WCAP 8587

"Equipment Qualification Data Packages"

Supplement 1

EQDP-ESE-3A

Differential Pressure Transmitters: Qualification Group A

Revision 4

Instruction Sheet

The following instructional information and checklist is being furnished to help insert the following into WCAP-8587 Supplement 1 EQDP-ESE-3 Class 3 (Non-Proprietary). Discard the old sheet and insert the new sheets as listed below. Revised information is indicated by a bar and number 4 on the outside margin of the page.

Remove (Front/Back)	Insert (Front/Back)
Cover sheet/--	Cover sheet/--
page 2/3	page 2/3
8/9	8/9
10/11	10/11
12/13	12/13
15/--	15/--
16/--	16/--
19/--	19/--

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 Transmitters: Qualification Group A

APPROVED: _____

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SECTION 1 - SPECIFICATIONS

1.0 PERFORMANCE SPECIFICATIONS

1.1 Electrical Requirements

1.1.1 Voltage: 15 - 52 VDC ± 1V

1.1.2 Frequency: N/A

1.1.3 Load: 4 - 20 ma or 10 - 50 ma

1.1.4 Electromagnetic Interference: None

1.1.5 Other: None

1.2 Installation Requirements: Wall mounted per Westinghouse Drawing 8765D45 Revision 4

1.3 Auxiliary Devices: None

1.4 Preventative Maintenance Schedule: Per the Westinghouse Equipment Qualification test program, the maintenance required to maintain the qualified life stated in Section 1.9 is that the cover o-ring must be replaced each time the cover is removed. This does not preclude development of preventive maintenance program designed to enhance equipment performance and identify unanticipated equipment degradation as long as this program does not compromise the qualification status of the equipment. Surveillance activities may also be considered to support the basis for/and a possible extension of the qualified life. 4

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 [b]: Steam Generator Water Level (NR)

	Parameter	Normal Conditions	Abnormal Conditions	Containment Test Conditions	DBE Conditions[a] FLB	LOCA/SLB	Seismic	Post DBE Conditions[a] FLB/SLB	LOCA	Seismic
1.7.1	Time requirement	Continuous	Included under normal	Test Duration	< 5 min	Event Duration	Event Duration	4 months	4 months	Continuous
1.7.2	Performance [c] requirement [d]	± 1% 0.4 sec		No damage	± 11% 0.4 secs.	± 16% 10 secs.	± 11% 0.4 secs.	± 16% 10 secs	± 16% 10 secs	± 1% 0.4 secs

1.8 Environmental Conditions for Same Function[b]

1.8.1	Temperature (°F)	50 - 120	Included under normal	Ambient	Figure 2	Figure 2/3	Ambient	Figure 2	Figure 3	Ambient
1.8.2	Pressure (psig)	-0.1/+0.3		70	Figure 2	Figure 2/3	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	3.9×10^4, 0.4×10^5	4.1×10^7, 9×10^8	None
1.8.5	Chemicals	None		None	Figure 2	Figure 2/3	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) Reference accuracy specified. Values shown for accuracy under DBE and Post DBE conditions include ± 1% for normal conditions which is not part of the DBE induced effect.

(d) Time Response

2.7 Measured Variables

		Required	Not Required	
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	4
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	3
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,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		

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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 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 to which the differential pressure transmitters were subjected. Exceptions from adherence to the preferred test sequence and justification are provided. Sections 2.8.2 and 2.8.3, operation at normal conditions and at performance extremes are covered in production tests on all units.

High energy line break and post-HELB radiation doses are included with normal dose in testing and are not combined with temperature/humidity conditions. Because of the possibiity of radiation induced effects on the physical properties of the oil fill in the transmitters, time response tests before and after the test sequence were performed. Because any radiation induced viscosity changes in the oil would be permanent, adverse effects on time response, if any, could be detected after concluding the test sequence. As no other mechanism resulting from test conditions would be expected to affect time response, tests before and after the sequence are sufficient. 3

2.8.1 Inspection
2.8.2 Operation (including time response)

2.8.4 Mechanical Cycling/Accelerated Thermal Aging
2.8.4 Radiation - Normal 10 Year Dose
3 2.8.6 Radiation HELB/Post HELB Dose
2.8.5 Seismic Simulation/Vibration
2.8.6 Operation (Simulated High Energy Line Break Conditions)
2.8.7 Operation (Simulated Post-HELB Conditions)
2.8.2 Operation (including time response)
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 electronic differential pressure transmitters to perform their safety related functions described in EQDP 1.7 while exposed to the environments defined in EDQP Section 1.8.

2.10.2 Equipment Tested

Three ITT Barton Model 764 Differential Pressure Transmitters 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 differential pressure transmitters under normal/abnormal environment conditions is reflected by calibrations and temperature compensations performed on a production basis.

2.10.3.2 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 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 transmitter outputs were monitored and recorded.

2.10.3.3 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 (Figures 1a thru 1c) contains significant margin with respect to any single plant application referencing this program[1]. Each plant should compare to the required response spectra (RRS) 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 differential pressure transmitters were subjected to the HELB simulation profile of Figure 4. Following the 420°F temperature peak, the temperature gradually declines to 250°F and is held at saturated steam conditions for 15 days, simulating a four month period of post-HELB operation.

2.10.4 Conclusion

The qualification status of Qualification Group A Differential Pressure Transmitters 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., Phillips, R. J., Black, J. P., Rygg, D. E., "Equipment Qualification Test Report Differential Pressure Transmitters - Qualification Group A (Sesimic and Environmental Testing) WCAP-8687-Supp. 2-E03A (Proprietary).

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TABLE 1

ACTUAL QUALIFICATION TEST CONDITIONS

EQUIPMENT (1) SYSTEM/CATEGORY	LOCATION STRUCTURE/AREA	MANUFACTURER TYPE/MODEL	ABNORMAL/ACCIDENT ENVIRONMENTAL EXTREMES PARAMETER	SPECIFIED (2)	QUALIFIED	OPERABILITY REQ	OPERABILITY DEM	ACCURACY(%) REQ (3)	ACCURACY(%) DEM	QUAL LIFE(4)	QUAL METHOD	QUAL REF	QUAL PROGRAM STATUS
Pressurizer level transmitter/ PAMS/ Category a	Containment Bldg./outside missile shield	Barton 764 (5)	Temperature Pressure Rel. humidity Radiation Chemistry		420°F 57 psig 100% 5×10^7 R(γ) 9×10^8 R(β) 2500 ppm H_3BO_3 NaOH 10.7 pH	Post DBE 4 Mo.	Same	±15	Same	10 yrs.	Seq. Test	ESE-3	Completed
Steam Gen. level transmitter/ PAM's, RPS/ Category a	Containment Bldg./outside missile shield	Barton 764 (5)	Temperature Pressure Rel. humidity Radiation Chemistry		420°F 57 psig 100% 5×10^7 R(γ) 9×10^8 R(β) 2500 ppm H_3BO_3 NaOH 10.7 pH	Trip <5 min Post DBE 4 Mo.	Same	±10 (6) ±15	Same	10 yrs.	Seq. Test	ESE-3	Completed

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) The accuracies are changes in the transmitter accuracy due to severe environments. The error during normal and abnormal conditions is ±% of span. These errors do not include drift or signal processing inaccuracies.

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

(5) Serial numbers qualified are defined in the test report.

(6) For the D2 and D3 Steam Generators the required and demonstrated accuracy is +5%, -15%.

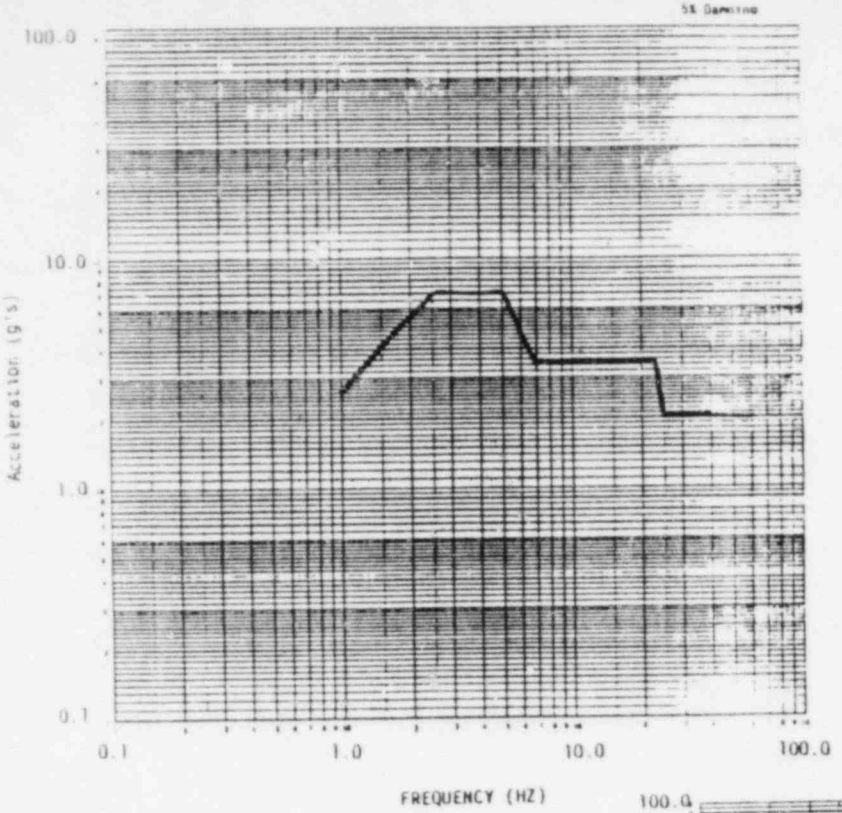


FIGURE 1A REQUIRED RESPONSE SPECTRUM FOR SAFE SHUTDOWN EARTHQUAKE (INPUT A)

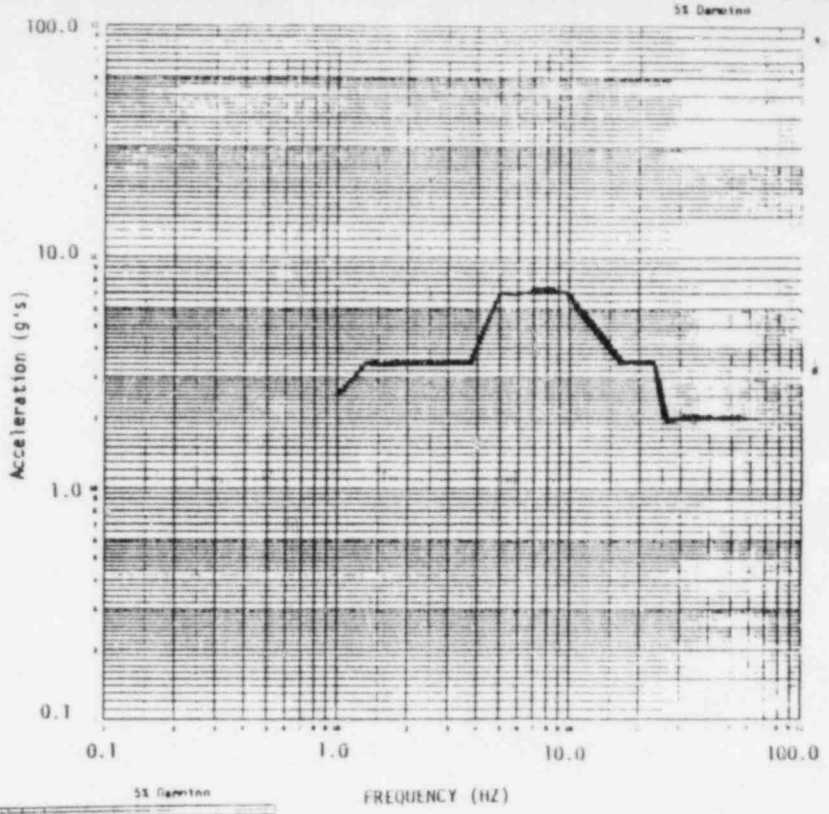


FIGURE 1B REQUIRED RESPONSE SPECTRUM FOR SAFE SHUTDOWN EARTHQUAKE (INPUT B)

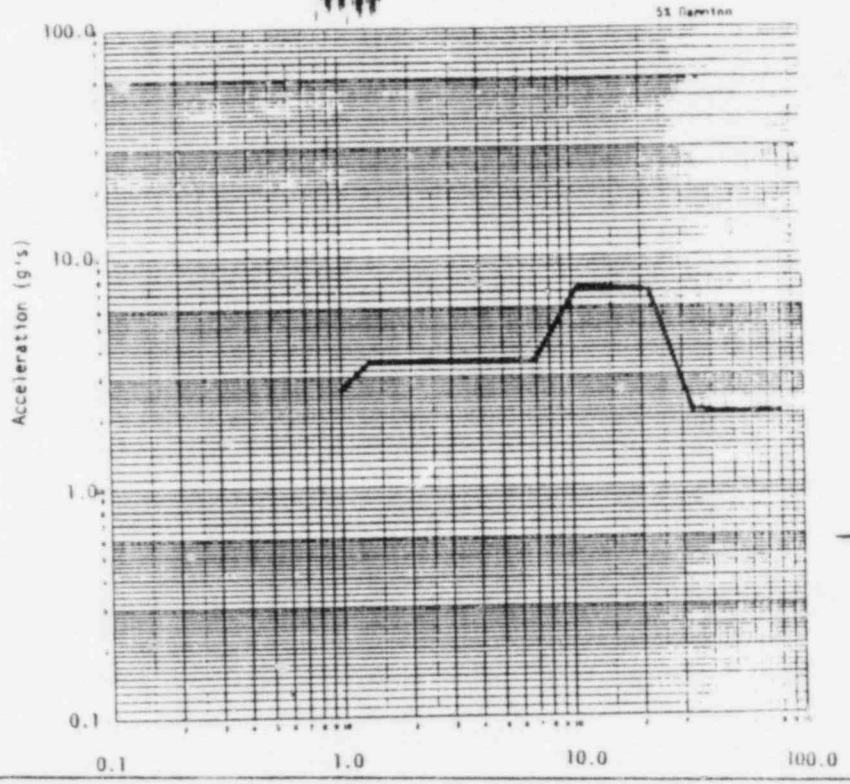
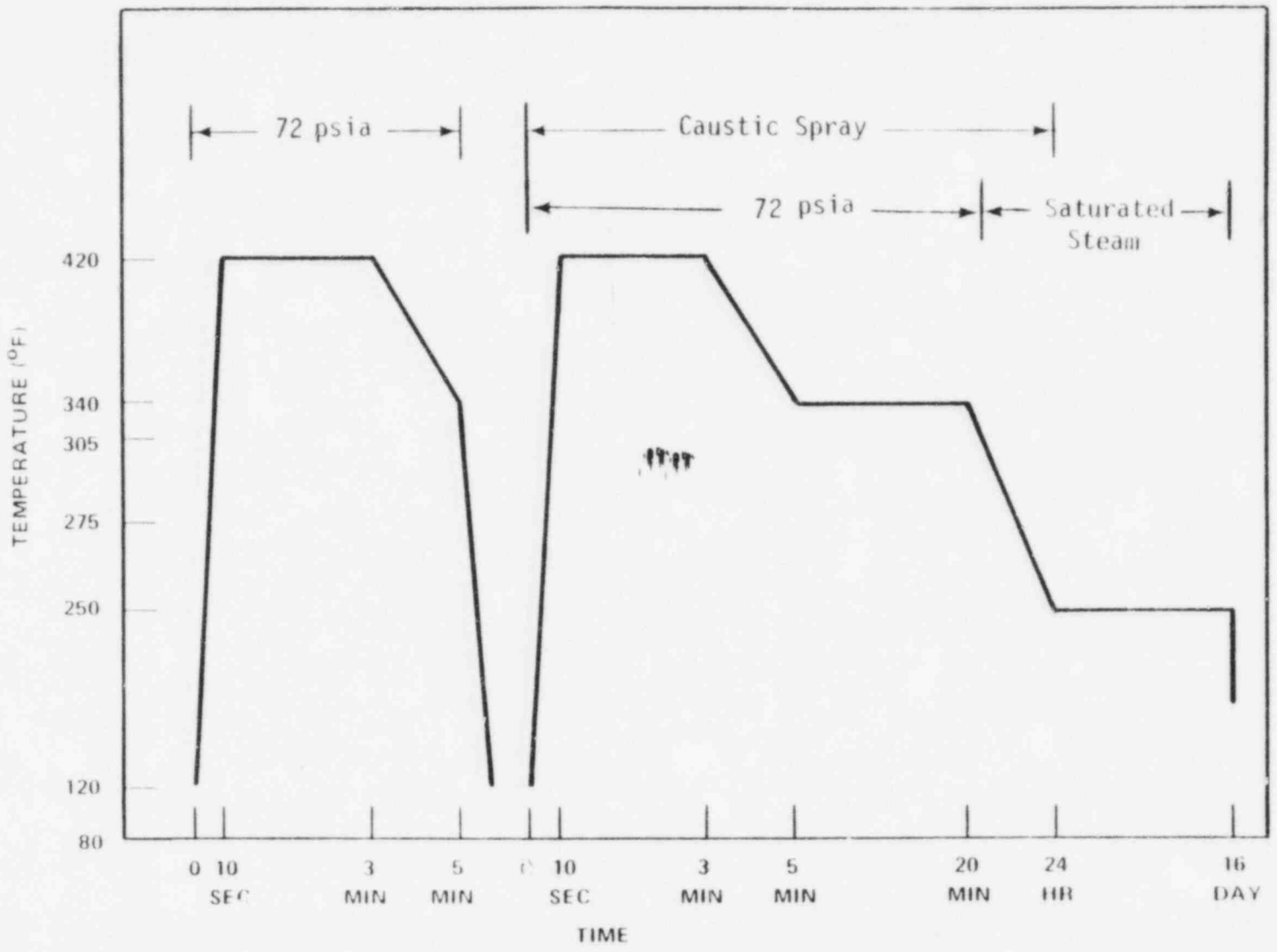


FIGURE 1C REQUIRED RESPONSE SPECTRUM FOR SAFE SHUTDOWN EARTHQUAKE (INPUT C)



*Time between temperature transients must be at least one hour or until test units return to a steady state output. Time above 340°F must be five minutes or less.

Figure 4. Test Envelope for In-Containment -HELB