EQUP-ESE-42
Rev. 0, 1/83

EQUIPMENT QUALIFICATION DATA PACKAGE

This document contains information, relative to the qualification of the equipment identified below, in accordance with the methodology of WCAP 8587. The Specification section (Section 1) defines the assumed limits for the equipment qualification and constitute interface requirements to the user.

Resistance Temperature Detectors: Surface Mounted

APPROVED: _____
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SECTION 1 - SPECIFICATIONS

1.0 PERFORMANCE SPECIFICATIONS

1.1 Electrical Requirements

1.1.1 Voltage: (Ref. 1.3 Auxiliary Devices with approximately 1 milliamp current))

1.1.2 Frequency: N/A

1.1.3 Load: N/A

1.1.4 Electromagnetic Interference: None

1.1.5 Other: Resistance 100.00 Ω at 32°F

1.2 Installation Requirements: Westinghouse Drawing 2654C65, Rev. 7

1.3 Auxiliary Devices: The qualification of the interface connections between the RTD and the R/E or R/I converter is not an objective of this qualification program. The interface connection will be subject to the same environmental conditions as the RTD.

1.4 Preventative Maintenance Schedule: None

1.5 Design Life: 40 years

1.6 Operating Cycles (Expected number of cycles during design life, including test): Continuous duty

1.7 Performance Requirements for[b]: RVLIS Impulse Line Temperature

	Parameter	Normal Conditions	Abnormal Conditions	Containment Test Conditions	DBE Conditions(a) FLB/SLB	DBE Conditions(a) LOCA	DBE Conditions(a) Seismic	Post DBE Conditions(a) FLB/SLB	Post DBE Conditions(a) LOCA	Post DBE Conditions(a) Seismic
1.7.1	Time requirement	Continuous	Included under normal	Test duration	< 5 mins	Event duration	Event duration	4 months	4 months	Continuous
1.7.2	Performance requirement	(c)	Included under normal	No damage	As normal	As normal	As normal	(f)	(f)	As normal

1.8 Environmental Conditions for Same Function[b]

1.8.1	Temperature(°F)	50-122	Included under normal	Ambient	Fig. 2	Fig. 3	Ambient	Fig. 4	Fig. 4	Ambient
1.8.2	Pressure (psig)	-0.1 to .3	Included under normal	70	Fig. 2	Fig. 3	0	Fig. 4	Fig. 4	0
1.8.3	Humidity (percent RH)	0-95	Included under normal	Ambient	100	100	Ambient	100	100	Ambient
1.8.4	Radiation (R)	18×10^6 $_\gamma$	Included under normal		Included under LOCA	1.22×10^8 $_\gamma$ 9.0×10^8 $_\beta$	None	Included under DBE conditions	Included under DBE conditions	None
1.8.5	Chemicals	None	Included under normal	None	Fig. 2	Fig. 3	None	Fig. 4	Fig. 4	None
1.8.6	Vibration	See Section 2.10	Included under normal	None	None	None	None	None	None	None
1.8.7	Acceleration (g)	None	Included under normal	None	None	None	See Sec. 2.10.3.3	None	None	None

Notes: a: DBE is the Design Basis Event.
b: Margin is not included in the parametersof this section.
c: + 0.2°F repeatability. First order timeresponse 8.0 seconds when directly immersed for step change of at least 20°F with a water flow of 3 ft/sec.
d: 10 year life assumed for dose calculation. Radioactive fluid defines normal rating dose.
e: contained accident
f: +5.0°F repeatability.

1.9 Qualified Life: The currently demonstrated qualified life is 10 years based on an average ambient temperature of 50°C (122°F). (See Table 1)

1.10 Remarks: None

SECTION 2 - QUALIFICATION BY TEST

2.0 TEST PLAN

2.1 Equipment Description: MINCO - Surface mounted resistance temperature detector

Model Numbers S8809 and S8810

2.2 Number Tested: Test performed on four (4) units

2.3 Mounting: Per Section 1.2

2.4 Connections: 3-wire connection to R/E converter

2.5 Aging Simulation Procedure:

Sequential simulation of thermal and radiation mechanisms as part of the overall test sequence.

2.6 Service Conditions to be Simulated by Test[1]

		Normal/Abnormal	Containment Test	Radiation Test	Seismic	HELB/Post-HELB
2.6.1	Temp. (°F)	40-122	Covered by HELB	Ambient	Ambient	Fig. 4
2.6.2	Pressure (psig)	0		0	0	Fig. 4
2.6.3	Humidity (percent RH)	Ambient		Ambient	Ambient	100
2.6.4	Radiation (R)	Included under radiation test		1.6×10^8 γ	None	Included under radiation test
2.6.5	Chemicals	None		None	None	Fig. 4
2.6.6	Vibration	None		None	Fig. 1	None
2.6.7	Acceleration (g)	None		None	Fig. 1	None

2.7 Measured Variables

This section identifies the parameters required to be measured during the test sequence.

			Required	Not Required
2.7.1	Category I - Environment			
	2.7.1.1	Temperature	B,C,E	A,B,C,D
	2.7.1.2	Pressure	E	A,B,C,D
	2.7.1.3	Moisture	E	A,B,C,D
	2.7.1.4	Gas Composition		A,B,C,D,E
	2.7.1.5	Vibration	D	A,B,C,E
	2.7.1.6	Time	B,C,D,E	A
2.7.2	Category II - Input Electrical Characteristics			
	2.7.2.1	Voltage	A,B,C,D,E	
	2.7.2.2	Current	A	B,C,D,E
	2.7.2.3	Frequency		A,B,C,D,E
	2.7.2.4	Power		A,B,C,D,E
	2.7.2.5	Other		A,B,C,D,E
2.7.3	Category III - Fluid Characteristics			
	2.7.3.1	Chemical Composition	E	A,B,C,D
	2.7.3.2	Flow Rate	E	A,B,C,D
	2.7.3.3	Spray	E	A,B,C,D
	2.7.3.4	Temperature		A,B,C,D,E
2.7.4	Category IV - Radiological Features			
	2.7.4.1	Energy Type	C	A,B,D,E
	2.7.4.2	Energy Level	C	A,B,D,E
	2.7.4.3	Dose Rate	C	A,B,D,E
	2.7.4.4	Integrated Dose	C	A,B,D,E

		Required	Not Required
2.7.5	Category V - Electrical Characteristics		
2.7.5.1	Insulation Resistance	A,C,E	B,D
2.7.5.2	Output Voltage		A,B,C,D,E
2.7.5.3	Output Current	A,B,C,D,E	
2.7.5.4	Output Power		A,B,C,D,E
2.7.5.5	Response Time	A	B,C,D,E
2.7.5.6	Frequency Characteristics		A,B,C,D,E
2.7.5.7	Simulated Load		A,B,C,D,E
2.7.6	Category VI - Mechanical Characteristics		
2.7.6.1	Thrust		A,B,C,D,E
2.7.6.2	Torque		A,B,C,D,E
2.7.6.3	Time		A,B,C,D,E
2.7.6.4	Load Profile		A,B,C,D,E
2.7.7	Category VII - Auxiliary Equipment (List Function and Required Measurements)		
2.7.7.1	R/E Converter Voltage (RTD analog out)	A,B,C,D,E	

A: Manufacturers Acceptance Test
B: Thermal Aging
C: Radiation
D: Seismic
E: HELB/Post HELB

2.8 Test Sequence Preferred

This section identifies the test sequences as specified in IEEE-323-1974

2.8.1 Inspection of Test Item
2.8.2 Operation (Normal Condition)
2.8.3 Operation (Performance Specifications Extremes, Section 1)
2.8.4 Simulated Aging
2.8.5 Vibration
2.8.6 Operation (Simulated High Energy Line Break Conditions)
2.8.7 Operation (Simulated Post HELB Conditions)
2.8.8 Inspection

2.9 Test Sequence Actual

This section identifies the actual test sequence which constitutes the qualification program for this equipment. A justification for anything other than the preferred sequence is provided. The normal operating test condition referred to is a static calibration check at 32°F, 212°F and 400°F. Time response testing has been successfully performed via type testing on a sample model of this RTD. Performance under abnormal operating conditions is covered under Sections 2.8.3 and 2.8.6. Westinghouse has identified no mechanisms that would cause a degradation in time response and not affect RTD calibration. Therefore, the calibration data taken during the test is adequate to monitor the performance of the RTD for both conditions. Since the probe materials are not sensitive to thermal degradation, time response testing has been excluded from the test sequence.

Test Sequence (from Section 2.8):

2.8.1 Inspection
2.8.2 Operation-Normal Condition (Static Calibration)
2.8.4 Thermal Aging

2.8.2 Static Calibration
2.8.4 Radiation, Normal and Post-Accident
2.8.2 Static Calibration
2.8.4 Environmental Vibration Induced Aging (Multi-frequency and dwell)
2.8.5 Operating Basis Earthquake, Safe Shutdown Earthquakes
2.8.2 Static Calibration
2.8.6 High Energy Line Break Simulation
2.8.7 Post HELB Simulation
2.8.2 Static Calibration
2.8.8 Inspection

2.10 Type Test Data

2.10.1 Objective

The objective of this test program is to demonstrate, employing the recommended practices of Reg. Guide 1.89 (IEEE 323-1974) and Reg. Guide 1.100 (IEEE 344-1975), the capability of the surface mounted resistance temperature detectors to complete their safety related functions described in EQDP Section 1.7 while exposed to the applicable environments defined in EQDP Section 1.8.

2.10.2 Equipment Tested

Four Minco surface mounted resistance temperature detectors, (2) S8809 and (2) S8810, were subjected to the test environments of the sequence shown in Section 2.9.

2.10.3 Test Summary

2.10.3.1 Normal Environment Testing

Operation of the Surface Mounted RTD's under normal conditions is reflected by the numerous

three temperature static calibrations performed between each phase of the test sequence reported in Reference 1.

2.10.3.2 Simulated Aging/Radiation

The test units were pre-conditioned to a simulated ten year aged condition prior to subjecting them to the design basis seismic event and high energy line break simulation. The aged condition was achieved by separate phases of accelerated thermal aging, radiation exposure to a total integrated gamma dose equivalent to a ten-year normal dose plus the design basis accident dose. Through all the pre-conditioning phases, the amplified RTD outputs were monitored to verify continuous operation.

2.10.3.3 Seismic Tests

The seismic testing employed single-frequency sinusoidal inputs and multi-axis multi-frequency inputs in accordance with Reg. Guide 1.100 (IEEE 344-1975). The generic required response spectra (RRS) shown in Figure 1A, 1B, and 1C, contains significant margin with respect to any single plant application referencing this program[1]. The required input motion (RIM) for the single frequency sinusoidal tests is shown in Figure 1D. Each plant should compare to the applicable RRS (A, B, or C) and the RIM to assure that a 10 percent margin exists based on their actual plant location.

2.10.3.4 High Energy Line Break/Post HELB Simulation

The surface mounted RTD's were subjected to the HELB simulation temperature profile of Figure 4. Following the second ramp the temperature gradually declines to 225°F and is held at saturated steam conditions for 12 days, simulating a four-month period of post HELB operation.

2.10.4 Conclusion

The qualification of the surface mounted RTD is demonstrated by the completion of the simulated aging and design basis event condition testing described herein and reported in Reference 1.

2.11 The generic tests completed by Westinghouse employ parameters designed to envelope a number of plant applications. Margin is a plant specific parameter and will be established by the applicant.

2.12 References

1. Hantz, P.T., Black, J.P., Skeers, D.M., Rygg, D.E., "Equipment Qualification Report, Resistance Temperature Detectors - Surface Mounted (Seismic and Environmental Testing)" WCAP-8687, Supplement 2-E42A (Proprietary).

SECTION 3 QUALIFICATION BY EXPERIENCE

Westinghouse does not employ operating experience in support of the qualification program for the Surface Mounted Resistance Temperature Detectors.

SECTION 4 QUALIFICATION BY ANALYSIS

Westinghouse employed analysis in support of the qualification program for other tube/pipe sizes of the surface mounted resistance temperature detectors. All MINCO RTD's qualified by this program are listed in Table 2.

Details of the analysis are provided in Reference 1.

TABLE 1

ACTUAL QUALIFICATION TEST CONDITIONS

EQUIPMENT (1) SYSTEM/CATEGORY	LOCATION STRUCTURE/AREA	MANUFACTURER TYPE/MODEL	ABNORMAL/ACCIDENT ENVIRONMENTAL EXTREMES PARAMETER	SPECIFIED (2)	QUALIFIED (3)	OPERABILITY REQ	OPERABILITY DEM	ACCURACY(4) REQ	ACCURACY(4) DEM	QUAL LIFE	QUAL METHOD	QUAL REF	QUAL PROGRAM STATUS
Surface mount RTD/RVLIS/ Category a	Containment Bldg./inside missile shield	See Table 2	Temperature		420°F	4 mo.	4 mo.	±5.0°F	±1.0 °F	10 yrs.	Seq. Test	ESE-42	Completed
			Pressure		75 psig								
			Rel. humidity		100%								
			Radiation		1.6×10^8 r			(4)	(4)	(5)			
			Chemistry		2750 ppm H_3BO_3 NaOh to 10.7 pH								

NOTES:

1. For definition of the equipment category, refer to NUREG-0588 "Interim Staff Position on Environmental Qualification of Safety-Related Electrical Equipment," Appendix E Section 2.
2. Plant specific environmental parameters are to be inserted by the applicant.
3. The values listed represent the design conditions plus margin. For completed programs, the values listed were met in the test. Any variations from the values listed were in a conservative direction or were not considered significant.
4. The accuracies are changes in the RTD due to severe environments. The calibration repeatability is ± 0.2°F and the environmental allowance is ± 4.8°F. These errors do not include the channel inaccuracies or process errors. Response times and seismic accuracies are contained in the equipment EQDP.
5. Qualified life assumed a normal temperature of 50°C.

TABLE 2

Surface mounted RTD Applications
Qualified by Test or Analysis Program

MINCO Model No.	Tube/Pipe Size and Schedule
S8809	3/16 Inch Tube
S8810	1 Inch Tube
**	1/4 Inch Tube
**	3/8 Inch Tube
**	1 Inch Pipe Sch. 160
**	3 Inch Pipe Sch. 160
**	6 Inch Pipe Sch. 160
**	8 Inch Pipe Sch. 160
**	1/2 Inch Pipe Sch. 160
S8810*	1 Inch Pipe

*Length of MI cable is 900 inches

**Model No's. unassigned

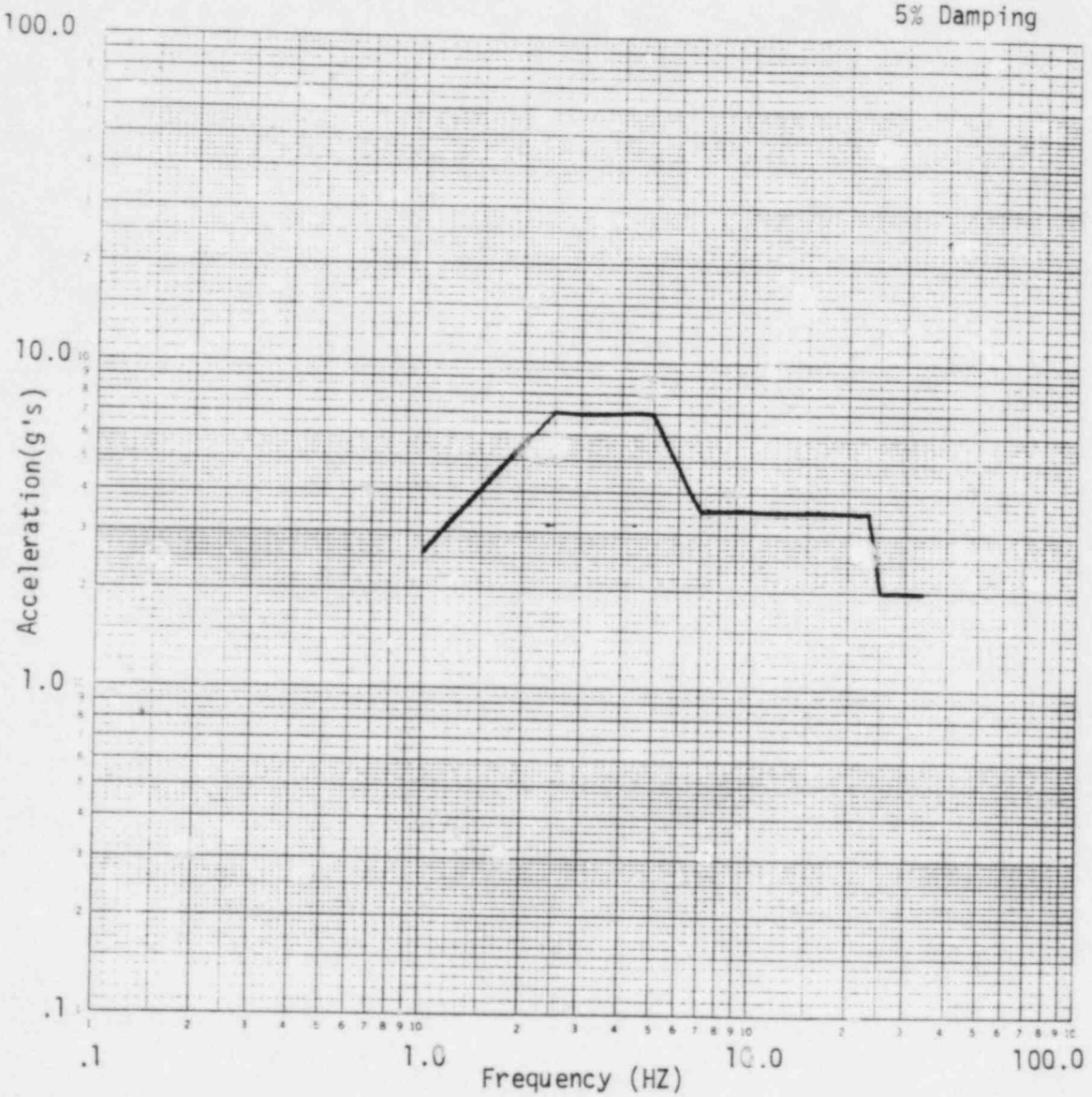


Figure 1A Required Response Spectrum for Safe Shutdown Earthquake (Input A)

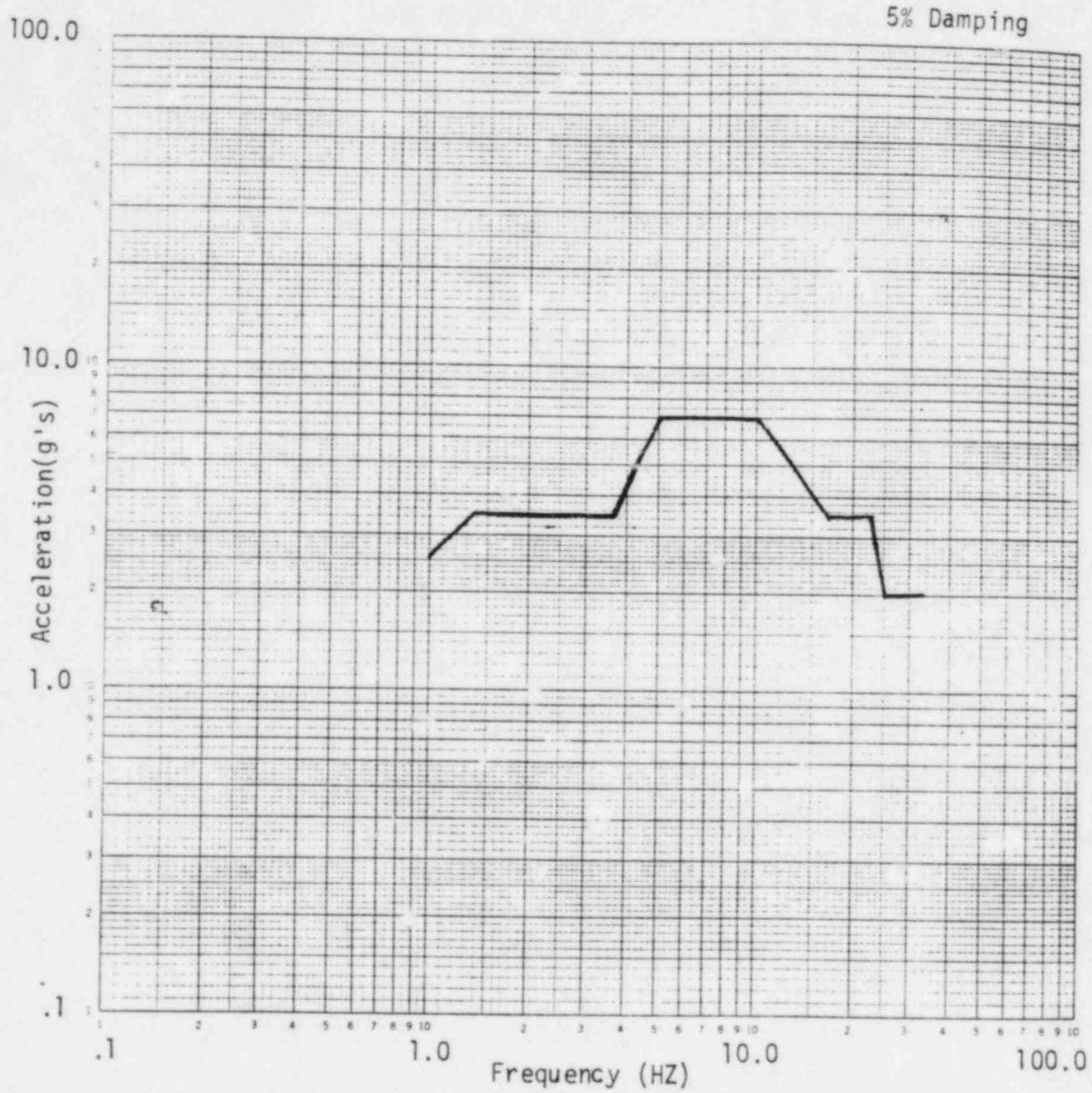


Figure 1B Required Response Spectrum for Safe Shutdown Earthquake (Input B)

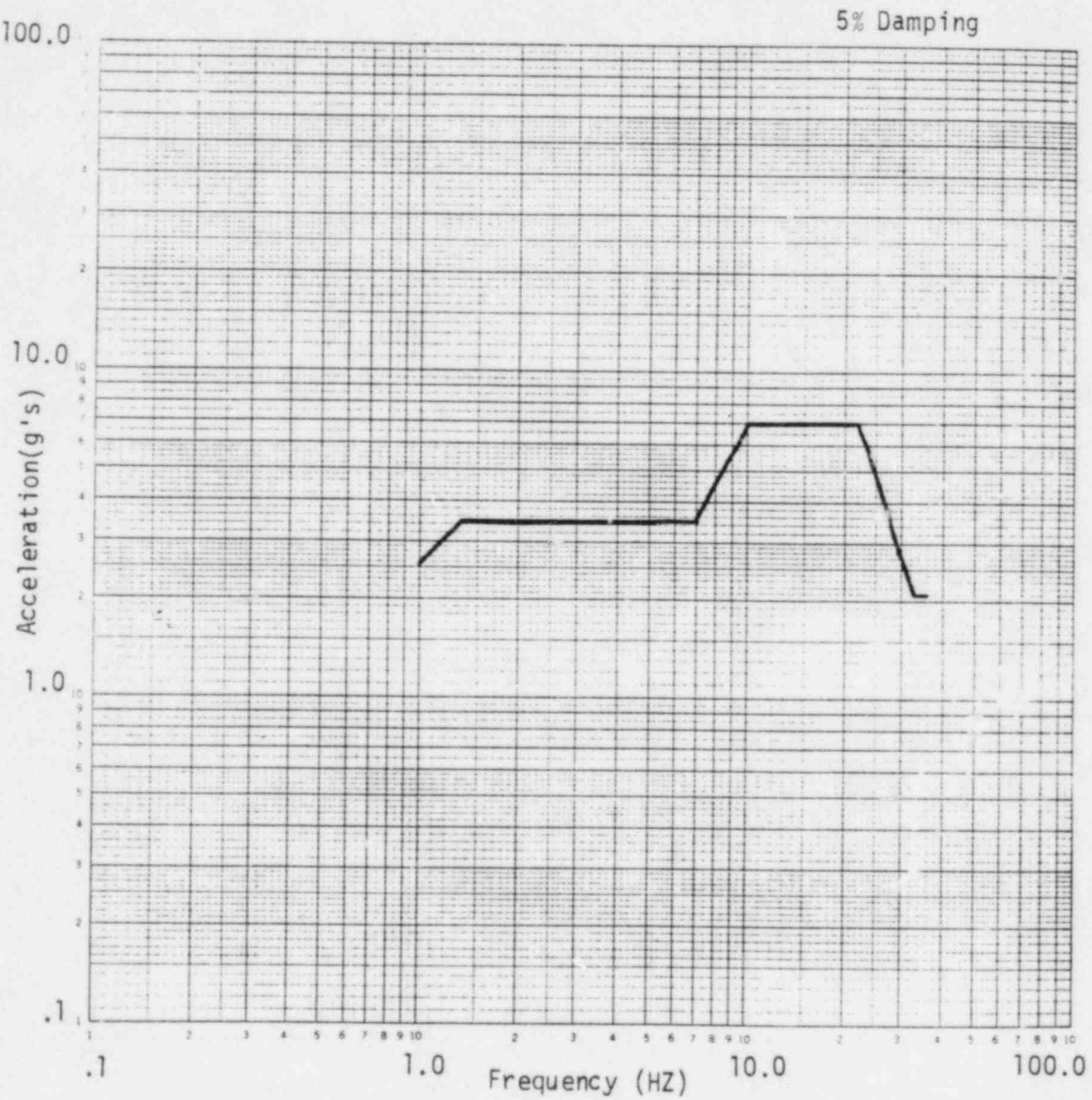


Figure 1C Required Response Spectrum for Safe Shutdown Earthquake (Input C)

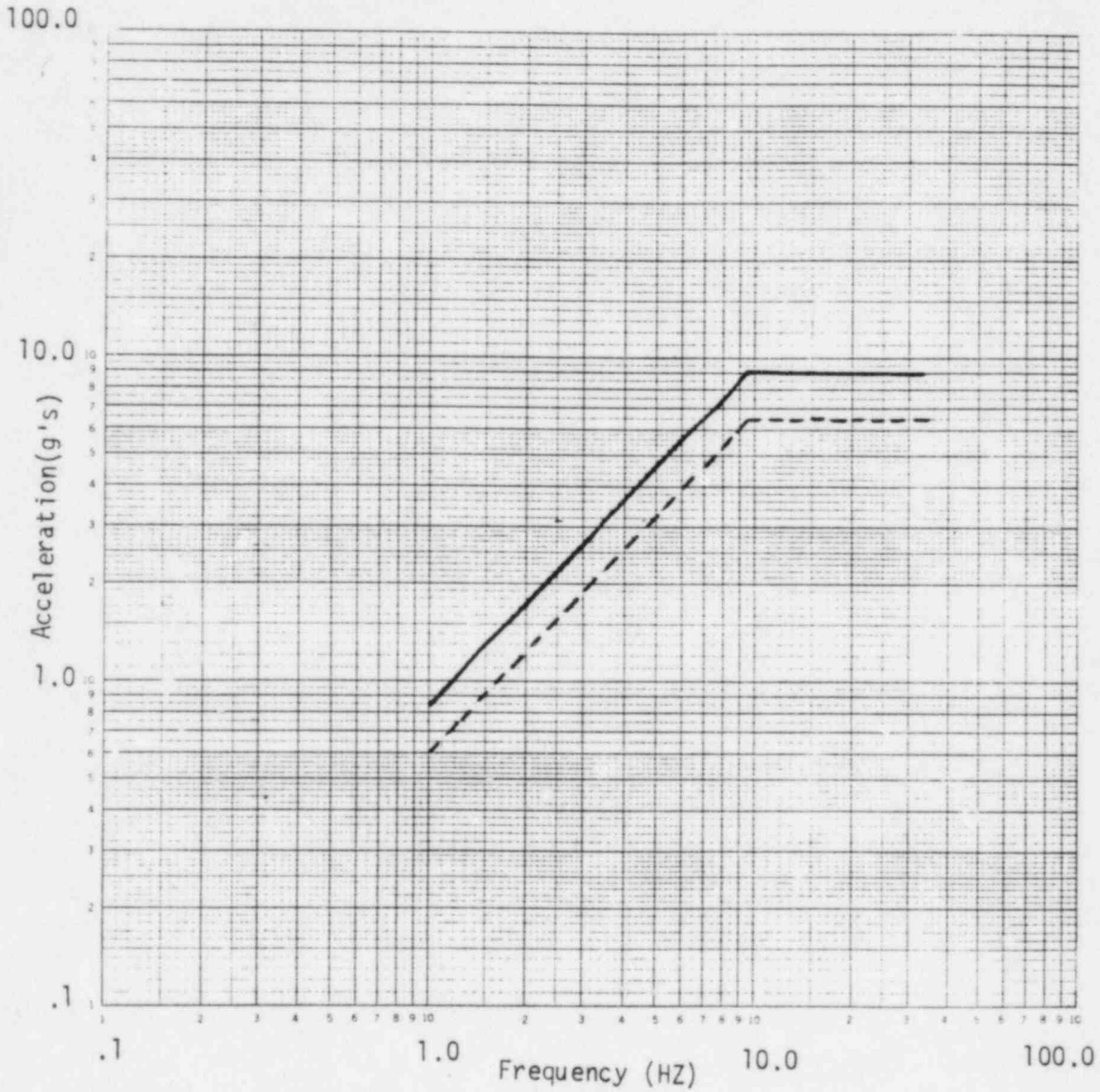
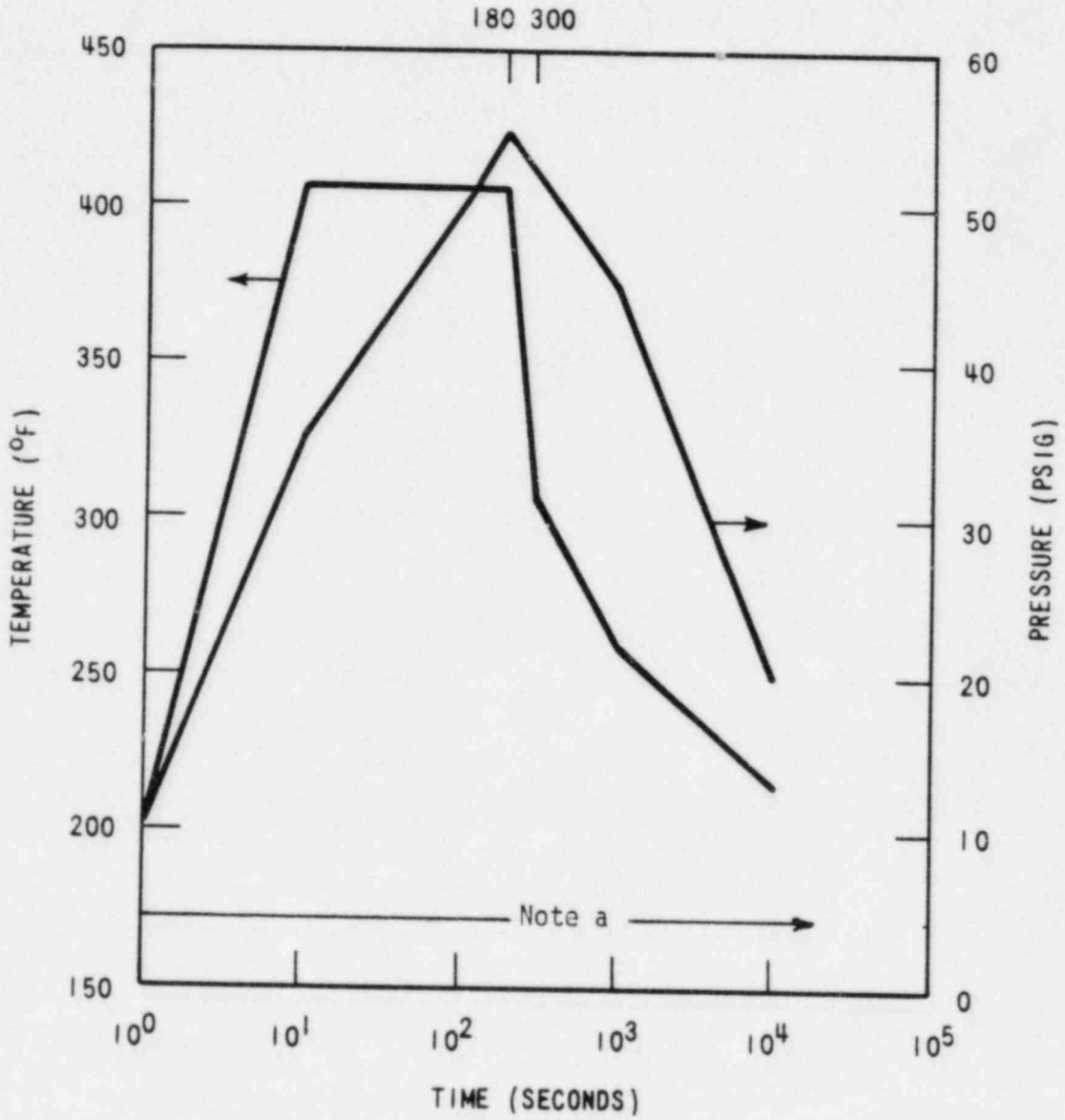
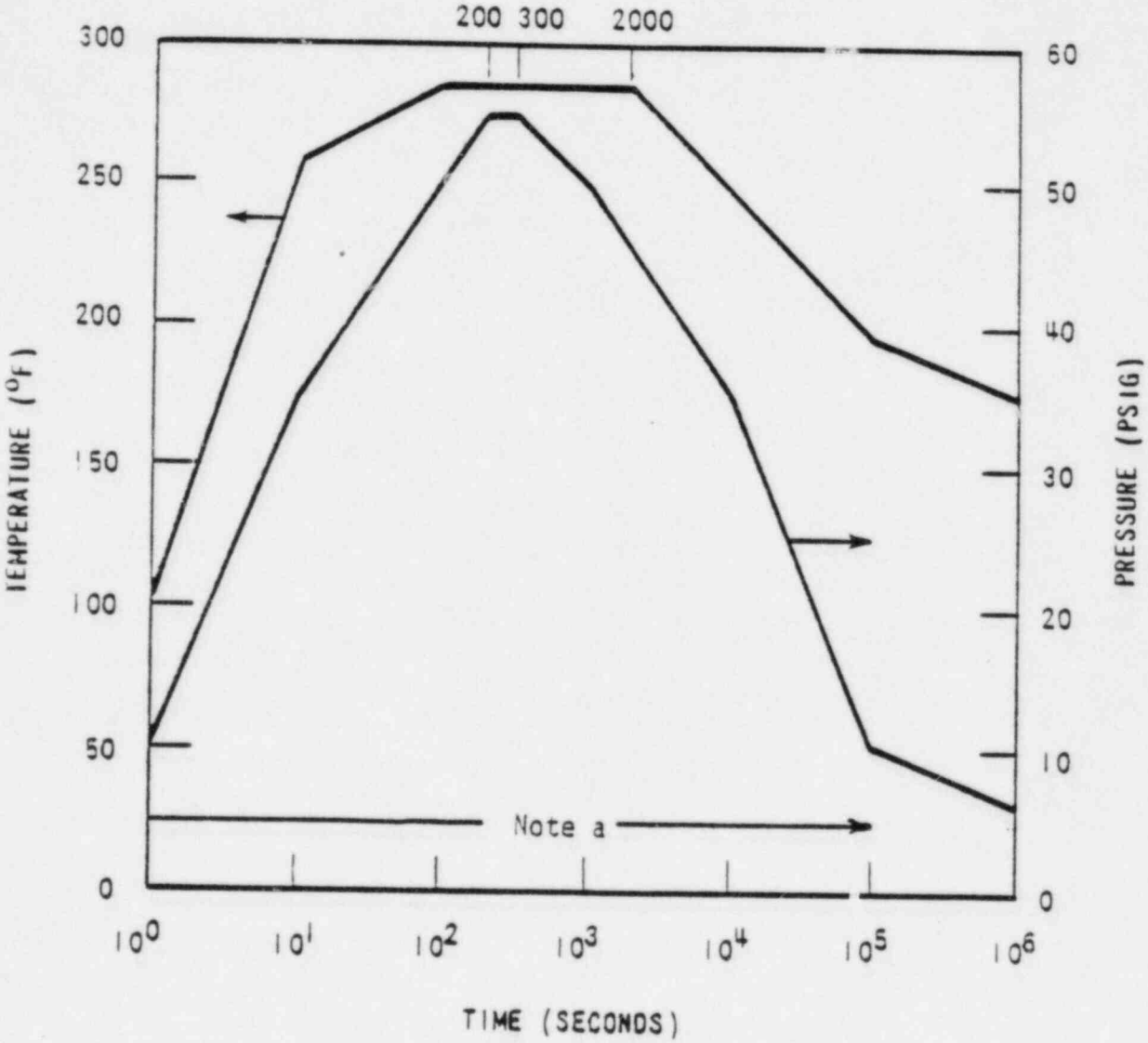


Figure 1D Safe Shutdown Earthquake Required Input Motion (RIM)



Note a: Initial 24 hour containment spray solution of 2500 PPM Boron in water buffered with NaOH to yield a pH of 10.7

Figure 2 Containment Environmental Design Conditions - Main Steam Line Break and Feedline Break



Note a: Initial 24 hour containment spray solution of 2500 PPM Boron in water buffered with NaOH to yield a pH of 10.7

Figure 3. Containment Environmental Design Conditions

- LOCA -

SLB/FLB/LOCA PROFILE

INITIAL 24 HOUR CONTAINMENT SOLUTION OF 2750 PPM BORON IN WATER BUFFERED WITH 0.24% NaOH TO YIELD A pH OF 10.7

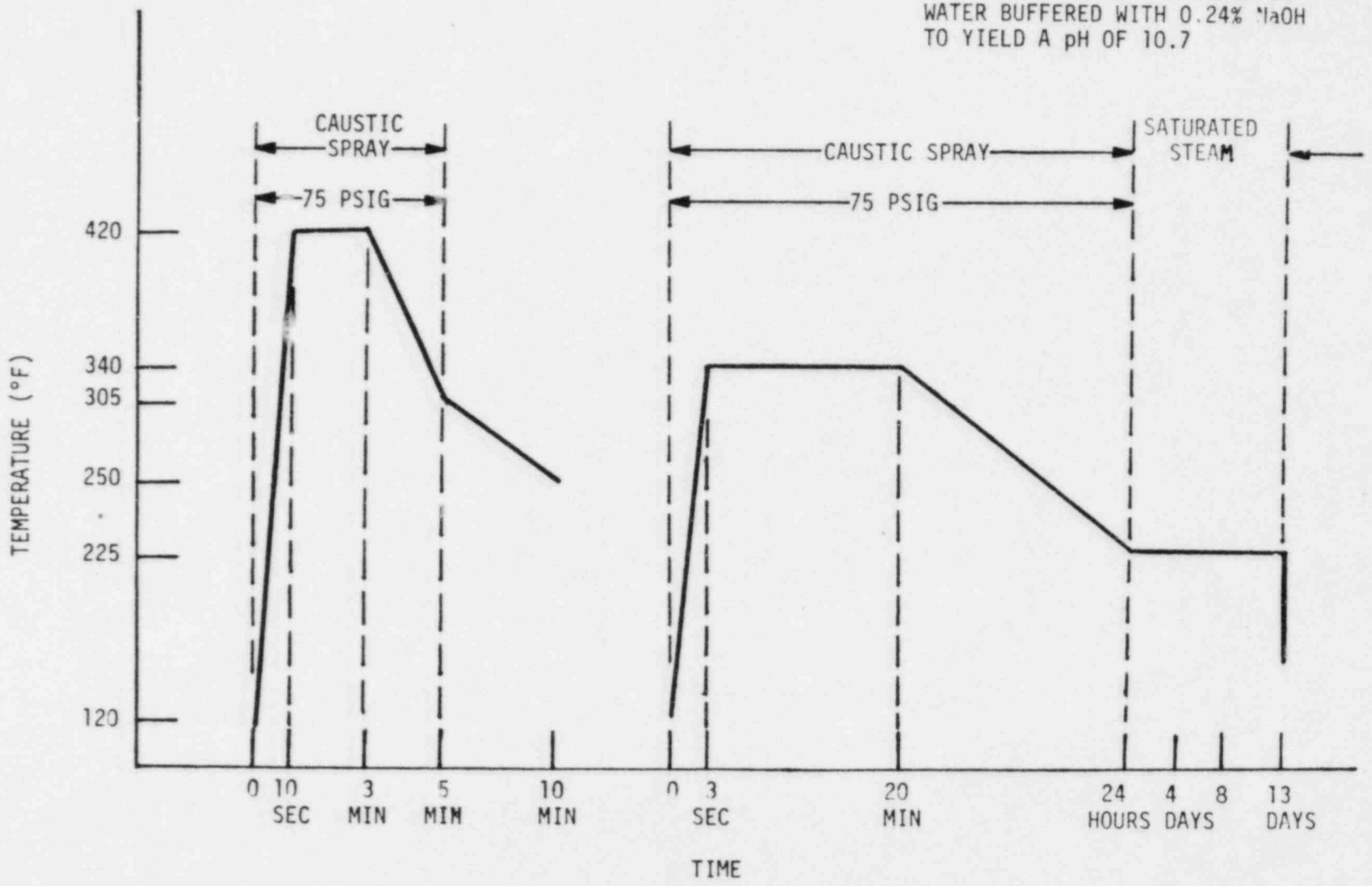


FIGURE 4