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: Fast Response Well Mounted

APPROVED: _____
for T. M. Anderson, Manager
Nuclear Safety Department

WESTINGHOUSE ELECTRIC CORPORATION
NUCLEAR ENERGY SYSTEMS
P.O. BOX 355
PITTSBURGH, PENNSYLVANIA 15230

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 410 Ω at 525°F

1.2 Installation Requirements: W Drawing 1683C01

1.3 Auxiliary Devices: Thermowell, R/E or R/I Converter and the RTD requires an interface connection which will be subject to the same conditions as the RTD. The qualification of these interface connections is not an objective of this program

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]: T_C - Narrow Range

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

1.8 Environmental Conditions for Same Function[b]

1.8.1	Temperature(^{0}F)	Fluid 700 Ambient 140		Ambient		Fig. 1	Ambient			Ambient
1.8.2	Pressure (psig)	-0.1 to .3 (RTD) 3125 (well)		70		Fig. 1	0			0
1.8.3	Humidity (percent RH)	95		Ambient		100	Ambient			Ambient
1.8.4	Radiation (R)	1.4×10^8 $_\gamma$ (tip)(d) 8×10^6 $_\gamma$(cable)(d)			None	10^7 $_\gamma$(tip)[e] < 10^4 $_\gamma$(cable) < 10^5 $_\beta$(cable)	None			None
1.8.5	Chemicals	None				Fig. 1	None			None
1.8.6	Vibration	See Section 2.10				None	None			None
1.8.7	Acceleration (g)	None				None	Fig. 2			None

Notes: a: DBE is the Design Basis Event.
b: Margin is not included in the parameters of this section.
c: + 0.2°F repeatability, first order time response 5.0 seconds w/well for step change of at least 20°F with a water flow of 3 ft/sec.
d: 20 year life assumed for dose calculation's. Radioactive fluid defines normal rating dose.
e: Contained accident

1.9 Qualified Life: 20 years

1.10 Remarks: None

SECTION 2 - QUALIFICATION BY TEST

2.0 TEST PLAN

2.1 Equipment Description: RdF Fast response well mounted thermowell mounted resistance temperature detectors

2.2 Number Tested: Lot test performed on four (4) units

2.3 Mounting: Per Section 1.2

2.4 Connections: 4-wire cable to R/E converter

2.5 Aging Simulation Procedure:

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

2.6 Service Conditions to be Simulated by Test[1]

		Normal	Abnormal	Containment Test	Seismic	HELB	Post-HELB
2.6.1	Temp. (^{o}F)	Ambient	Included under normal	Covered by HELB	Ambient	Fig. 3	N/A
2.6.2	Pressure (psig)	0			0	Fig. 3	Fig. 3
2.6.3	Humidity (percent RH)	Ambient			Ambient	100	100
2.6.4	Radiation (R)	1.55×10^{8} γ(tip) 8×10^{6} γ (cable)			None	Included under normal	Included under normal
2.6.5	Chemicals	None			None	Fig. 3	Fig. 3
2.6.6	Vibration	See Section 2.10.3.2			None	None	None
2.6.7	Acceleration (g)	None			See Section 2.10.3.3	None	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	A	B,C
2.7.1.2	Pressure	A	B,C
2.7.1.3	Moisture	A	B,C
2.7.1.4	Gas Composition		A,B,C
2.7.1.5	Vibration	B	A,C
2.7.1.6	Time	A,B,C	
2.7.2	**Category II - Input Electrical Characteristics**		
2.7.2.1	Voltage		A,B,C
2.7.2.2	Current		A,B,C
2.7.2.3	Frequency		A,B,C
2.7.2.4	Power		A,B,C
2.7.2.5	Other	A,B,C	
2.7.3	**Category III - Fluid Characteristics**		
2.7.3.1	Chemical Composition		A,B,C
2.7.3.2	Flow Rate		A,B,C
2.7.3.3	Spray	A	B,C
2.7.3.4	Temperature		A,B,C
2.7.4	**Category IV - Radiological Features**		
2.7.4.1	Energy Type	C	A,B
2.7.4.2	Energy Level	C	A,B
2.7.4.3	Dose Rate	C	A,B
2.7.4.4	Integrated Dose	C	A,B

		Required	Not Required
2.7.5	Category V - Electrical Characteristics		
2.7.5.1	Insulation Resistance		A,B,C
2.7.5.2	Output Voltage		A,B,C
2.7.5.3	Output Current		A,B,C
2.7.5.4	Output Power		A,B,C
2.7.5.5	Response Time		A,B,C
2.7.5.6	Frequency Characteristics		A,B,C
2.7.5.7	Simulated Load		A,B,C
2.7.6	Category VI - Mechanical Characteristics		
2.7.6.1	Thrust		A,B,C
2.7.6.2	Torque		A,B,C
2.7.6.3	Time		A,B,C
2.7.6.4	Load Profile		A,B,C
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	

A: HELB Test
B: Seismic Test
C: Radiation Test

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 condition referred to is a static calibration check at three temperatures. This is included to more readily identify effects of the various test conditions on the test equipment. Performance under abnormal operating conditions is covered under Sections 2.8.2 and 2.8.6.

Test Sequence (from Section 2.8):

2.8.1 Inspection
2.8.2 Operation-Normal Condition (Static Calibration)
2.8.4 Thermal Aging, Thermal Cycling
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
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 fast response 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 RdF thermowell mounted fast response resistance temperature detectors 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 fast response 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

The test units were pre-conditioned to a simulated twenty 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, thermal cycling, radiation exposure to a total integrated gamma dose equivalent to a twenty-year normal dose plus the design basis accident dose and accelerated flow induced and pipe vibration simulation. Through all the pre-conditioning phases, the amplified RTD outputs were monitored to verify continuous operation.

2.10.3.3 Seismic Tests

The single design basis event capable of producing an adverse environment at the equipment location is a seismic event. The seismic testing reported in Reference 1 was completed on aged equipment employing many multi-axis, single-frequency inputs in accordance with Reg. Guide 1.100 (IEEE 344-1975). The generic required response spectrum (Figure 1) contains significant margin with respect to any single plant application referencing this program(1).

2.10.3.4 High Energy Line Break/Post HELB Simulation

The fast response RTD's were subjected to the HELB simulation temperature profile of Figure 3. 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. This post-accident aging simulation was performed but not required for this application.

2.10.4 Conclusion

The qualification status of the Fast Response Well Mounted RTD's is demonstrated by the completion of the simulated aging and design basis 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

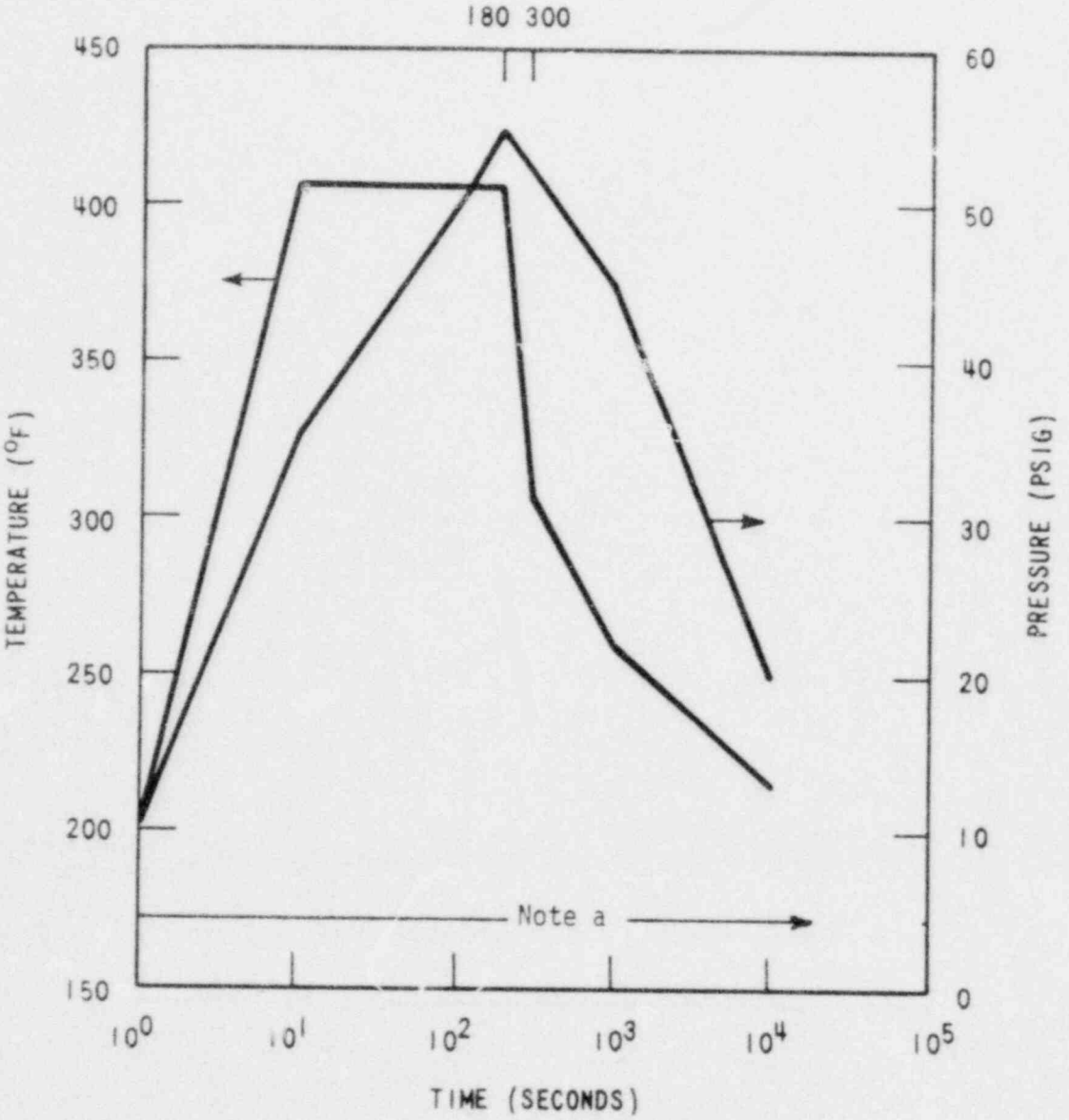
1. Skeers, D.M.,Rens, T.E., "Equipment Qualification Report, Resistance Temperature Detectors - Fast Response Well Mounted (Seismic and Environmental Testing)" WCAP-8687, Supplement 2-E07A (Proprietary), WCAP-8587, Supplement 2-E07A (Non-Pro- prietary), March, 1981.

SECTIONS 3 QUALIFICATION BY EXPERIENCE

Westinghouse does not employ operating experience or analysis in support of the qualification program for the Fast Response Well Mounted RTD's. .

SECTION 4 QUALIFICATION BY ANALYSIS

Analysis is employed for the Fast Response Well Mounted RTD's to support the use of the pressure tight metal hose as discussed in Reference 1.



Note a: Initial 24 hour containment spray solution of 2500 ppm boron with 0.24% NaOH

Figure 1. Containment Environmental Design Conditions - Main Steam Line Break and Feedline Break

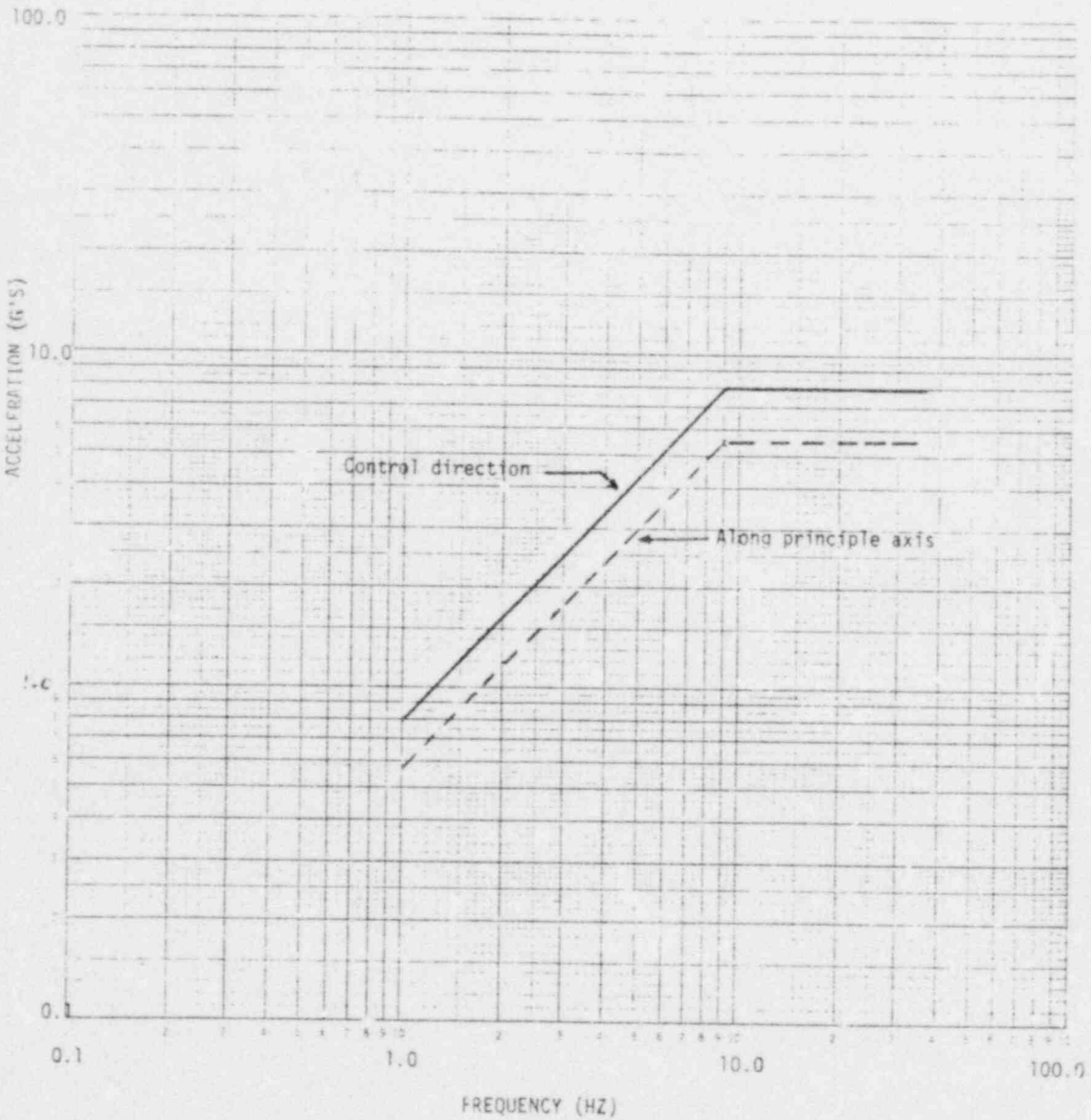


Figure 2. Simulated Seismic Conditions (SSE)

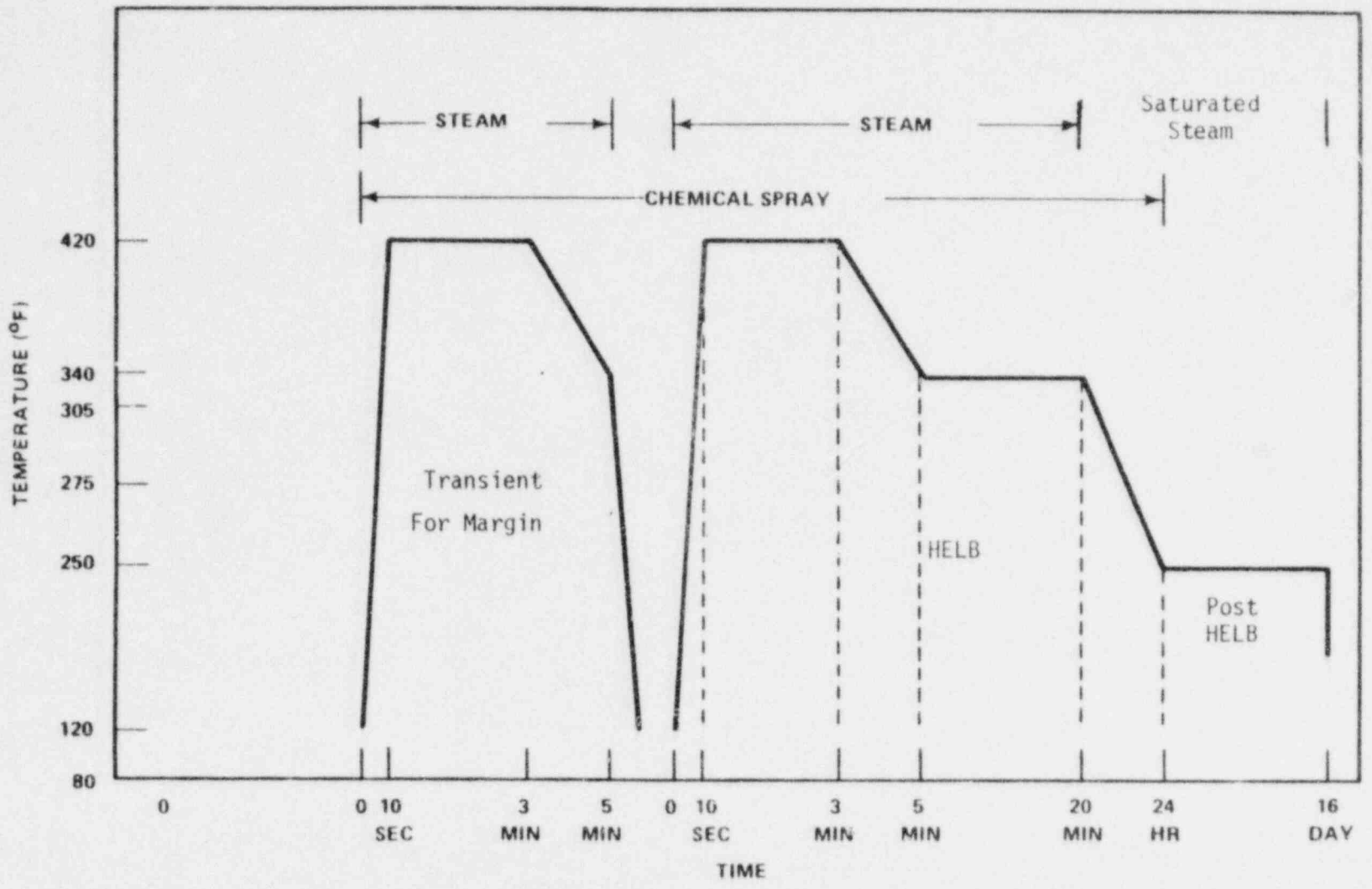


Figure 3. Test Envelope for In-Containment