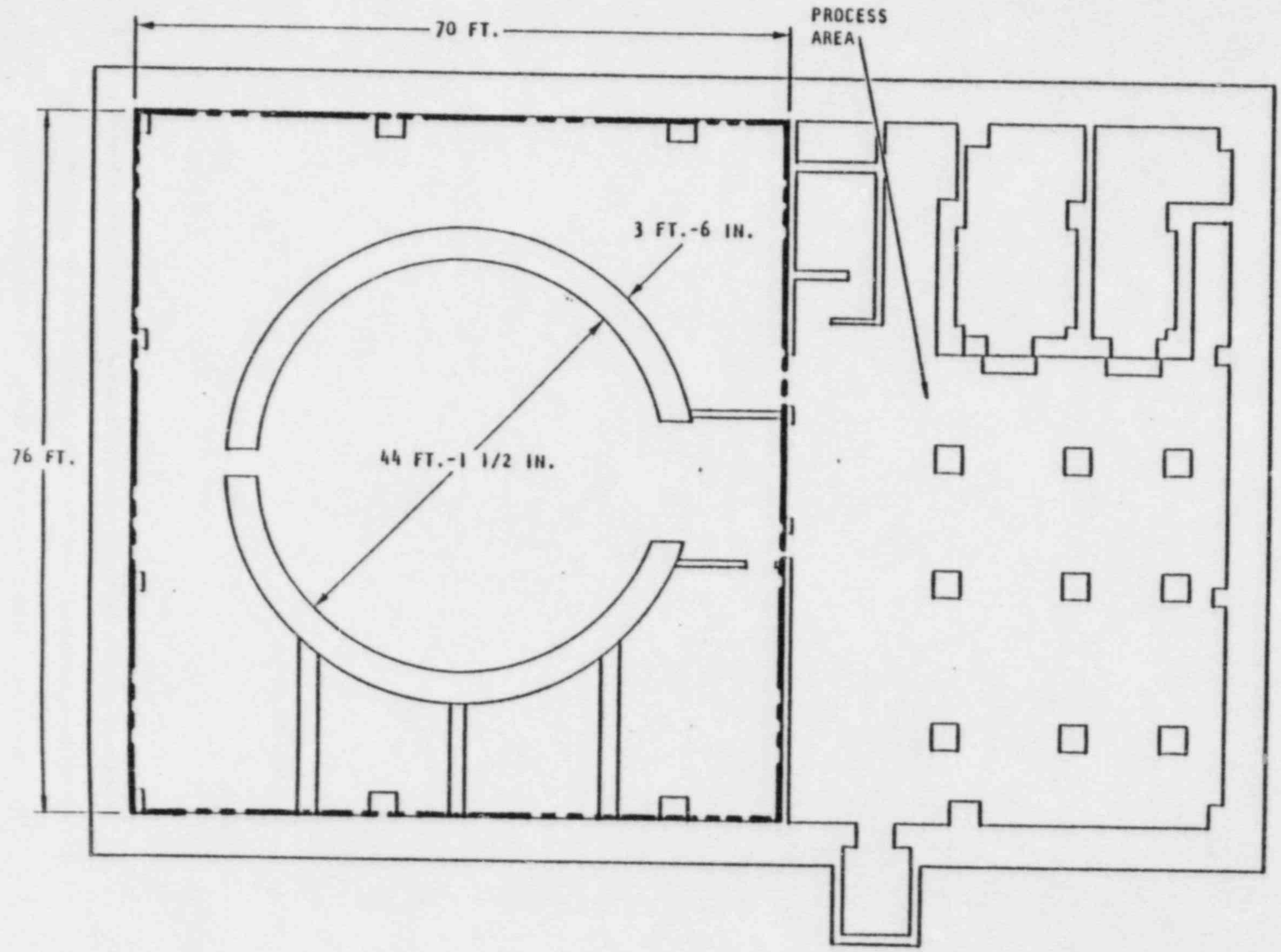

Fig. 5. Reactor building plan view at elevation 4740 ft-6 in. showing region of analysis

FIGURE 6

TURBINE BUILDING RESPONSE TO HOT REHEAT OFFSET RUPTURE, HRH-1

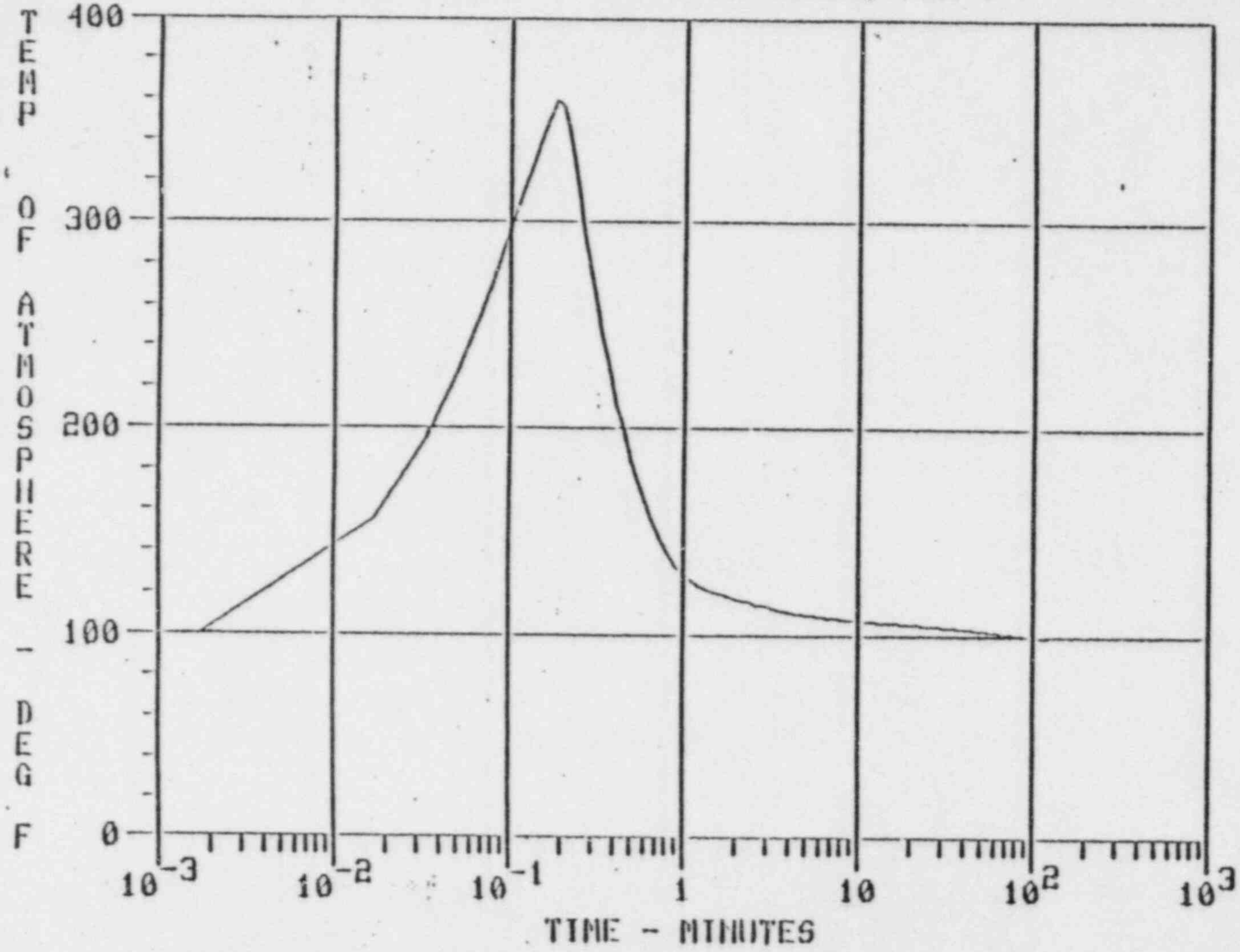

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FIGURE 7

REACTOR BUILDING TEMPERATURE RESPONSE TO HOT REHEAT OFFSET RUPTURE, HRH-2

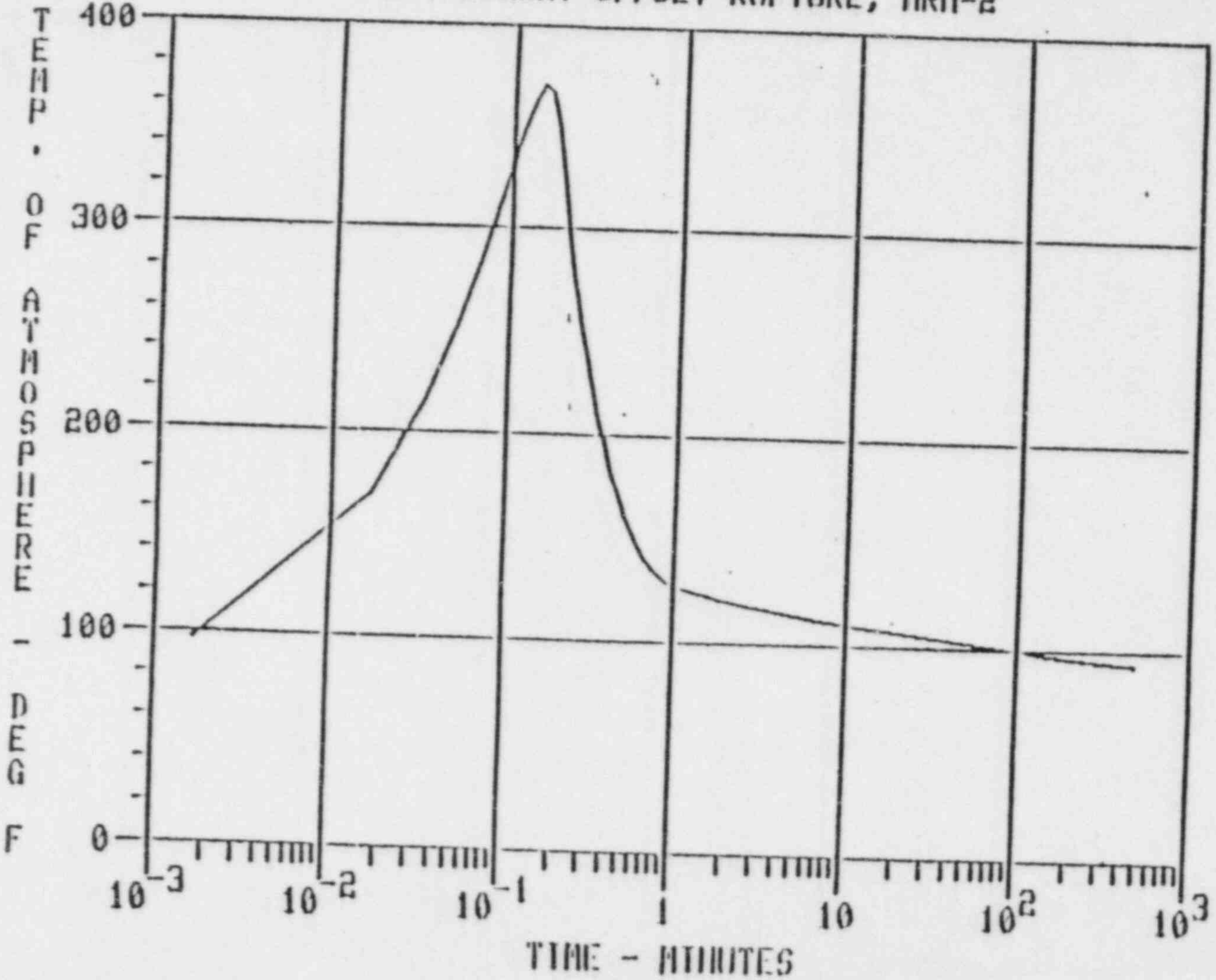

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FIGURE 8

REACTOR BUILDING TEMPERATURE RESPONSE TO COLD REHEAT STEAM PIPE RUPTURE, CRH-19

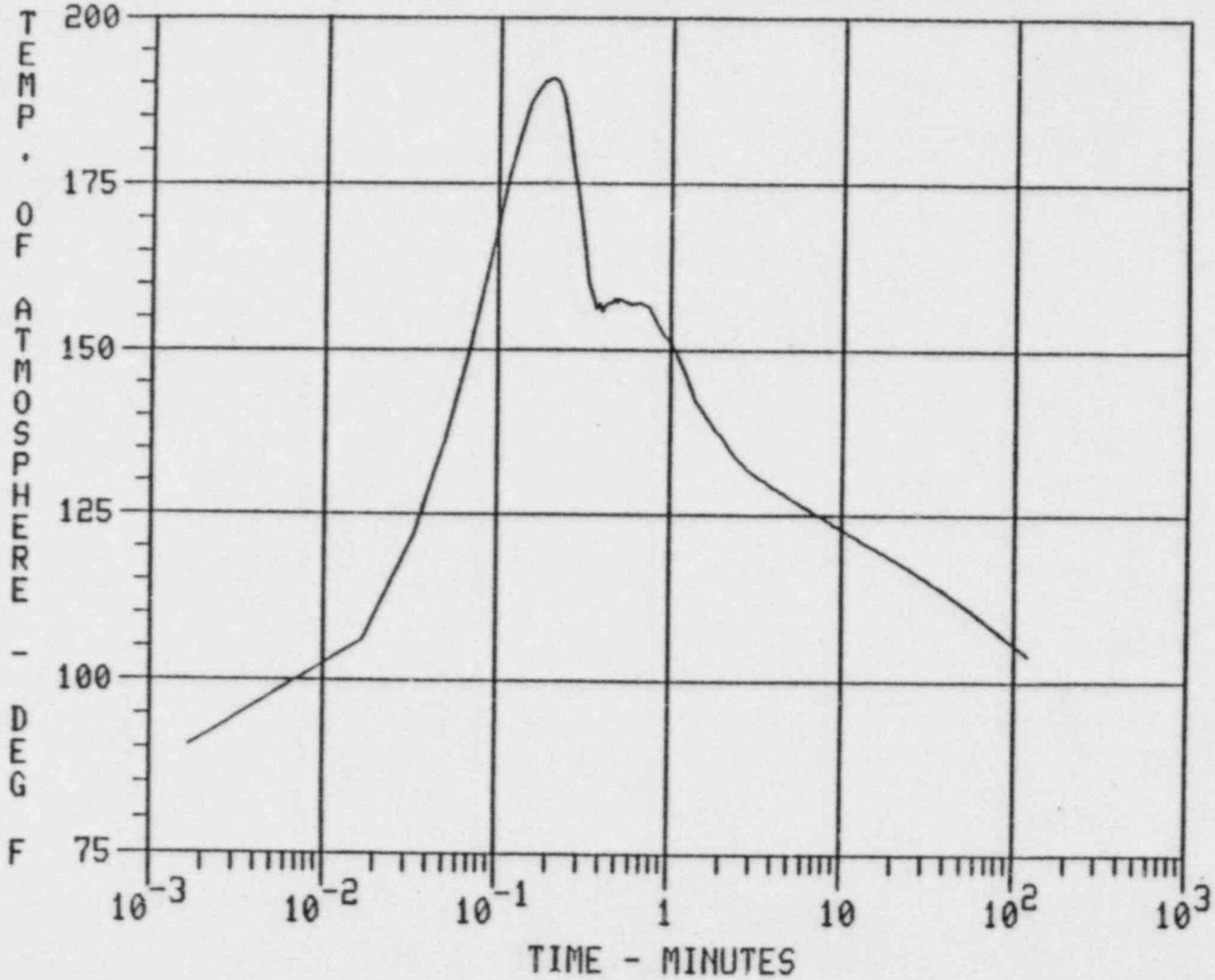

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FIGURE 9

TURBINE BUILDING HUMIDITY RESPONSE TO
HOT REHEAT OFFSET RUPTURE, HRH-1

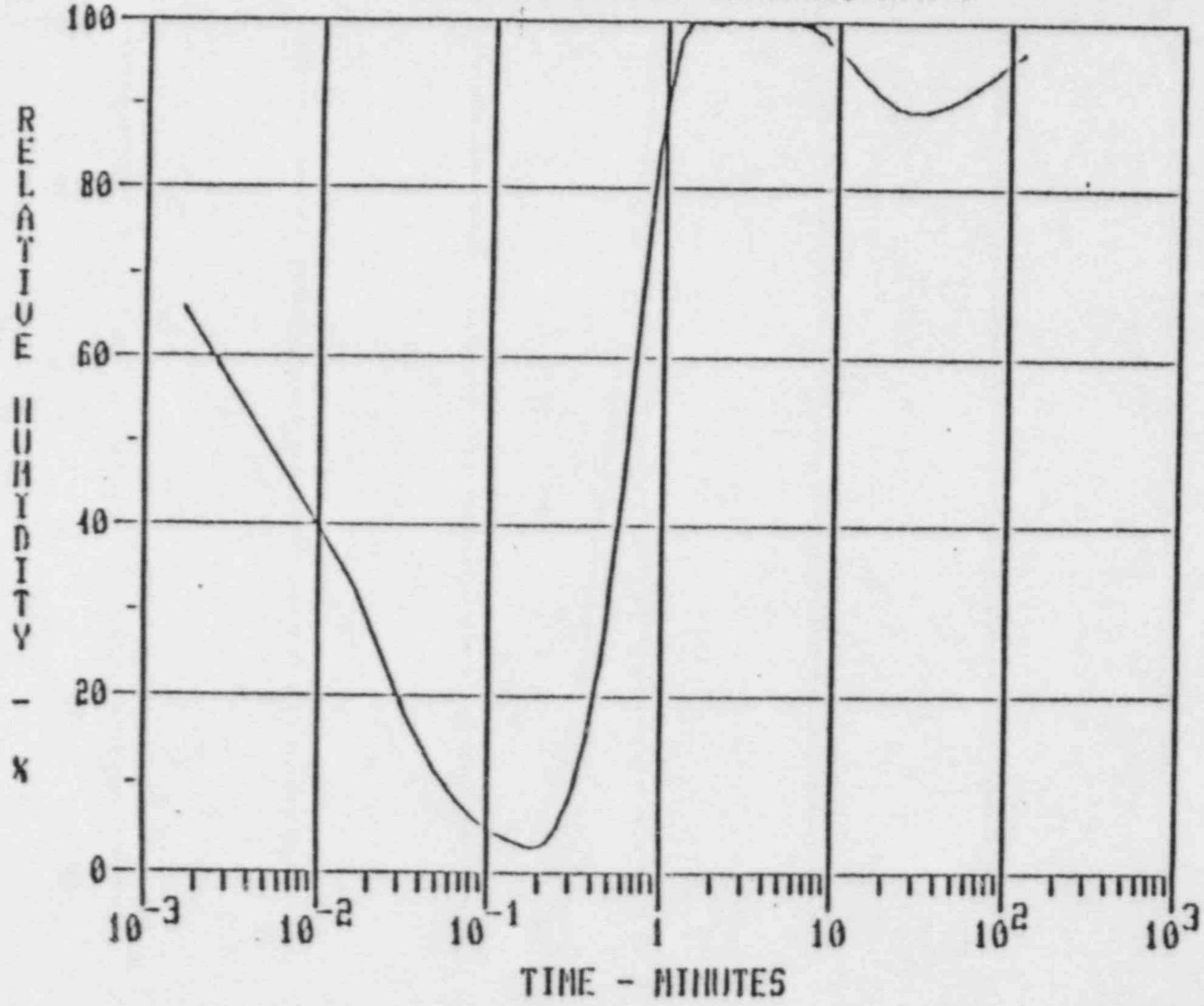

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FIGURE 10

REACTOR BUILDING HUMIDITY RESPONSE TO HOT REHEAT OFFSET RUPTURE, HRH-2

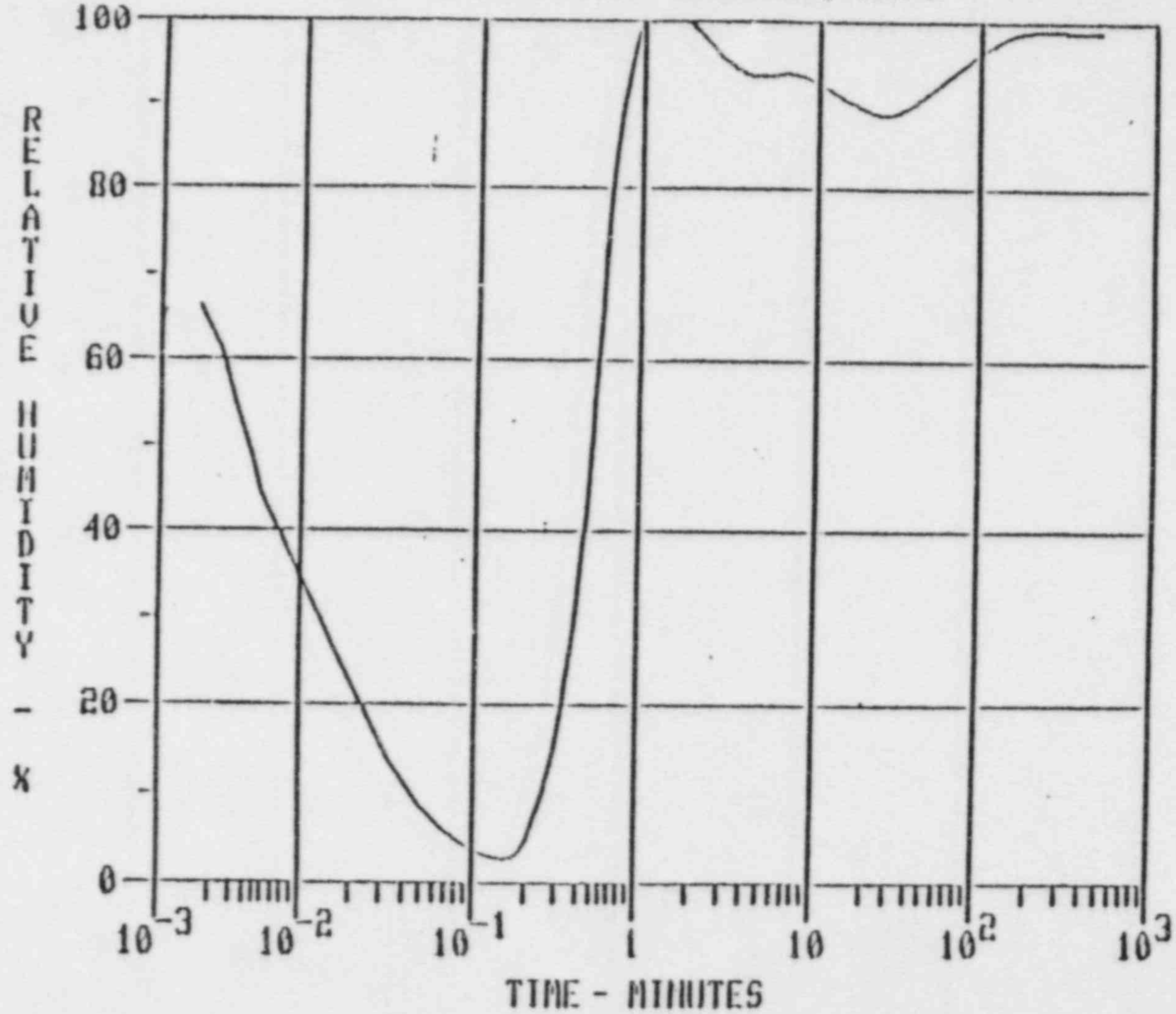

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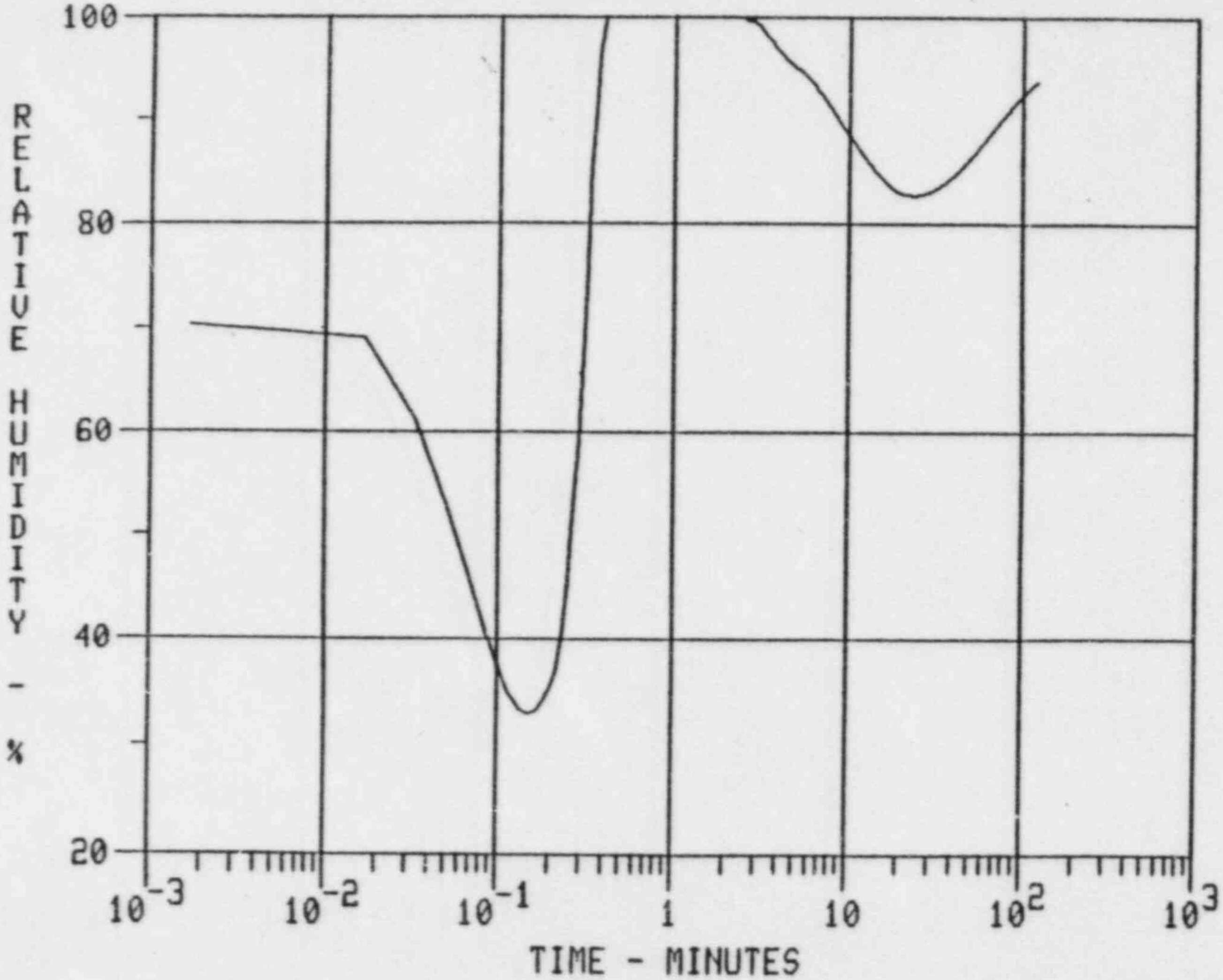
FIGURE 11

REACTOR BUILDING HUMIDITY RESPONSE TO COLD REHEAT STEAM PIPE RUPTURE, CRH-19



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