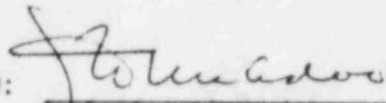


EQUIPMENT QUALIFICATION DATA PACKAGE

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

Differential Pressure Indicating Switch: Qualification Group A

APPROVED:


for E. P. Rahe, Manager
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SECTION 1 - SPECIFICATIONS

1.0 PERFORMANCE SPECIFICATIONS

1.1 Electrical Requirements

1.1.1 Voltage: 115 VAC/115 VDC

1.1.2 Frequency: N/A

1.1.3 Load: AC/4 Amps DC/.1 Amp

1.1.4 Electromagnetic Interference: None

1.1.5 Other: None

1.2 Installation Requirements: Wall mounted per Westinghouse Drawing 9559D44, Rev. 3

1.3 Auxiliary Devices: None

1.4 Preventative Maintenance Schedule: None; maintenance and calibration in accordance with manual when required.

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 Function: Reactor Vessel Level Instrumentation Hydraulic Isolator

Parameter	Normal Conditions	Abnormal Conditions	Containment Test Conditions	DBE Conditions ^(a)			Post DBE Conditions ^(a)		
				FLB/SLB	LOCA	Seismic	FLB/SLB	LOCA	Seismic
1.7.1 Time requirement	Continuous	Included under normal	Test Duration	4 Months	Event Duration	Event Duration	4 months	4 months	Continuous
1.7.2 Performance requirement (c)	(d)		No damage	(d)	(d)	(d)	(d)	(d)	(d)

1.8 Environmental Conditions for Same Function^(b)

1.8.1 Temperature (°F)	50 - 122	Included under normal	Ambient	Figure 2	Figure 3	Ambient	Figure 2	Figure 3	Ambient
1.8.2 Pressure (psig)	-0.1/+0.3		70	Figure 2	Figure 3	0	Figure 2	Figure 3	0
1.8.3 Humidity (% RH)	0 - 95		Ambient	100	100	Ambient	100	100	Ambient
1.8.4 Radiation (R)	$< 10^4$		None	Included Under Post DBE	Included Under Post DBE	None	$3.9 \times 10^4 \gamma$ $6.4 \times 10^5 \beta$	$4.1 \times 10^7 \gamma$ $9 \times 10^8 \beta$	None
1.8.5 Chemicals	None		None	Figure 2	Figure 3	None	Figure 2	Figure 3	None
1.8.6 Vibration	None		None	None	None	None	None	None	None
1.8.7 Acceleration (g)	None		None	None	None	Figure 1	None	None	None

- Notes: (a) DBE is the Design Basis Event.
 (b) Margin is not included in the parameters of this section.
 (c) Time Response
 (d) No contribution to transmitter reference accuracy.

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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

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EQUIPMENT QUALIFICATION DATA (PART 2 - QUALIFICATION BY TEST)

2.0 TEST PLAN

The thermal aging and mechanical cycling tests were performed at Westinghouse Forest Hills Site in Pittsburgh, Pennsylvania. The gamma irradiation of the switch was performed at Radiation Technology in Rockaway, New Jersey. Design basis event seismic simulation was performed at Westinghouse Advanced Energy Systems Division (AESD), in Large Pennsylvania. The High Energy Line Break simulation was performed at the Westinghouse Forest Hills Site in Pittsburgh, Pennsylvania.

2.1 Equipment Description: ITT Barton - Differential Pressure
Indicating Switch Model 581

2.2 Number Tested: 3 Barton units

2.3 Mounting: Per Westinghouse Drawing 9559D44, Rev. 3

2.4 Connections: (a) Electrical connections, two wires
(b) Process connections, capillary tube

2.5 Aging Simulation Procedure

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

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2.6 Simulated Service Conditions⁽¹⁾: See Section 2.11 for notes.

		<u>Normal/ Abnormal</u>	<u>Thermal Aging/ Mechanical Cycling</u>	<u>Radiation</u>	<u>Cont. Test</u>	<u>Seismic</u>	<u>HELB/ Post-HELB</u>
2.6.1	Temp (°F)	40 - 120°F	104°F (10 years)	Ambient	Covered by HELB	Ambient	Figure 4
2.6.2	Pressure (psig)	Atmos.	Atmos.	Atmos.		Atmos.	Figure 4
2.6.3	Humidity (% RH)	0 - 95	Ambient	Ambient		Ambient	100
2.6.4	Radiation (R)	None	None	5×10^7 _Y 9×10^8 _B		None	Included under radiation
2.6.5	Chemicals	None	None	None		None	Figure 4
2.6.6	Vibration	None	None	None		5 OBE's	None
2.6.7	Acceleration (g)	None	None			TRS>RRS Figure 1	None
2.6.8	Process Cycling	None	10^6	None		None	None

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2.7 Measured Variables

		<u>Required</u>	<u>Not Required</u>
2.7.1	Category I - Environment		
2.7.1.1	Temperature	A,B,C,D,E	
2.7.1.2	Pressure	E	A,B,C,D
2.7.1.3	Moisture	A,E	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	A,B,C,D,E	
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

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	<u>Required</u>	<u>Not Required</u>
2.7.5 Category V - Electrical Characteristics		
2.7.5.1 Insulation Resistance		A,B,C,D,E
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		
None		

-
- A: Normal/Abnormal (Type Test)
 - B: Thermal Aging/Mechanical Cycling
 - C: Radiation
 - D: Seismic
 - E: HELB/Post-HELB

2.8 Test Sequence Preferred

This section identifies the preferred test sequence as specified in IEEE-323-74.

- 2.8.1 Inspection of Test Item
- 2.8.2 Operation (Normal Condition)
- 2.8.3 Operation (Performance Specification 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 to which the differential pressure indicating switches were subjected. Sections 2.8.2 and 2.8.3, Operation at Normal Conditions and at Performance Specification Extremes are covered by operation throughout the sequence, including under the more severe HELB conditions. High energy line break and post-HELB radiation doses are included with normal dose in testing and are not combined with temperature/humidity conditions.

2.9.1 Test Sequence Actual

- 2.9.1 Inspection
- 2.9.2 Operation - Normal Conditions
- 2.9.3 Operation - Performance Specification Extremes
- 2.9.4 Mechanical Cycling/Electrical Cycling/Accelerated Thermal Aging
- 2.9.4 Radiation - Normal 10 Year Dose
- 2.9.5 Radiation HELB/Post HELB Dose
- 2.9.6 Seismic Simulation/Vibration
- 2.9.7 Operation (Simulated High Energy Line Break Conditions)
- 2.9.8 Operation (Simulated Post-HELB Conditions)
- 2.9.9 Operation (Including time response)
- 2.9.10 Inspection - if required

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 differential pressure indicating switch to perform its safety related functions described in EQDP 1.7 while exposed to the environments defined in EDQP Section 1.8.

2.10.2 Equipment Tested

2.10.2.1 Test Units

Three (3) ITT Barton Model 581 Differential Pressure Indicating Switches were subjected to the test environments of the sequence shown in Section 2.9.1.

2.10.3 Test Summary

2.10.3.1 Test Summary

2.10.3.1.1 Normal Environment Testing

Operation of the differential pressure indicating switches under normal/abnormal environment conditions is demonstrated by operation throughout the test sequence, including at more severe DBE conditions.

2.10.3.1.2 Simulated Aging

The units were pre-conditioned to a simulated ten year aged condition prior to subjecting them to the design basis seismic event and high

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energy line break simulations. The aged condition was achieved by separate phases of mechanical cycling, accelerated thermal aging and gamma radiation dose equivalent to the ten year normal gamma dose plus the design basis accident gamma dose plus the gamma equivalent beta dose. Throughout the pre-conditioning phases the switch contacts were monitored and recorded.

2.10.3.1.3 Seismic Tests

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

2.10.3.1.4 High Energy Line Break/Post HELB Simulation

The Differential Pressure Indicating Switches were subjected to the HELB simulation profile of Figure 4. Following the 340°F temperature peak, 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 status of Qualification Group A Differential Pressure Indicating Switch is demonstrated by the completion of the simulated aging and design basis event condition testing described herein and reported in Reference 1.

2.11 Section 2 Notes

- (1) 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. Skeers, D. M., Black, J. P., Rygg, D. E., "Equipment Qualification Test Report Differential Pressure Indicating Switch - Qualification Group A (Siesmic and Environmental Testing)" WCAP-8687-Supp. 2-E49A (Proprietary).

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SECTION 3 AND 4 QUALIFICATION BY EXPERIENCE AND/OR ANALYSIS

Westinghouse does not employ operating experience or analysis in support of the qualification program for the Differential Pressure Indicating Switch - Qualification Group A.

TABLE 1

ACTUAL QUALIFICATION TEST CONDITIONS

EQUIPMENT (1) SYSTEM/CATEGORY	LOCATION STRUCTURE/AREA	MANUFACTURER TYPE/MODEL	ABNORMAL/ACCIDENT PARAMETER	ENVIRONMENTAL SPECIFIED (2)	EXTREMES QUALIFIED	OPERABILITY		ACCURACY (3)		QUAL LIFE	QUAL METHOD	QUAL REF	QUAL PROGRAM STATUS	
						REQ	DEM	REQ	DEM					
RVLIS indicating switch/ Category a	Outside	Barton 581	Temperature		420°F	Post	Same	±15	Same	10	Seq.	ESE-	Completed	
	Containment		Pressure		57 psig	DBE				yrs.	Test	49		
	Bldg.		Rel. humidity		100%	4 Mo.								
			Radiation		5x10 ⁷ R(γ)									
					9x10 ⁸ R(β)									
			Chemistry		2500 ppm									
					H ₃ BO ₃									
					NaOH									
					10.7 pH									

Notes: (1) For definition of the equipment category, refer to NUREG-0588 "Interim Staff Position on Environmental Qualification of Safety-Related Equipment Electrical Equipment," Appendix E Section 2.

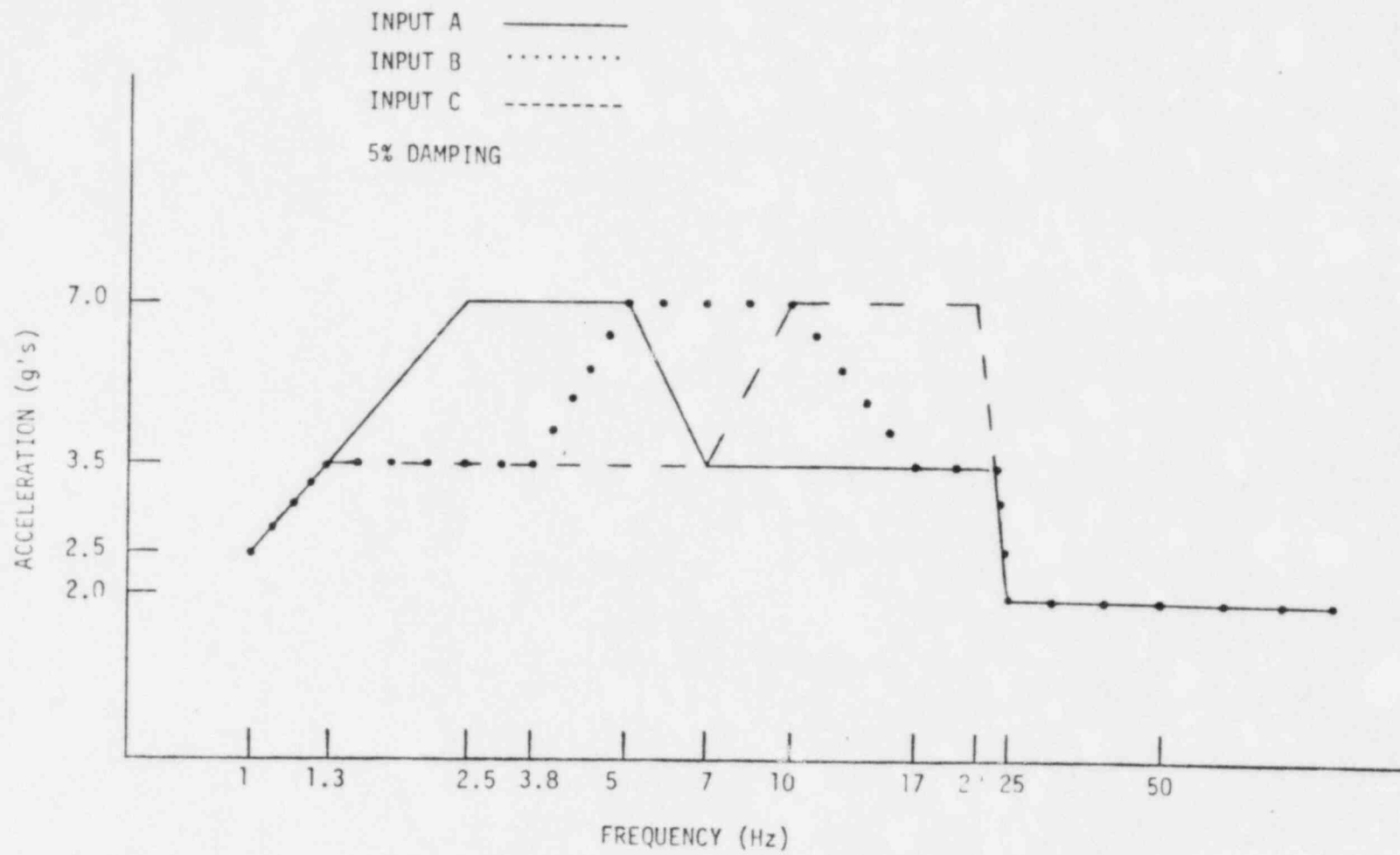
(2) Plant specific environmental parameters are to be inserted by the applicant.

(3) Qualified life is based on a service condition of 104°F (40°C).



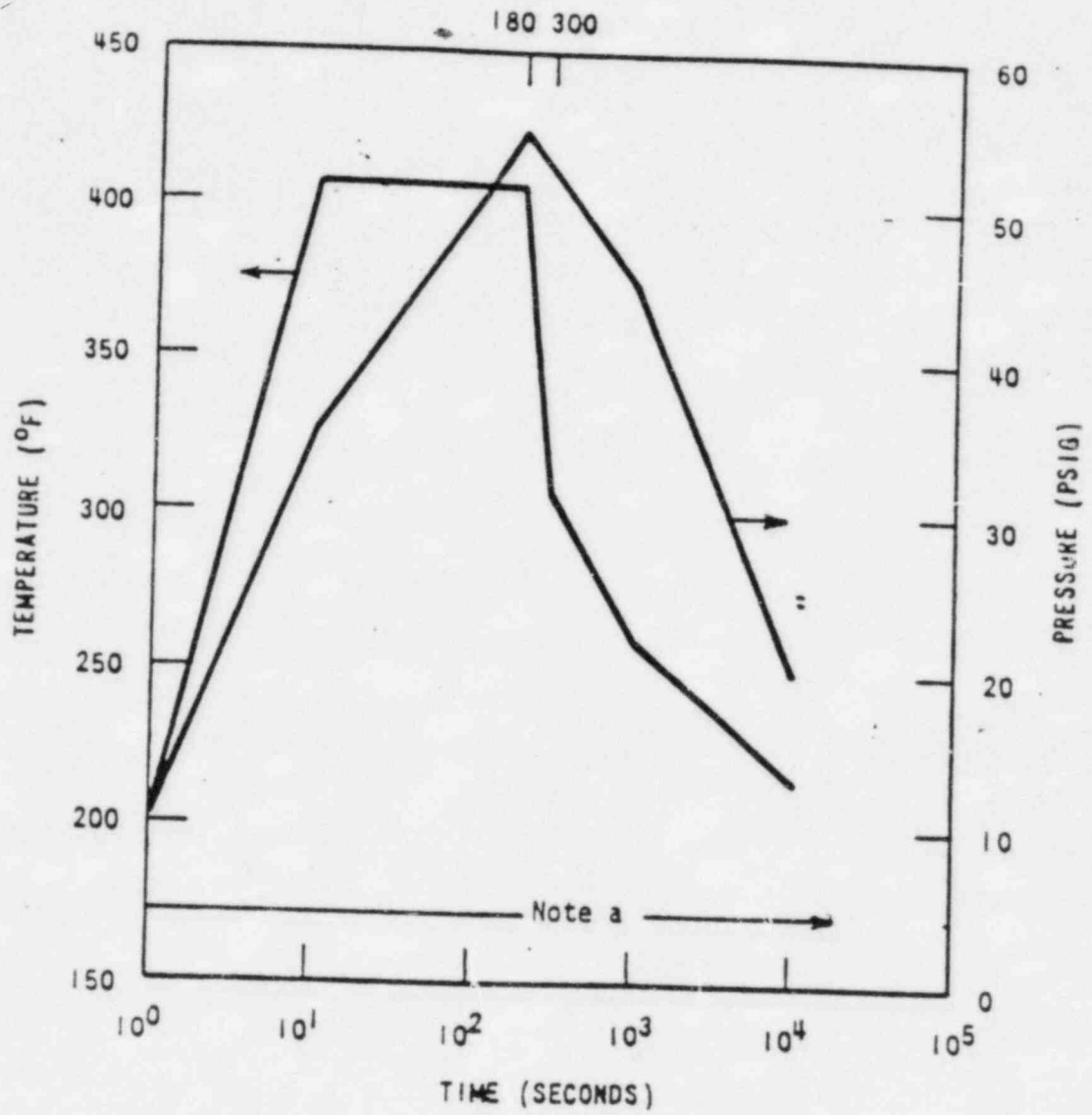
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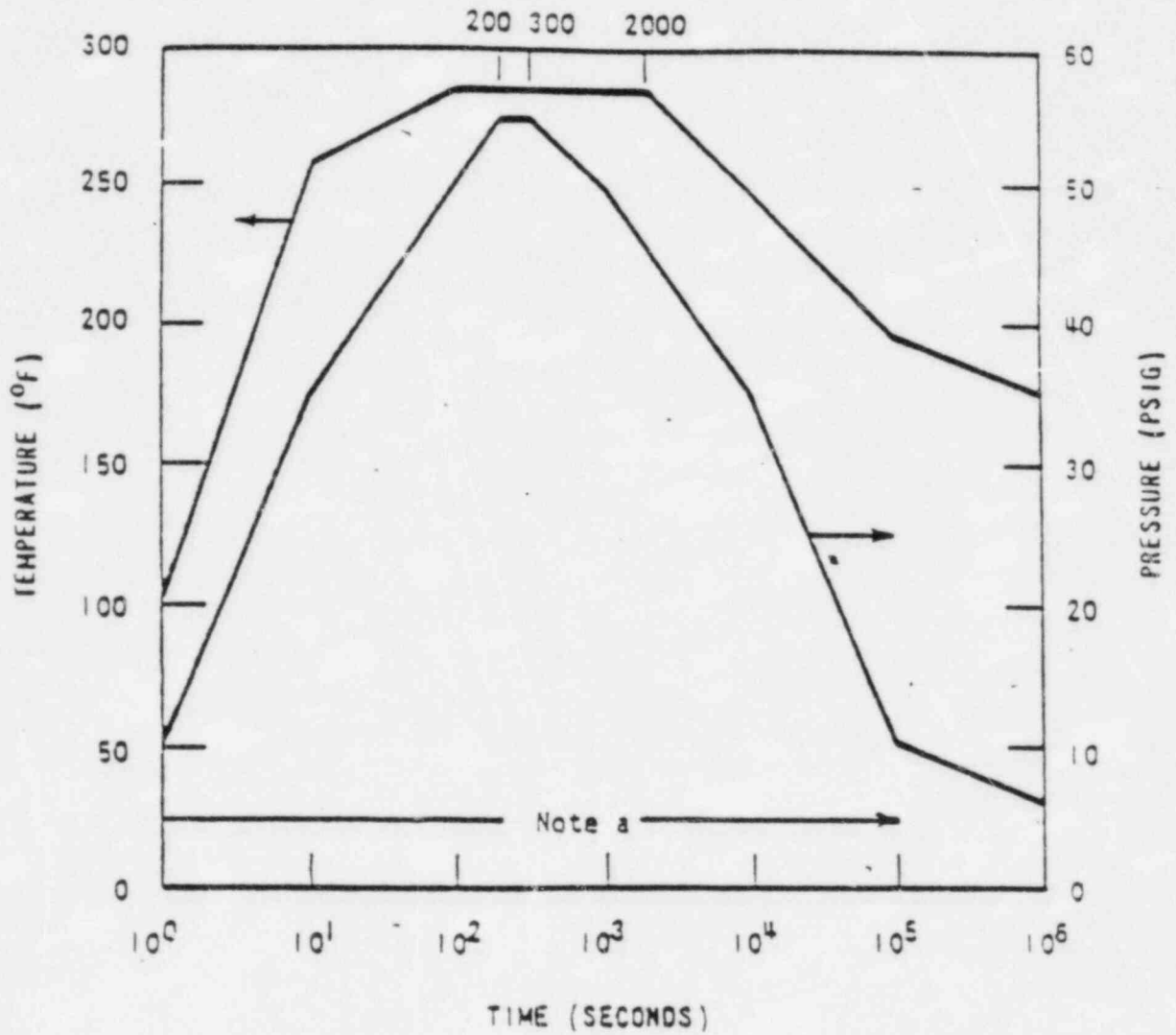
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FIGURE 1
 REQUIRED RESPONSE SPECTRA FOR SAFE SHUTDOWN EARTHQUAKE
 (SSE) DP INDICATING SWITCH SEISMIC QUALIFICATION
 ALONG EQUIPMENT PRINCIPLE AXES
 (NOTE: OPERATING BASIS EARTHQUAKE (OBE) REQUIRED RESPONSE SPECTRUM = 0.5 SSE OF INPUT B)



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

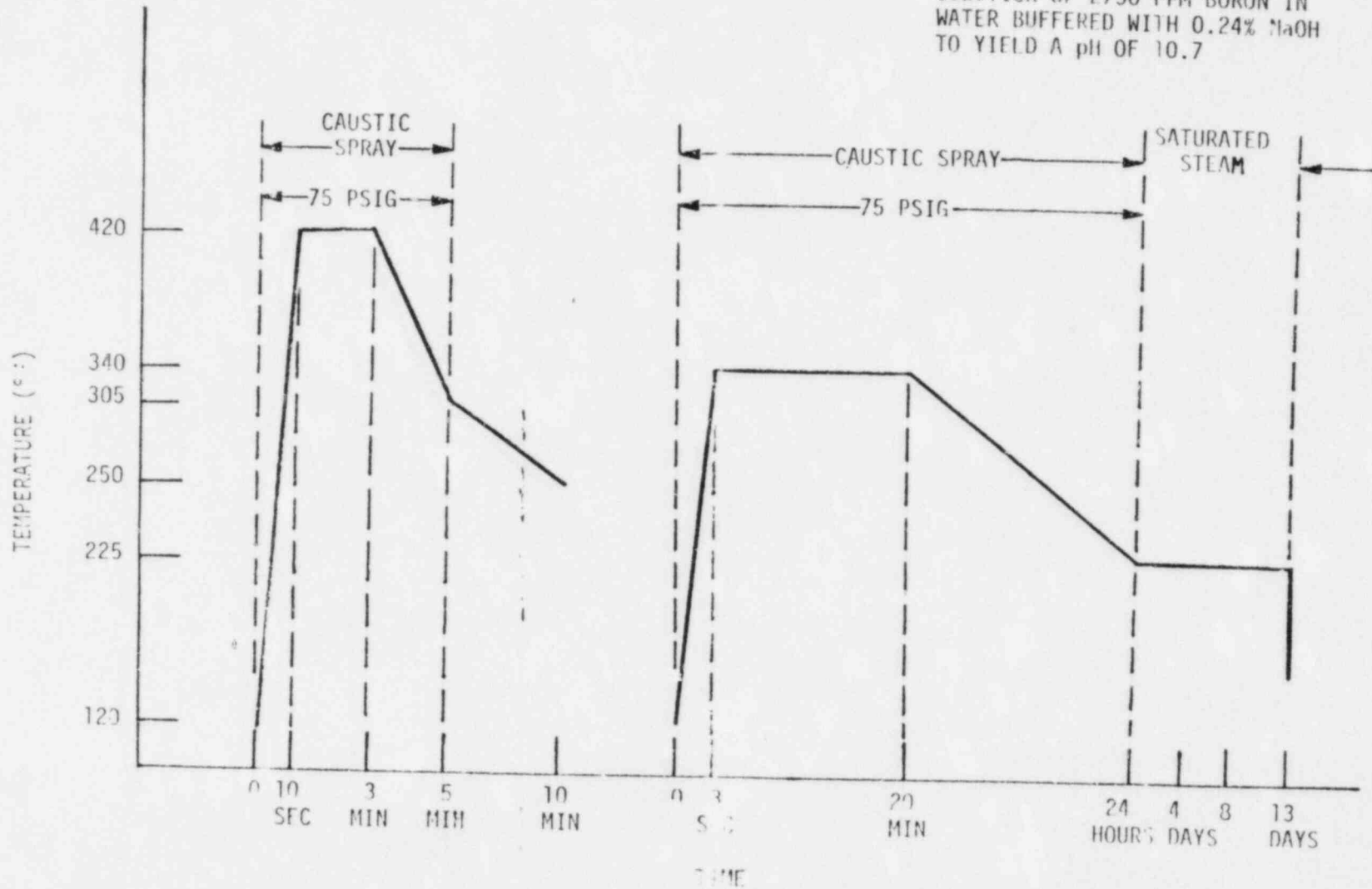


Figure 4