Westinghouse
Electric Corporation

Electronic Components
Divisions

Westinghouse Circle
Horseheads New York 14845

PEN-TR-81-37

June 2, 1981
July 7, 1981, Rev. 1

ANALYSIS AND REPORT ON THE SAFETY RELATED ELECTRIC PENETRATIONS FOR THE INDIAN POINT PLANT #3

Ref. S.O.D. Purchase Order #416962

W IGTD Purchase Order #546 SSG416962-SN

R. L. Korner
Project Engineer

INDEX

1.0 IDENTIFICATION OF EQUIPMENT AND MATERIALS

Penet. Nozzle Number	Conductor Size	Number of Cables	Item No. (Dwg. E2198)	W WX Number
H19	#16 AWG	36 conductor STQ	3	31776
H23	#16 AWG	36 conductor STQ	3	31776
H25	#16 AWG	36 conductor STQ	3	31776
H27	#16 AWG	60 conductor STP	2	31775
H28	#16 AWG	36 conductor STQ	3	31776
H33	#16 AWG	60 conductor STP	2	31775
H35	#16 AWG	60 conductor STP	2	31775
H42	#16 AWG	60 conductor STP	2	31775
H32	350 MCM	6 conductor	6	31892
H37	350 MCM	6 conductor	6	31892
H45	350 MCM	6 conductor	6	31892
H50	350 MCM	6 conductor	6	31892
H53	350 MCM	6 conductor	6	31892
H57	350 MCM	6 conductor	6	31892
H36	#12 AWG	180 conductor	1	31774
H46	#12 AWG	180 conductor	1	31774
H47	#12 AWG	180 conductor	1	31774
H48	#12 AWG	180 conductor	1	31774
H49	#12 AWG	180 conductor	1	31774
H51	#12 AWG	180 conductor	1	31774
H52	#12 AWG	180 conductor	1	31774
H55	#12 AWG	180 conductor	1	31774
H56	#12 AWG	180 conductor	1	31774

Penetration assemblies of all types are shown as installed in composite drawing E2198.

Further clarification of the type (6) penetration is shown in drawing 75-31892.

2.0 PURPOSE OF THIS REPORT

To provide analysis and test report data to support the capability of these electric penetrations to function under postulated accident conditions.

3.0 QUALIFICATION TEST PLAN

The electric penetrations under test fall into two basic types.

3.1 Types 1, 2 and 3 (Dwg. E2198)

These penetrations have conductors ranging in size from #16 AWG to #12 AWG, and are sealed with ceramic seals. Pigtails are spliced to the seal conductors and are then potted to protect and strain relieve the splices and seals.

All pressure retaining components are either metal or ceramics and are not subject to ageing or irradiation effects. A test report on LOCA performance of this design will be included. Other materials will be identified. The effects of thermal ageing, chemical spray and irradiation will be analyzed relative to the required function for each particular material.

Cable qualification is included in Section 12. The cable which was used is identified as follows:

Penetration Type	Manufacturer
1	#12 AWG single conductor HTK Kerite FR Jacket (600V)
2	#16 AWG Shielded Twisted Pair B.I.W. "Bosrad 7" (600V)
3	#16 AWG Shielded Twisted Quad B.I.W. "Bosrad 7" (600V)

3.2 Type 6 (Dwg. E41071)

This penetration has (6) 350 MCM conductors sealed with large ceramic seals. All functioning components are either metal or ceramics and are not subject to ageing or irradiation effects.

A test report on the LOCA performance including chemical spray of the seal assembly will be included.

The internal cable is Kerite 350 MCM HTK with FR jacket (600V). Qualification for this cable is not included.

4.0 REQUIRED ENVIRONMENTAL CONDITIONS

4.1 Irradiation 2 X 10^7 Rads gamma

4.2 Normal Ambient 50°C - 122°F

4.3 Other Requirements

DEFINITION OF AND BASIS FOR HOSTILE SERVICE CONDITIONS

1. Description of In Containment Environment.

   (a) The highest temperature and pressure from a LOCA is a double ended cold leg break (Ref FSAR Section 14.3), resulting in a Containment temperature rise to 287°F, (See Figure 1) and a Containment pressure of 40 psig. (See Figure 2)

   (b) The pressure and temperature from a steam line break is mitigated by a "prompt redundant spray system", therefore LOCA conditions are governing (Ref Guidelines for Evaluating Environmental Qualification of Class 1E Electrical Equipment in Operating Reactors).

   (c) The radiation dose for 30 days following a LOCA including normal radiation is assumed to yield a total integrated dose of 2×10^7 Rads, (Ref Guidelines for evaluating environmental qualification of Class 1E electrical equipment in operating reactors.)

   (d) The Containment Spray chemistry using 40% sodium hydroxide and 2000ppm boric acid solution, yields a ph of approximately 10. (Response to bulletin 77-04.)

2. Description of Main Steam, Main Feed and Auxiliary Feed Pump areas outside Containment.

   (a) The highest temperature and pressure from a break in the Auxiliary Feed Pump Steam Line in the Auxiliary Feed Pump Room is 213°F and 0.9 psig. These are reduced to ambient within 5 minutes because of High Temperature Trip Sensors set at 135°F, thereby isolating the Auxiliary Steam Driven Pump Steam Line. (Ref Analysis of High Energy Lines in letter Trosten to Giambusso dated May 14, 1973)

   (b) The highest temperature and pressure from a Main Feed or Steam Line break in the Main Feed and Steam area is a negligible temperature increase and a pressure of 0.42 psig. (Ref analysis of High Energy Lines in letter Trosten to Giambusso dated May 14, 1973.)

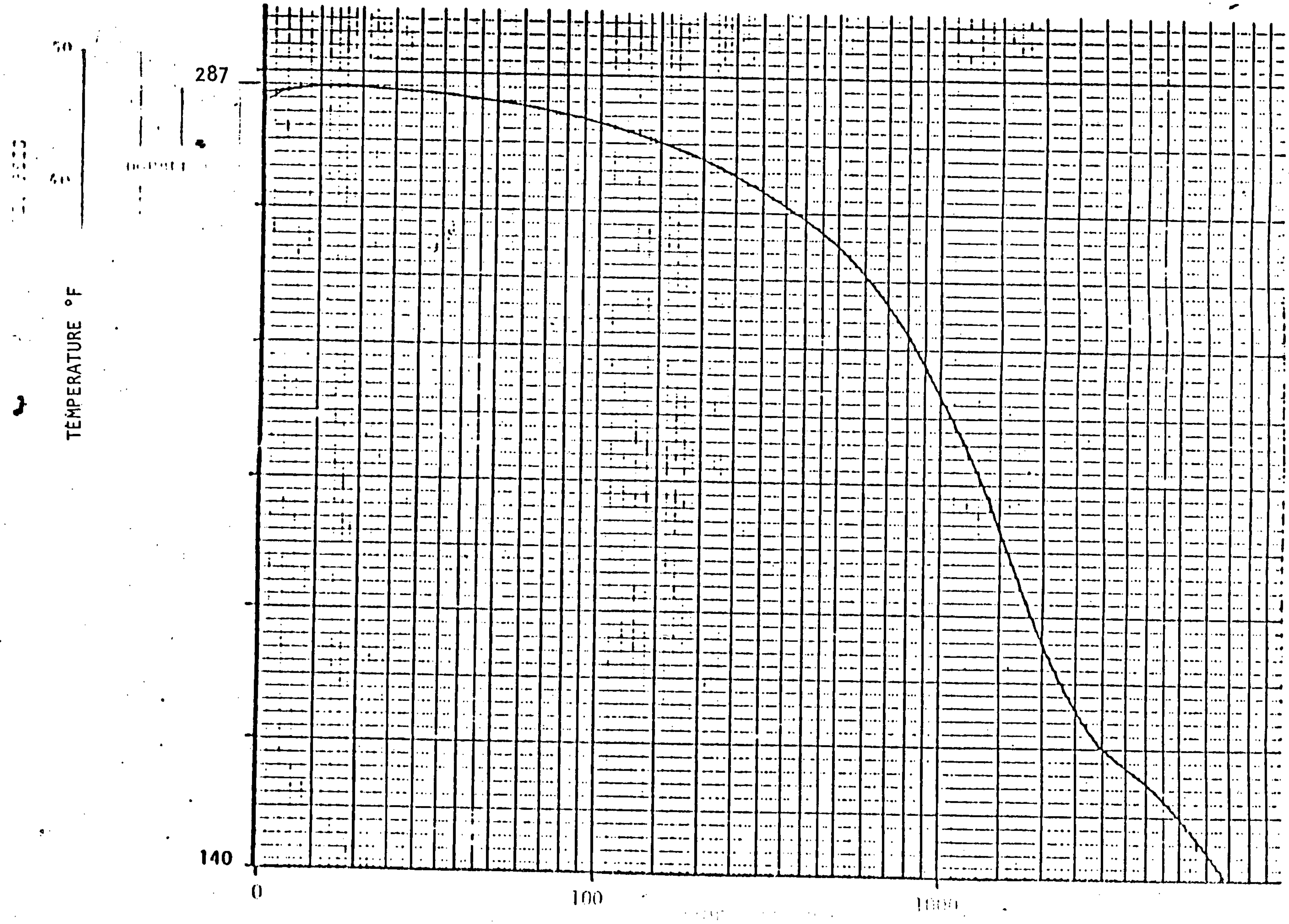
   (c) Radiation integrated dose for 30 days including normal radiation is negligible (response to NUREG-0578) and therefore is neglected.

3. Description of Pipe Penetration, Residual Heat Removal and Safety Injection areas in the Auxiliary Building.

(a) The radiation levels in this area are very dependent upon location up to a maximum integrated dose of 3.6×10^6 Rads for 30 days. (Ref response to NUREC-0578)

(b) Temperatures and pressures do not increase because of the accident.

CONTAINMENT ATMOSPHERE TEMPERATURE
DESIGN BASES SAFETY INJECTION



CONTAINME... RE TRANSIENT

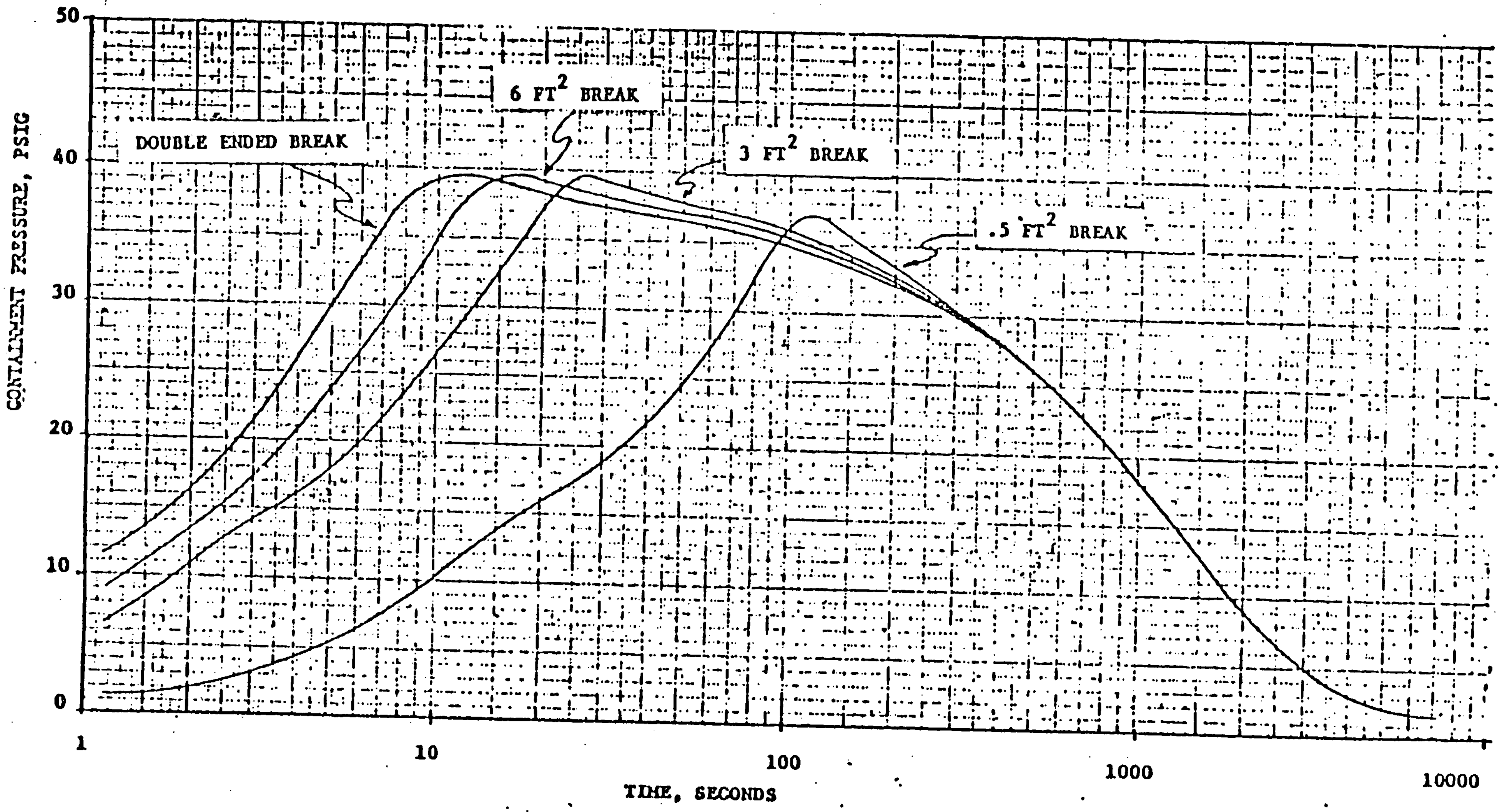
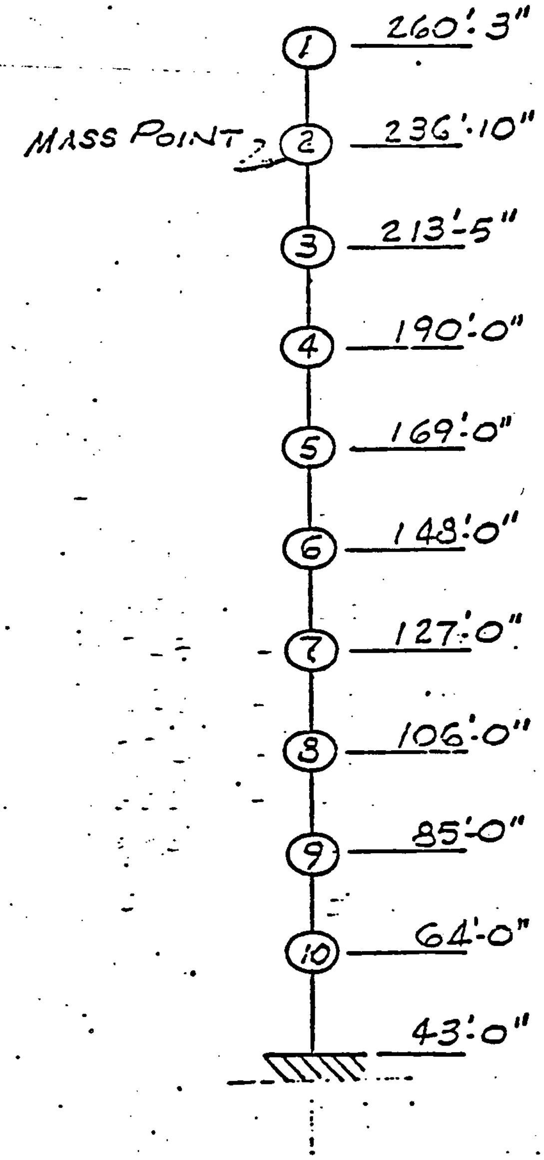


TABLE 1

CONTAINMENT STRUCTURE
FREQUENCIES AND MODE SHAPES

MASS POINT	f_1 = 4.19 Hz	f_2 = 11.91 Hz	f_3 = 22.38 Hz	f_4 = 24.10 Hz	f_5 = 34.34 Hz	f_6 = 39.94 Hz
1	1.00	-1.00	-.00712	1.00	-1.00	.838
2	.907	-.631	.578	.665	-.158	-.728
3	.801	-.197	.885	.0151	.697	-.775
4	.683	.283	.697	-.578	.623	.655
5	.579	.538	.333	-.672	-.0658	1.00
6	.471	.745	-.219	-.415	-.703	.215
7	.363	.828	-.734	.0527	-.642	-.690
8	.257	.778	-1.00	.484	.0686	-.587
9	.159	.602	-.911	.649	.733	.293
10	.0723	.329	-.518	.457	.698	.687
11	0	0	0	0	0	0

WESTINGHOUSE ELECTRIC CORPORATION



LUMPED MASS MODEL OF CONTAINMENT STRUCTURE.

FIGURE 1

ALONG THE AXIS IN THE HORIZONTAL MODE:
HOUSNER RESPONSE SPECTRA NORMALIZED TO .10g

STRUCTURE: CONTAINMENT BUILDING
STRUCTURAL DAMPING VALUE: 2 %
MASS POINT: GROUND RESPONSE
ELEVATION: 43'-0"

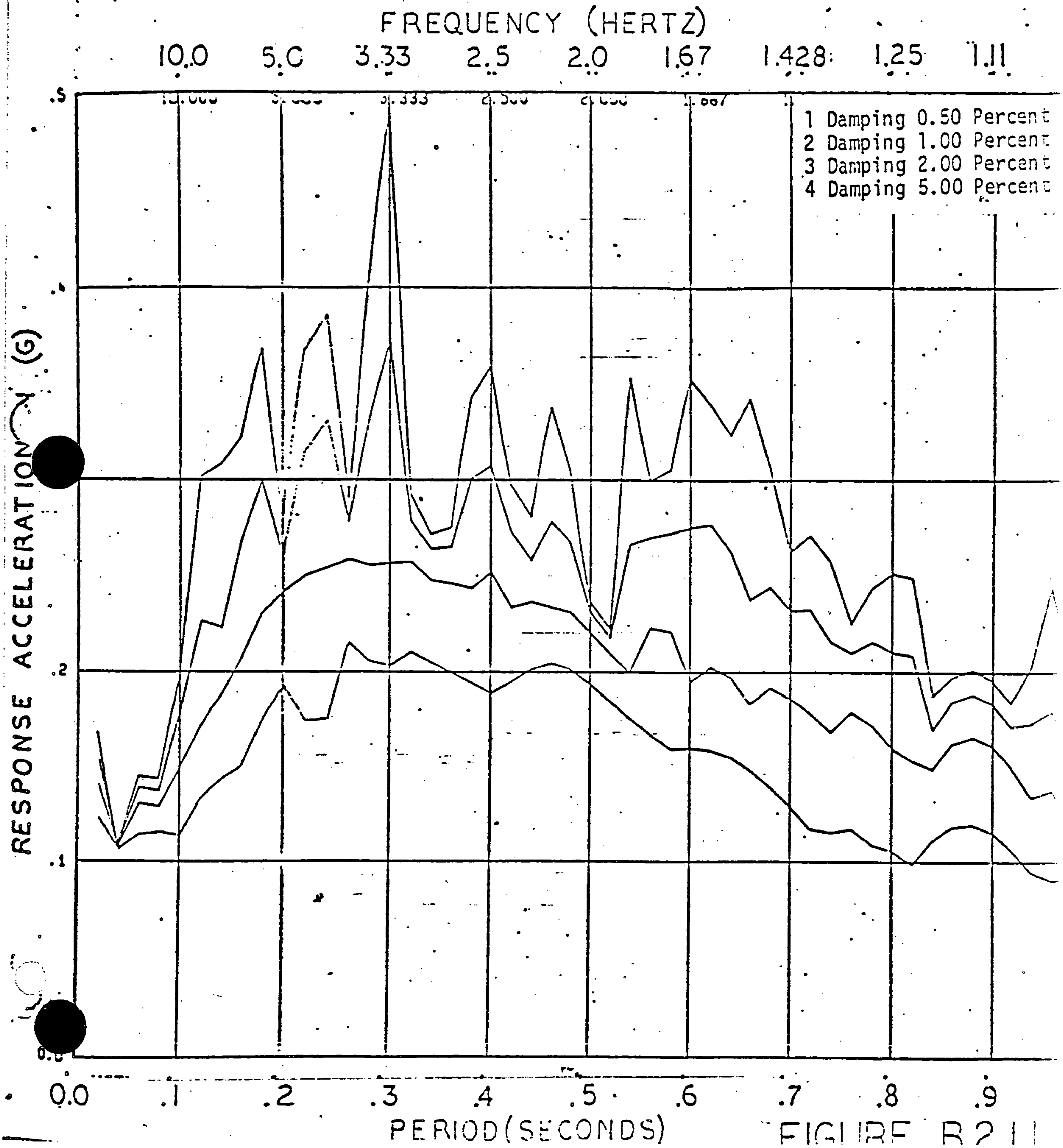


FIGURE R2.11

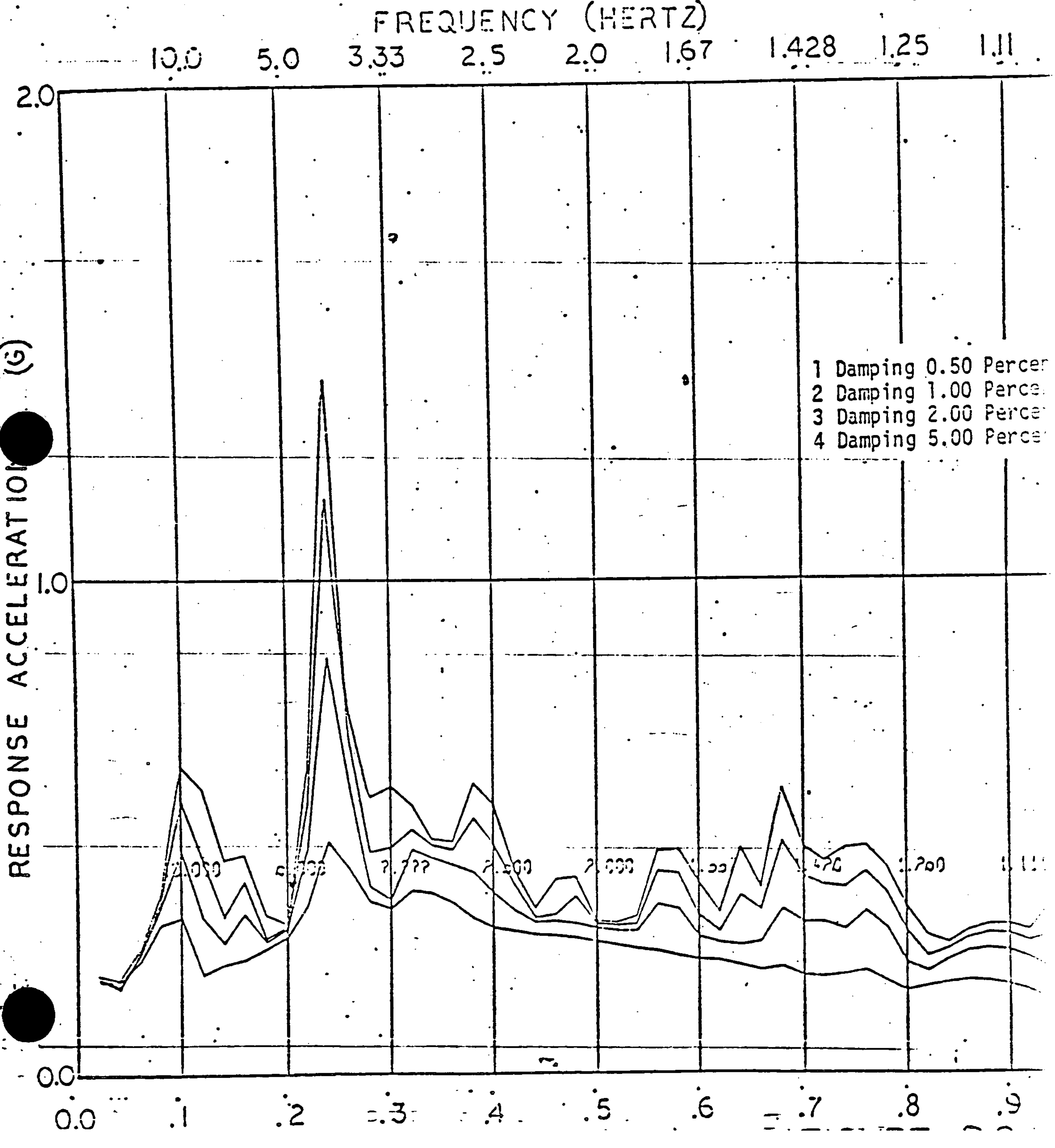
RESPONSE ACCELERATION FOR DBE EARTHQUAKE ALONG THE AXIS IN THE HORIZONTAL MODE. HOUSNER RESPONSE SPECTRA NORMALIZED TO .15g

STRUCTURE: CONTAINMENT BUILDING

STRUCTURAL DAMPING VALUE: 5%

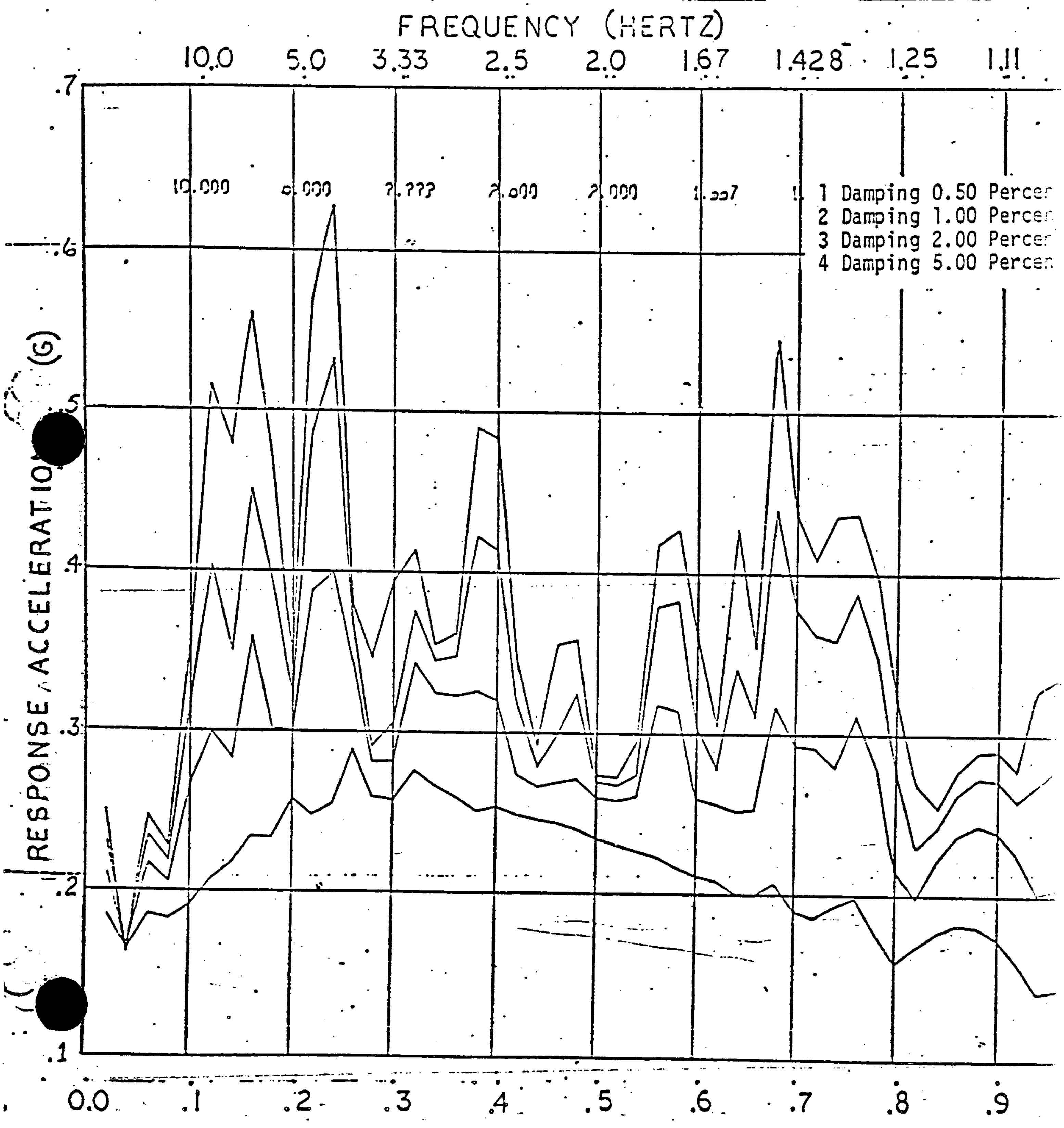
MASS POINT: 9

ELEVATION: 85'-0"



RESPONSE ACCELERATION FOR DBE EARTHQUAKE
ALONG THE AXIS IN THE HORIZONTAL MODE
HOUSNER RESPONSE SPECTRA NORMALIZED TO .15g

STRUCTURE: CONTAINMENT BUILDING
STRUCTURAL DAMPING VALUE: 5 %
MASS POINT: GROUND RESPONSE
ELEVATION: 43'-0"



RESPONSE ACCELERATION FOR DBE EARTHQUAKE
ALONG THE AXIS IN THE HORIZONTAL MODE.
HOUSNER RESPONSE SPECTRA NORMALIZED TO .15g

STRUCTURE: CONTAINMENT BUILDING
STRUCTURAL DAMPING VALUE: 5%
MASS POINT: 9
ELEVATION: 85'-0"

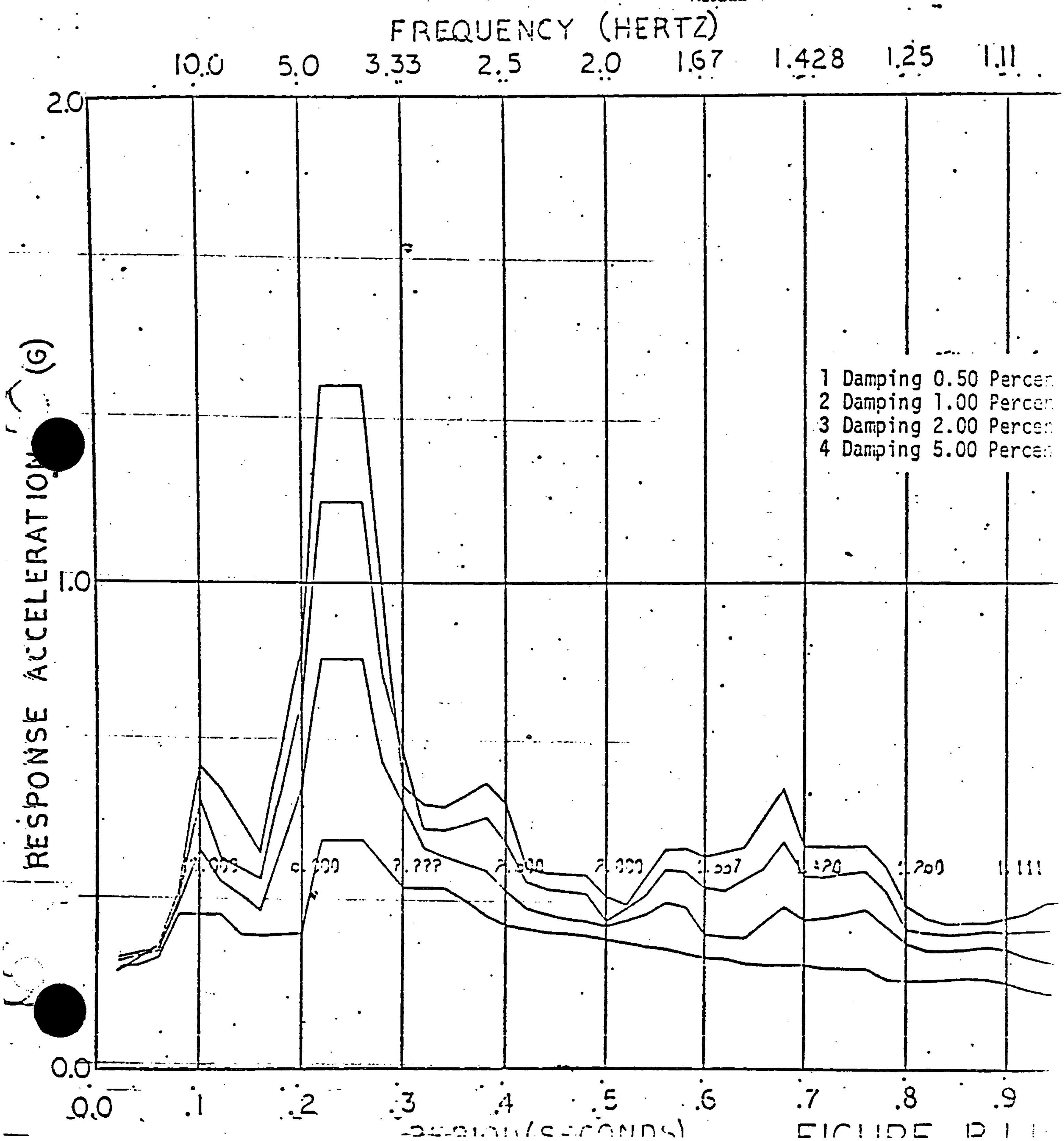


FIGURE B

ALONG THE AXIS IN THE HORIZONTAL MODE:
HOUSNER RESPONSE SPECTRA NORMALIZED TO .15g

STRUCTURE: CONTAINMENT BUILDING
STRUCTURAL DAMPING VALUE: 5 %
MASS POINT: GROUND RESPONSE
ELEVATION: 43'-0"

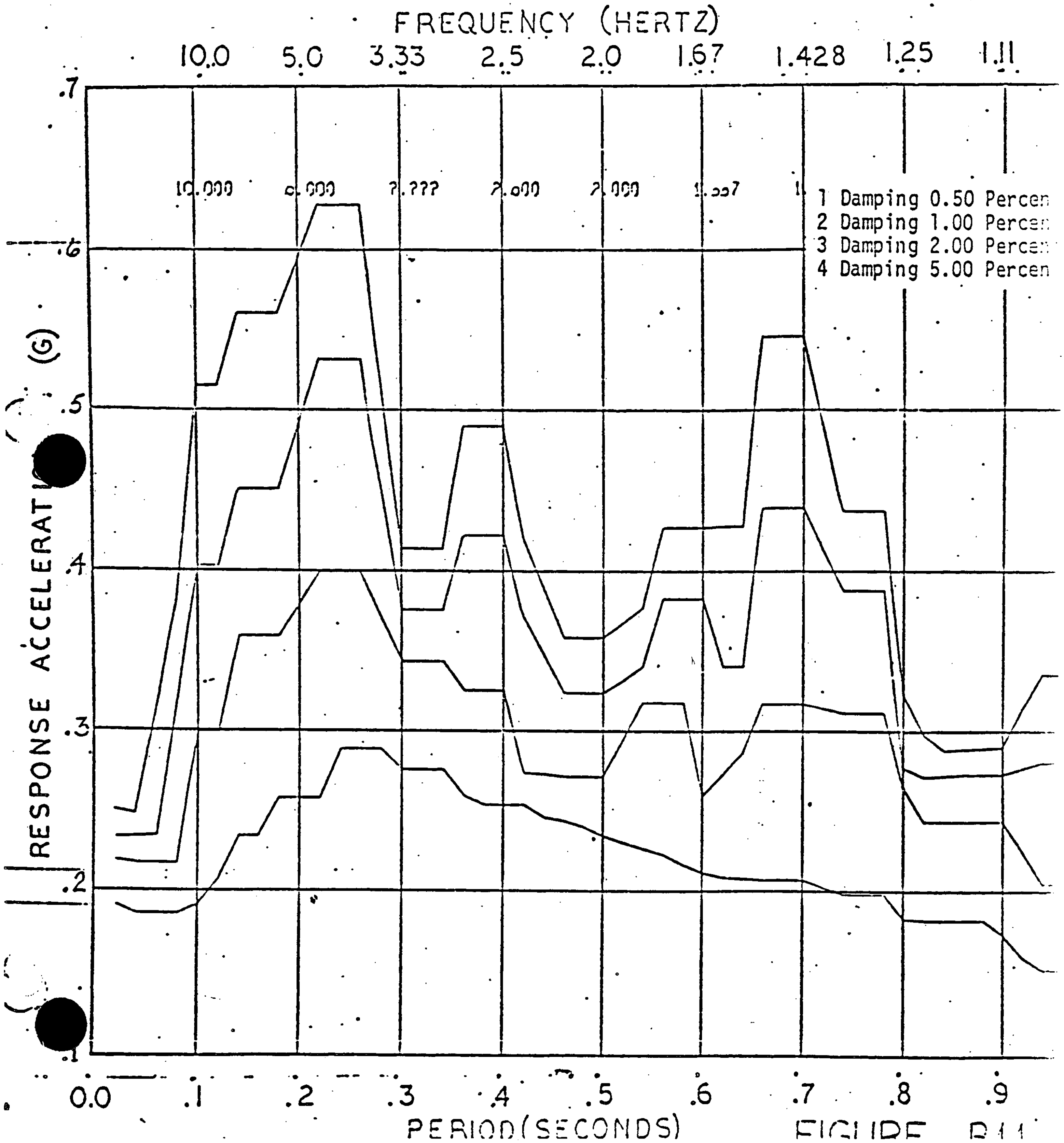


FIGURE B11

ALONG THE AXIS IN THE HORIZONTAL MODE:
HOUSNER RESPONSE SPECTRA NORMALIZED TO .10g

STRUCTURE: CONTAINMENT BUILDING
STRUCTURAL DAMPING VALUE: 2 %
MASS POINT: 9
ELEVATION: 85'-0"

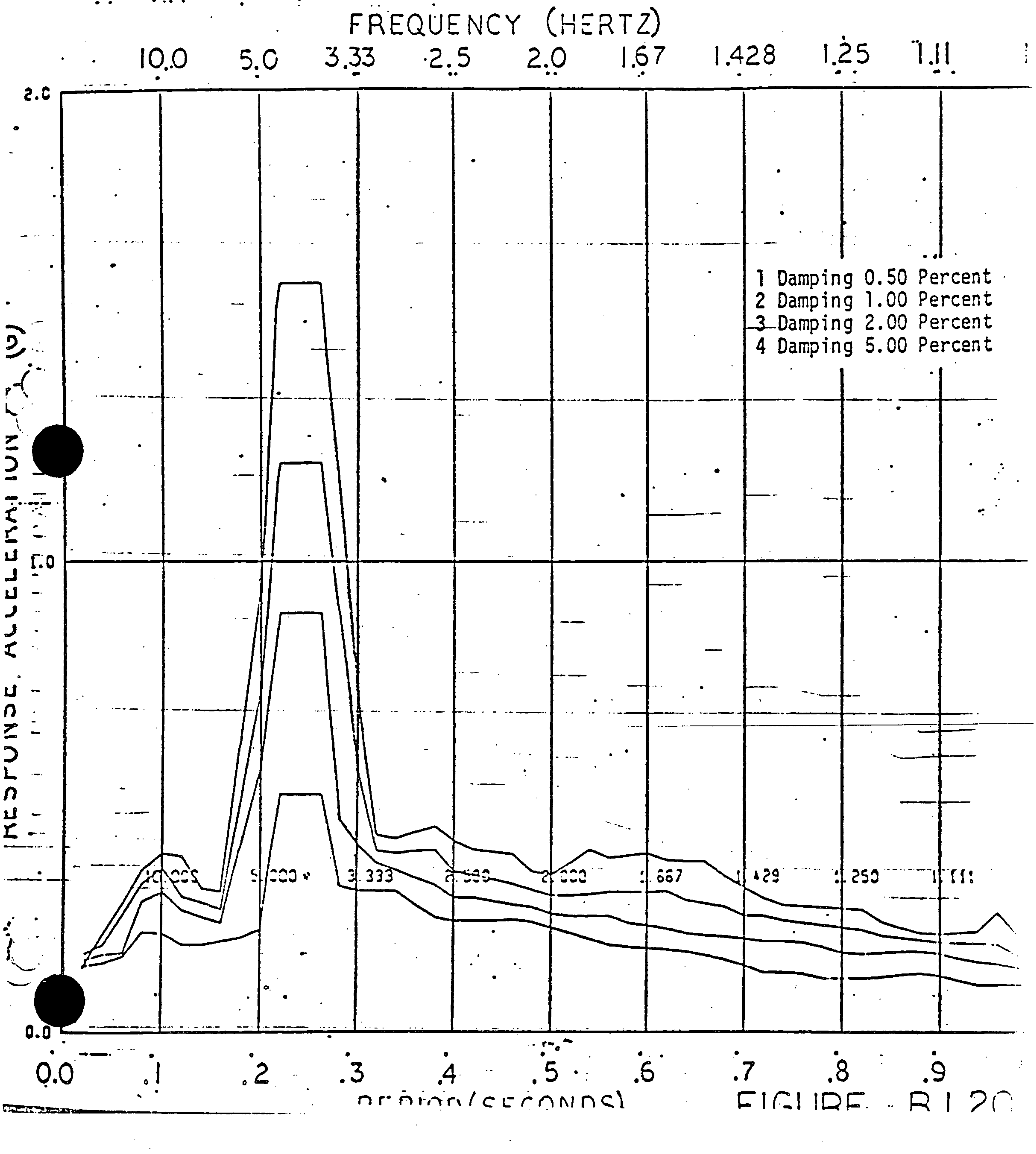


FIGURE B.1.20

ALONG THE AXIS IN THE HORIZONTAL MODE,
HOUSNER RESPONSE SPECTRA NORMALIZED TO .10g

STRUCTURE: CONTAINMENT BUILDING
STRUCTURAL DAMPING VALUE: 2 %
MASS POINT: GROUND RESPONSE
ELEVATION: 43'-0"

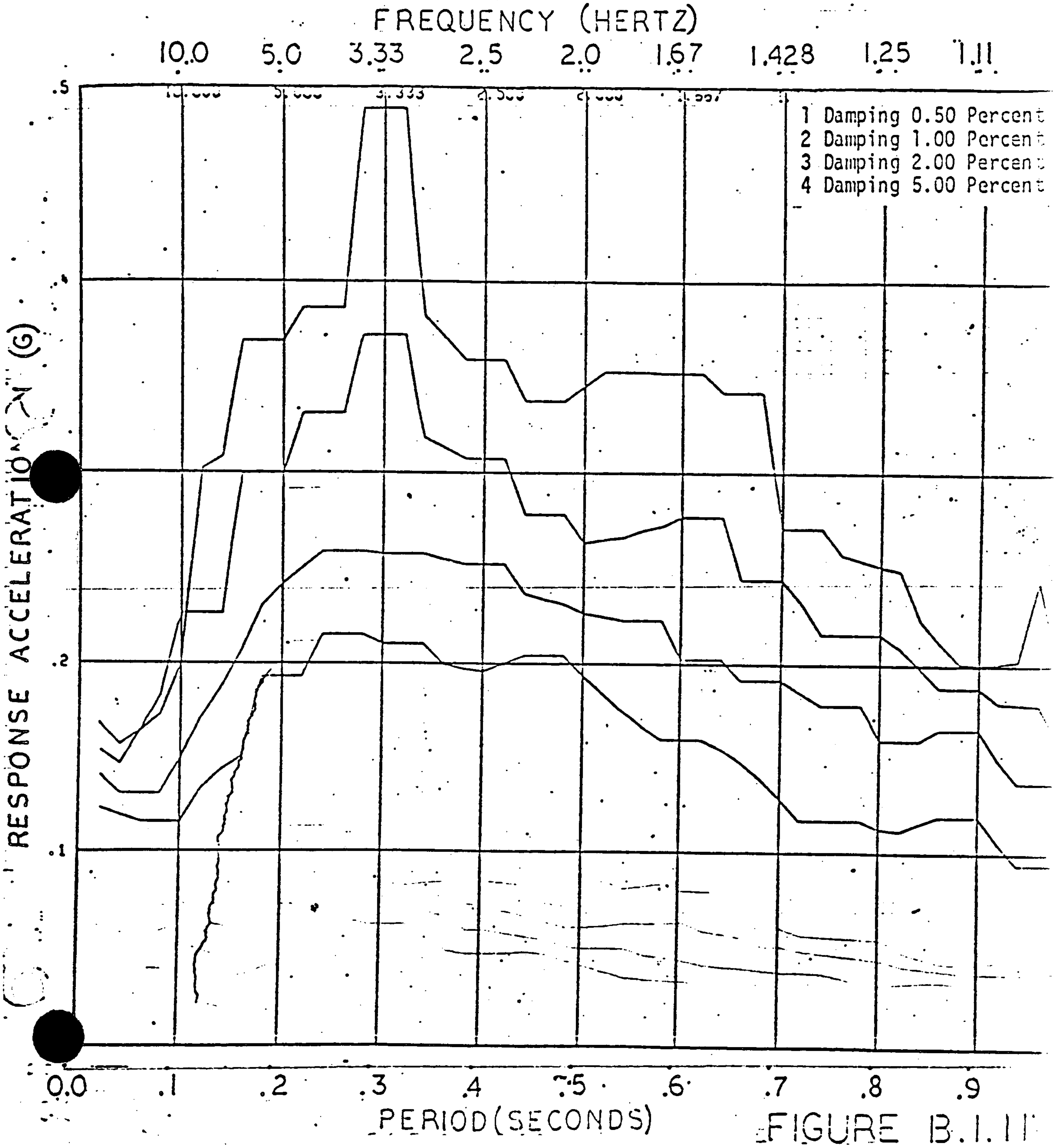


FIGURE B.1.11

5.0 QUALIFICATION DATA FOR TYPES 1, 2, 3

Westinghouse
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Electronic Components
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Horseheads New York 14845

PEN-RLK-3-16-01

ACCIDENT ENVIRONMENT TEST REPORT

R. L. Korner 3/23/73

Report written by R. L. Korner

Sworn To Before me this
23rd day March 1973

Marcus V. Dilmore

Notarized by

NOTARY PUBLIC, STATE OF NEW YORK
MARCUS V. DILMORE
OFFICIAL NO. 08-0301330
Term Expires March 30, 1975
APPOINTED IN CHEMUNG COUNTY

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March 16, 1973

PEN-RLK-3-16-01

ACCIDENT ENVIRONMENT TEST REPORT

Test Completed 2/5/73

The purpose of this test is to ensure that the design submitted is capable of maintaining seal integrity electrical insulation quality after being subjected to "accident" ambient conditions for temperature and pressure as required by IEEE Standard #317.

Penetration under test:

The penetration under test is a prototype which represents three types of penetrations for the Brunswick plant. There are 36 conductors with #1 AWG pigtails representing the class B prototype. Fifty #10 AWG conductors are included for the Class C penetration. Five copper-constantan thermocouples (pairs) were included to complete the requirement for the Class D penetration.

Conclusion:

The prototype penetration built to represent the Class B, C and D. Brunswick penetration satisfactorily passed the accident environment test.

1. The canister remained leak tight for the conditions of the test. (L.R. was less than 1 X 10^{-6} std. cc/sec. helium).

2. Insulation resistance for thermocouples remained above 10^{10} ohms after test (Class D).

3. Insulation resistance for #1 AWG - 600 V remained above 10^8 ohms after test. Two other conductors dropped to $8X10^6$ and $3X10^5$ ohms, however, these values are considered operable.

Procedure:

The penetration was initially checked for leakage with the Helium mass spectrometer leak detector. It was then penumatically tested at 80 psig to volumetrically determine if any leakage occurred at this stress loading. The penetration was found leak tight. Electrical tests were performed to determine the insulation resistance, the contact resistance and the dielectric strength test of the conductors before and after the accident environment exposure.

An inboard weld ring was welded to the canister to enable attachment to the steam chamber.

Prior to attaching the penetration to the steam chamber electrical connections were made to permit simulation of function during test. These connections are shown schematically in Figure 1.

Nine number 1 AWG cables were selected to have 60 Amp flowing through each of them. A pair of #10 AWG cables were loaded to 15 Amp. Two thermocouples pairs were twisted and welded to make thermocouples. One of these thermocouples was attached to one of the #1 AWG cable jackets, the other thermocouple was allowed to float loosely inside the steam chamber. See Figure 2.

The required test conditions are as follows:

340^oF	56 PSIG	6 Hrs.)	Inboard
320^oF - 250^oF		18 Hrs.)	Header
148^oF for 1 hour		)	Outboard End

Fig. 3 shows photographs of the penetration mounted on the steam chamber with instrumentation for pressure and temperature measurement located in place.

List of equipment used:

Thermometer	0 - 100^oC
L&N Speedomax Recorder	6 point temperature
Penetration Gage - Pressure	0 - 60 psig
Steam Gage - Pressure	0 - 150 psig
L&N Potentiometer	2 point

NOTE 1 - All tests for leakage were performed with a Helium mass spectrometer. In all cases no leakage was detected. The sensitivity of the instrument with the sniffing technique used is 1 X 10^{-6} std. cc/sec. (Helium).

The steam chamber is equipped with supplementary electrical heaters to boost the temperature above the saturated steam temperature which corresponds to 56 PSIG. These were turned on prior to start of the test.

Temperature rose to 300°F in about two minutes. The required temperature of 340°F was achieved fifteen minutes after start of the test.

Steam at atmospheric temperature was fed to the outboard end of the penetration to simulate the required conditions.

Chemical spray was not used in this particular test. The effect of borated water on the penetration cables which are the only exposed functional parts is discussed in Section 12.0 - Report B904 - Boston Insulated Wire Co.

Results of Test:

The conditions of the test have been transcribed from the actual chart which is filed with figuring book #130832. Figure 4 shows the measured temperatures as time progressed. The decay in temperature which occurs after the six hour hold at 340°F was accomplished in three steps so as to approximate the specified temperature decay.

At the start of test, the internal pressure inside the penetration was 14.2 psig at 250°C. Upon completion of the test, the pressure when corrected to the initial temperature was found to be 14.3 psig. The small difference can be attributed to gage reading error. Since the leak monitoring pressure before and after test were the same, it can be concluded that no leakage occurred during the test.

THERMOCOUPLE LEAD TESTS (CLASS D): The five thermocouple pairs which were present were checked for insulation resistance after completion of the test. The following values were obtained for the insulation resistance in ohms taken at 500V D.C. with a megohmmeter.

	T.C. #4	T.C. #5	T.C. #6	T.C. #7	T.C. #8
Copper to Ground	2×10^{10}	1×10^{10}	1×10^{10}	8×10^{10}	8×10^{10}
Constantan to Ground	1.5×10^{10}	1.5×10^{10}	1×10^{10}	9×10^{10}	9×10^{10}
Shield to Ground	1.2×10^{10}	1.5×10^{10}	1.1×10^{10}	9.5×10^{10}	8×10^{10}
Shield to Copper	5×10^{11}	1×10^{11}	1.5×10^{11}	3×10^{11}	1.5×10^{11}
Constantan to Copper	1.5×10^{11}	1×10^{11}	1.1×10^{11}	1.2×10^{11}	1.3×10^{11}
Shield to Constantan	2×10^{11}	5×10^{11}	1.5×10^{11}	4×10^{11}	2×10^{11}

All the above values are satisfactory for instrumentation service.

The thermocouples were also subjected to a 1 KV AC dielectric strength test before and after test. All conductors passed this test.

LOW VOLTAGE CONTROL (CLASS C) #10 AWG Conductors: Table #1 compares the insulation resistance and the contact resistance before and after steam testing. The three conductors which were loaded to 15A during test were #31, 32 and 33. These degraded somewhat but not significantly different from other conductors which weren't loaded. All insulation resistances remained above 10^8 Ohms except #15 and #44, which fell to $8X10^6$ and $3X10^5$ Ohms. Since these circuits will be operating at 120 volts it is felt that this degradation will not be detrimental to function.

Dielectric test at 2.7 KV subsequent to steam testing was satisfactory for all conductors except #44.

Contact Resistance improved ever so slightly after test.

LOW VOLTAGE POWER (#1 AWG Conductors Class B): Table 2 compares the insulation resistance and contact resistance before and after steam testing. The nine conductors which were loaded to 60 A during steam test were #78 through #86. Degradation was about the same as for the unloaded conductors, however, none of these conductors were below $5X10^8$ Ohms.

Conductors #64, 73, 77, 91 and 94 were low in resistance prior to the test, but the heat imposed by the test improved their insulation resistance.

Contact resistance remained essentially the same.

Dielectric test at 2.7 KV subsequent to steam testing was satisfactory for all conductors.

TABLE I

Comparison of Insulation Resistance and Contact Resistance Before and After Steam Test for #10 AWG Conductor Sizes.

Cond. Ident. Number	Insulation Resistance Ohms		Contact Resistance Ohms	
	Before	After	Before	After
3	4×10^{11}	5×10^{10}	6×10^{-3}	7×10^{-3}
12	5×10^{11}	2×10^{10}	7×10^{-3}	7×10^{-3}
13	5×10^{11}	2×10^{10}	7×10^{-3}	7×10^{-3}
14	9×10^{13}	1×10^{10}	7×10^{-3}	7×10^{-3}
15	5×10^{11}	8×10^{6}	7×10^{-3}	7×10^{-3}
16	7×10^{13}	3×10^{10}	7×10^{-3}	7×10^{-3}
17	5×10^{11}	5×10^{10}	7×10^{-3}	7×10^{-3}
18	5×10^{11}	5×10^{10}	7×10^{-3}	7×10^{-3}
19	5×10^{11}	2×10^{10}	7×10^{-3}	7×10^{-3}
20	4×10^{11}	2×10^{10}	7×10^{-3}	7×10^{-3}
21	3×10^{11}	2×10^{10}	7×10^{-3}	8×10^{-3}
22	2×10^{11}	1×10^{10}	7×10^{-3}	7×10^{-3}
23	4×10^{11}	8×10^{9}	7×10^{-3}	8×10^{-3}
24	3×10^{11}	1.5×10^{10}	7×10^{-3}	7×10^{-3}
25	2×10^{11}	3×10^{10}	7×10^{-3}	7×10^{-3}
26	1.5×10^{11}	1×10^{10}	7×10^{-3}	8×10^{-3}
27	3×10^{11}	3×10^{10}	7×10^{-3}	8×10^{-3}
28	4×10^{11}	3×10^{10}	7×10^{-3}	8×10^{-3}
29	5×10^{11}	3×10^{9}	7×10^{-3}	8×10^{-3}
30	5×10^{11}	6×10^{8}	7×10^{-3}	8×10^{-3}
31	5×10^{11}	5×10^{10}	7×10^{-3}	8×10^{-3}
32	3×10^{11}	5×10^{10}	7×10^{-3}	8×10^{-3}
33	4×10^{11}	5×10^{8}	7×10^{-3}	8×10^{-3}
34	4×10^{11}	5×10^{10}	7×10^{-3}	8×10^{-3}
35	5×10^{11}	5×10^{10}	7×10^{-3}	8×10^{-3}

Cond. Ident. Number	Insulation Resistance Ohms		Contact Resistance Ohms	
	Before	After	Before	After
36	$3X10^{11}$	$3X10^{10}$	$7X10^{-3}$	$8X10^{-3}$
37	$3X10^{11}$	$7X10^{10}$	$7X10^{-3}$	$8X10^{-3}$
38	$5X10^{11}$	$5X10^{10}$	$7X10^{-3}$	$8X10^{-3}$
39	$5X10^{11}$	$5X10^{10}$	$7X10^{-3}$	$8X10^{-3}$
40	$5X10^{11}$	$3X10^{10}$	$6X10^{-3}$	$8X10^{-3}$
41	$5X10^{11}$	$2X10^{10}$	$7X10^{-3}$	$8X10^{-3}$
42	$4X10^{11}$	$3X10^{10}$	$7X10^{-3}$	$8X10^{-3}$
43	$4X10^{11}$	$5X10^{10}$	$7X10^{-3}$	$8X10^{-3}$
44	$3X10^{11}$	$3X10^{5}$	$7X10^{-3}$	$8X10^{-3}$
45	$1.5X10^{11}$	$2X10^{8}$	$6X10^{-3}$	$8X10^{-3}$
46	$4X10^{11}$	$8X10^{10}$	$6X10^{-3}$	$8X10^{-3}$
47	$3X10^{11}$	$5X10^{10}$	$7X10^{-3}$	$8X10^{-3}$
48	$5X10^{11}$	$3X10^{10}$	$6X10^{-3}$	$8X10^{-3}$
49	$5X10^{11}$	$3X10^{10}$	$7X10^{-3}$	$8X10^{-3}$
50	$4X10^{11}$	$5X10^{10}$	$7X10^{-3}$	$8X10^{-3}$
51	$5X10^{11}$	$5X10^{10}$	$6X10^{-3}$	$7X10^{-3}$
52	$5X10^{11}$	$5X10^{10}$	$7X10^{-3}$	$7X10^{-3}$
53	$5X10^{11}$	$5X10^{10}$	$7X10^{-3}$	$8X10^{-3}$
54	$4X10^{11}$	$8X10^{10}$	$6X10^{-3}$	$7X10^{-3}$
55	$3X10^{11}$	$5X10^{10}$	$6X10^{-3}$	$7X10^{-3}$
56	$5X10^{11}$	$3X10^{10}$	$6X10^{-3}$	$7X10^{-3}$
57	$4X10^{11}$	$2X10^{10}$	$6X10^{-3}$	$7X10^{-3}$
58	$5X10^{11}$	$1X10^{10}$	$6X10^{-3}$	$7X10^{-3}$
59	$5X10^{11}$	$5X10^{10}$	$7X10^{-3}$	$7X10^{-3}$
60	$5X10^{11}$	$5X10^{10}$	$6X10^{-3}$	$7X10^{-3}$

TABLE 2

Comparison of Insulation Resistance and Contact Resistance before and After Steam Test for #1 AWG Conductor Sizes.

Conduc. Ident. Number	Insulation Resistance Ohms		Contact Resistance Ohms	
	Before	After	Before	After
61	$2X10^{11}$	$1.5X10^{9}$	$2X10^{-3}$	$2X10^{-3}$
62	$2X10^{11}$	$5X10^{8}$	$2X10^{-3}$	$3X10^{-3}$
63	$2X10^{11}$	$2X10^{9}$	$2X10^{-3}$	$1.5X10^{-3}$
64	$3X10^{7}$	$2X10^{9}$	$3X10^{-3}$	$2X10^{-3}$
65	$2X10^{11}$	$5X10^{10}$	$2X10^{-3}$	$2X10^{-3}$
66	$2X10^{11}$	$2X10^{9}$	$3X10^{-3}$	$2X10^{-3}$
67	$2X10^{11}$	$5X10^{8}$	$2X10^{-3}$	$2X10^{-3}$
68	$2X10^{11}$	$7X10^{9}$	$2X10^{-3}$	$2X10^{-3}$
69	$2X10^{11}$	$1X10^{9}$	$2X10^{-3}$	$2X10^{-3}$
70	$2X10^{11}$	$6X10^{10}$	$3X10^{-3}$	$1X10^{-3}$
71	$1.5X10^{11}$	$7X10^{8}$	$1X10^{-3}$	$1X10^{-3}$
72	$1.4X10^{11}$	$8X10^{8}$	$4X10^{-3}$	$3X10^{-3}$
73	$5X10^{7}$	$5X10^{8}$	$3X10^{-3}$	$2X10^{-3}$
74	$1.3X10^{11}$	$5X10^{8}$	$2X10^{-3}$	$2X10^{-3}$
75	$2X10^{11}$	$5X10^{8}$	$3X10^{-3}$	$2X10^{-3}$
76	$1.5X10^{11}$	$9X10^{8}$	$2X10^{-3}$	$2X10^{-3}$
77	$5X10^{7}$	$1X10^{9}$	$2X10^{-3}$	$1X10^{-3}$
78	$1X10^{12}$	$5X10^{8}$	$1X10^{-3}$	$1X10^{-3}$
79	$1X10^{12}$	$1X10^{10}$	$1X10^{-3}$	$1X10^{-3}$
80	$1X10^{12}$	$3X10^{9}$	$1X10^{-3}$	$1X10^{-3}$
81	$1X10^{12}$	$1X10^{9}$	$3X10^{-3}$	$2X10^{-3}$
82	$1X10^{12}$	$5X10^{9}$	$2X10^{-3}$	$2X10^{-4}$
83	$1.5X10^{12}$	$5X10^{9}$	$1X10^{-3}$	$1X10^{-3}$
84	$2X10^{12}$	$1X10^{10}$	$1X10^{-3}$	$1X10^{-3}$
85	$1.5X10^{12}$	$3X10^{10}$	$1X10^{-3}$	$1X10^{-3}$
86	$1X10^{12}$	$8X10^{8}$	$1X10^{-3}$	$1X10^{-3}$
87	$5X10^{8}$	$5X10^{9}$	$1X10^{-3}$	$1X10^{-3}$

Cond. Ident. Number	Insulation Resistance Ohms		Contact Resistance Ohms	
	Before	After	Before	After
88	$1X10^{12}$	$1X10^{10}$	$1X10^{-3}$	$1X10^{-3}$
89	$1.5X10^{11}$	$2X10^{10}$	$3X10^{-3}$	$2X10^{-3}$
90	$1.5X10^{11}$	$3X10^{10}$	$3X10^{-3}$	$1X10^{-3}$
91	$2X10^{7}$	$1X10^{10}$	$4X10^{-3}$	$2X10^{-3}$
92	$1X10^{12}$	$8X10^{9}$	$2X10^{-3}$	$2X10^{-3}$
93	$1X10^{12}$	$3X10^{9}$	$2X10^{-3}$	$1X10^{-3}$
94	$3X10^{7}$	$1X10^{10}$	$3X10^{-3}$	$2X10^{-3}$
95	$1.5X10^{11}$	$3X10^{9}$	$4X10^{-3}$	$3X10^{-3}$
96	$1.5X10^{11}$	$3X10^{10}$	$2X10^{-3}$	$2X10^{-3}$

FIGURE I

ELECTRICAL WIRING OF PENETRATION

During Accident Environment Test

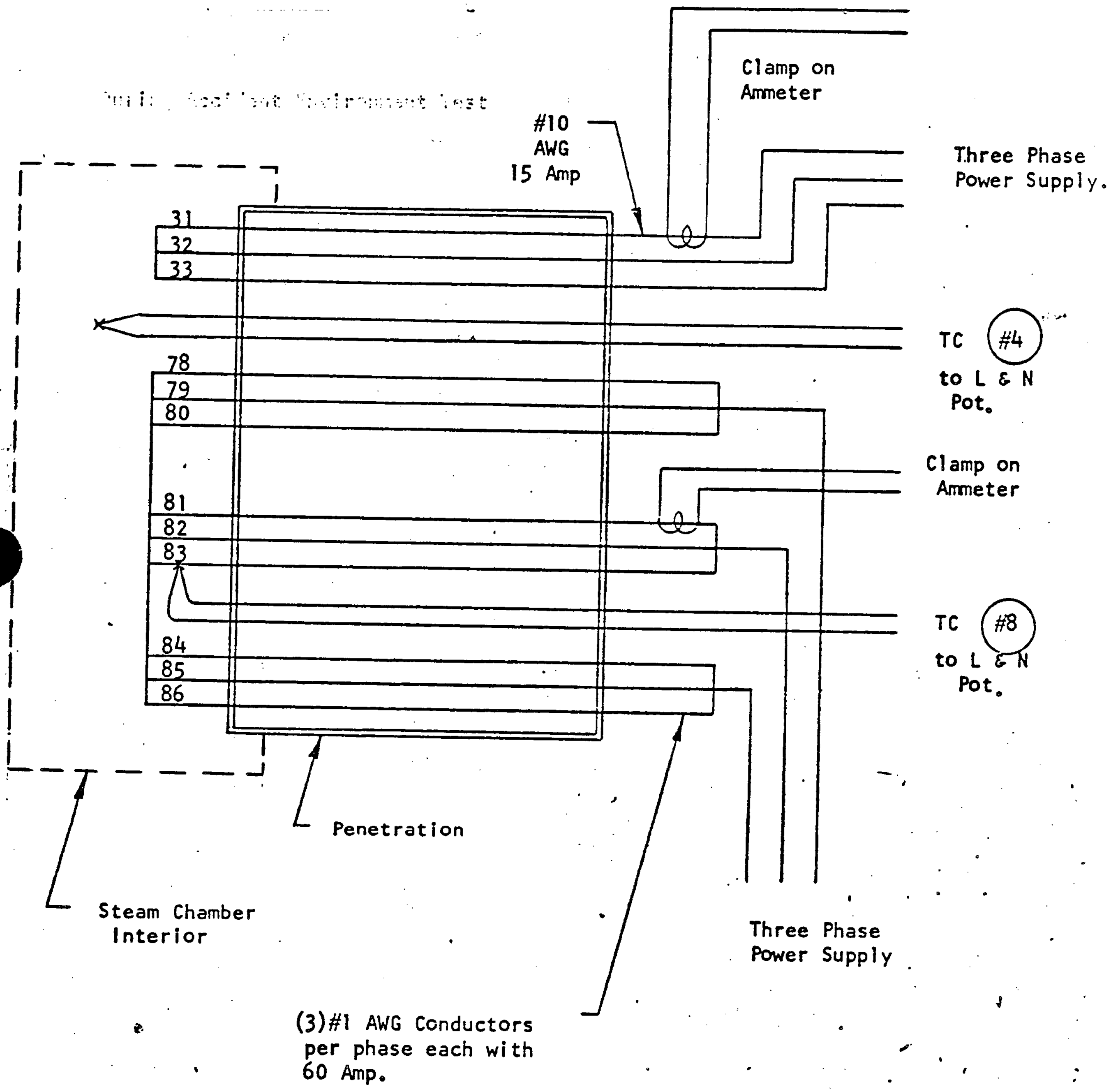


FIGURE 2

INSTRUMENTATION FOR ACCIDENT ENVIRONMENT TESTING

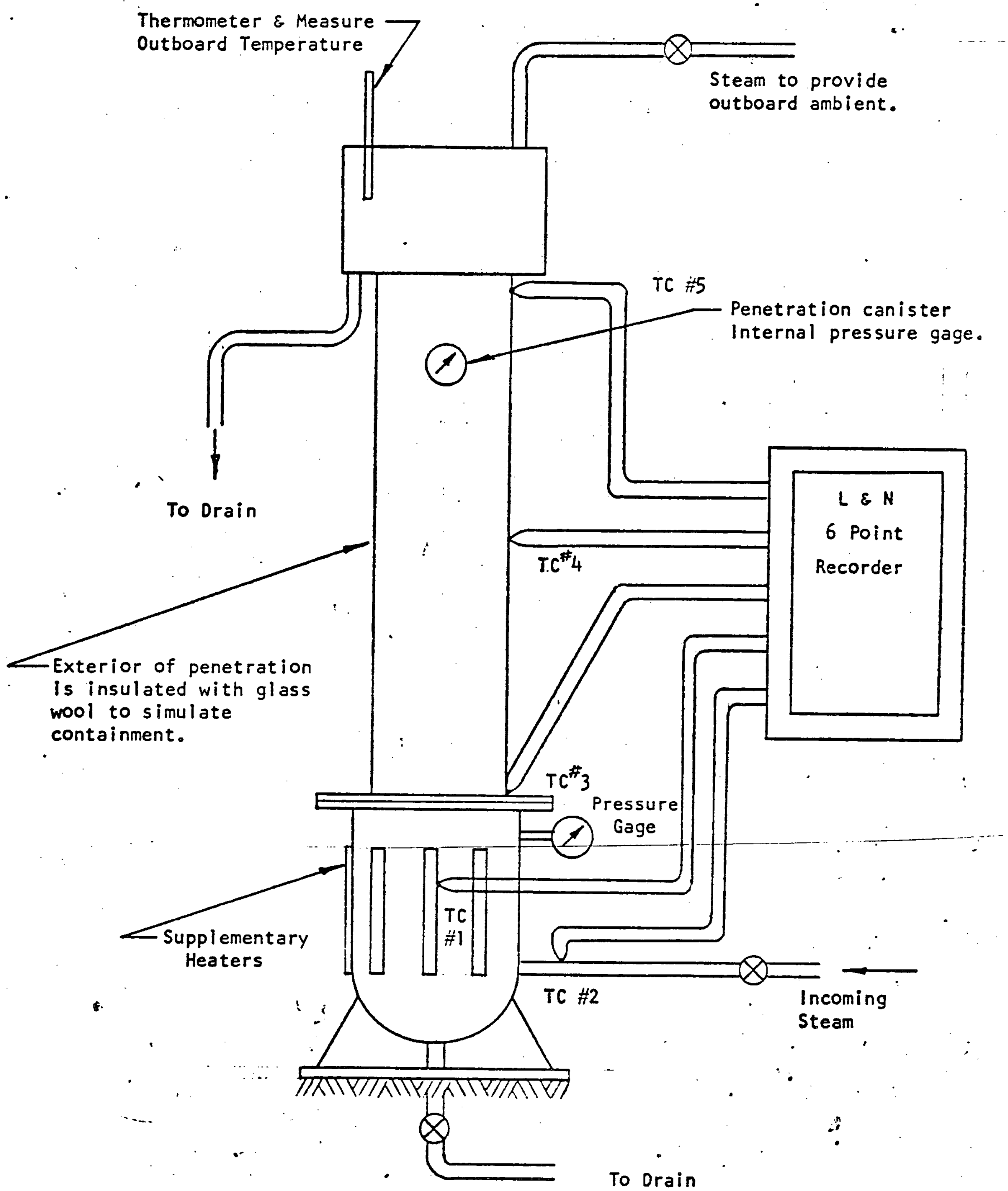
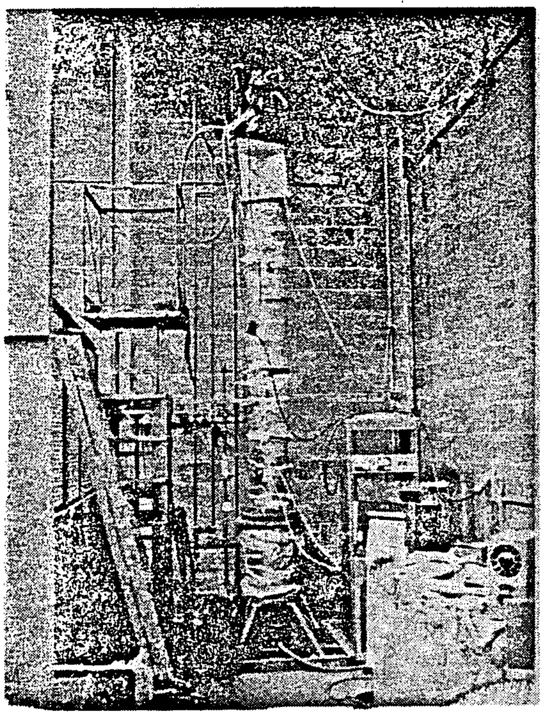
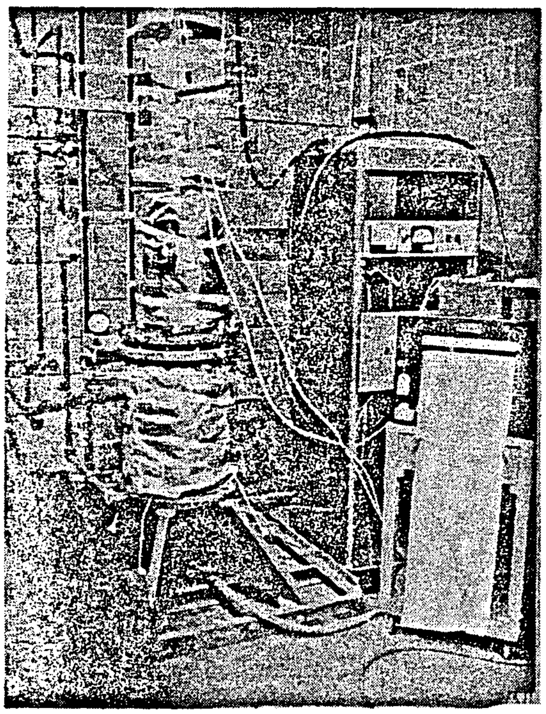


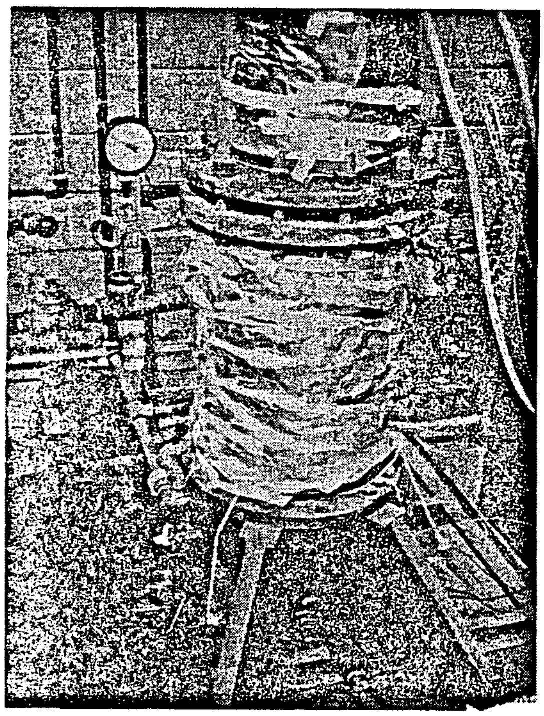
FIGURE 3



Overall View of Accident Environment Test Equipment



Steam Chamber and Instrumentation



Steam Chamber