

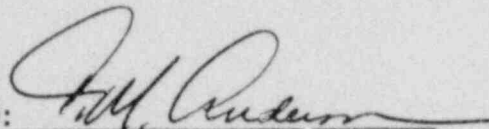
EQUIPMENT QUALIFICATION DATA PACKAGE

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.

Nuclear Instrumentation System (NIS) Console

(Power Range Channel)

APPROVED:



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SECTION 1 - SPECIFICATIONS

1.0 PERFORMANCE SPECIFICATIONS

1.1 Electrical Requirements

- 1.1.1 Voltage: 118 VAC  $\pm$  5%
- 1.1.2 Frequency: 60  $\pm$  1 Hz or 50  $\pm$  1 Hz
- 1.1.3 Load: 294 watts (single rack with four drawers)
- 1.1.4 Electromagnetic Interference:  $\pm$  0.5% (P-P) of output span in frequency range which could affect downstream modules: demonstrated per MIL-N-19900B.
- 1.1.5 Other: None

1.2 Installation Requirements: Westinghouse Drawing 6055D66 Revision C. Location in a controlled environment. C&ES Standard 2.3.

1.3 Auxiliary Devices: 2-Section and 4-Section, Power Range Neutron Detectors (EQDP-ESE-8 and 22)

1.4 Preventative Maintenance Schedule: The details of any preventative maintenance schedule, assumed in establishing the qualified life, will be specified in this section on completion of the Westinghouse Aging Evaluation program.

1.5 Design Life: 40 years - auxiliary devices (1.3) 5 years.

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

1.7 Performance Requirements for<sup>(b)</sup>: All NIS Safety Related Functions

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	12 hours	N/A	N/A	N/A	event duration	N/A	N/A	Continuous
1.7.2 Performance requirement	Note c	as normal				as normal			as normal
1.8 Environmental Conditions for Same Function <sup>(b)</sup>									
1.8.1 Temperature <sup>0</sup> F	60 - 80	Note d				ambient			ambient conditions
1.8.2 pressure (psig)	0	0				0			
1.8.3 Humidity (% RH)	30 - 50	Note d				ambient			
1.8.4 Radiation (R)	< 400	None				None			
1.8.5 Chemicals	None	None				None			
1.8.6 Vibration	None	None				None			
1.8.7 Acceleration (g)	None	None				Fig. 2			

- Notes: a: DBE is the Design Basis Event.  
 b: Margins are not included in the parameters specified in this section.  
 c: NIS power range performance requirements are specified on page 4.  
 d: Figure I, envelope 3. However, for plants having a Class IE HVAC for the area in which the NIS is located, the abnormal extremes are the same as the normal specified above.

NIS PERFORMANCE REQUIREMENTS

Power Range Channel

1. Accuracy

Bistable Setpoints	$\pm 1$ P.U.	
Analog Outputs (Isolation)	$\pm 1$ P.U.	0-120 P.U.
	$\pm 5$ P.U.	120-200 P.U.

P.U. = 1% of rated Reactor Full Power

2. Response Time

A. Level Trip

65 MSEC  $\Delta$  Input from 5% below to 5% above setpoint

B. Flux Rate

0.2 sec for  $\Delta$  Input of 20%

1.9 Qualified Life: The demonstrated qualified life will be specified in this section on completion of subprogram C of the Westinghouse Aging Evaluation Program (Appendix B to WCAP 8587).

1.10 Remarks: None

SECTION 2 - QUALIFICATION BY TEST

2.0 TEST PLAN

- 2.1 Equipment Description: Nuclear Instrumentation System Console (Power Range Channel) (See Section 2.10.2).
- 2.2 Number Tested: Type test on one (1) representative protection channel set of drawers.
- 2.3 Mounting: Westinghouse Drawing 6055D66, Revision C.
- 2.4 Connections: Power and output connections on terminal boards, detector inputs by triax connectors.
- 2.5 Aging Simulation Procedure

By a separate component test program as described by Subprogram C of Appendix B to WCAP 8587.

2.6 Service Conditions to be Simulated by Test<sup>(1)</sup>

		<u>Normal</u>	<u>Abnormal</u>	<u>Containment</u>			
				<u>Test</u>	<u>Seismic</u>	<u>HELB</u>	<u>Post-HELB</u>
2.6.1	Temp. (°F)	ambient	Fig. 3	N/A	ambient	N/A	N/A
2.6.2	Pressure (psig)	0	0		0		
2.6.3	Humidity (% RH)	ambient	Fig. 3		ambient		
2.6.4	Radiation (R)	None	None		None		
2.6.5	Chemicals	None	None		None		
2.6.6	Vibration	None	None		None		
2.6.7	Acceleration (g)	None	None		TRS>RRS		



## 2.7 Measured Variables

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

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



	<u>Required</u>	<u>Not Required</u>
2.7.5 Category V - Electrical Characteristics		
2.7.5.1 Insulation Resistance		A,B
2.7.5.2 Output Voltage*	A,B	
2.7.5.3 Output Current*		A,B
2.7.5.4 Output Power*		A,B
2.7.5.5 Response Time*	A,B	
2.7.5.6 Frequency Characteristics*		A,B
2.7.5.7 Simulated Load*		A,B
2.7.6 Category VI - Mechanical Characteristics		
2.7.6.1 Thrust		A,B
2.7.6.2 Torque		A,B
2.7.6.3 Time		A,B
2.7.6.4 Load Profile		A,B
2.7.7 Category VII - Auxiliary Equipment		
None		

\* Analog and Bistable

A: Seismic Test

B: Operational Test, Abnormal Conditions

## 2.8 Test Sequence Preferred

This section identifies the preferred test sequence as specified by 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 Seismic
- 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(s) which, in total, constitutes the overall qualification program for this equipment. The separate subsections indicate the separate test sequences completed on differing, but essentially identical, equipment and/or components. The justification for employing anything other than the preferred sequence is as follows;

The DBE is simulated by the Seismic Test Sequence of Section 2.9.1. The HELB Tests (Section 2.8.6 and 2.8.7) have been excluded since the NIS console is not exposed to the HELB environment due to its location. The Abnormal Extremes Test of Section 2.9.2 was performed on similar equipment as permitted by IEEE-323-74 Section 6.3.2(3). The aging test employs the preferred test sequence (Section 2.8 excluding HELB and Abnormal Extremes Sections 2.8.6, 2.8.7, and 2.8.3) on a representative sample of components from the Power Range Channel of the NIS Console. The Aging Tests will demonstrate that during the qualified life there are no in-service aging mechanisms capable of reducing the capability of the Power Range Channel of the NIS Console to perform during or after a seismic event. As a consequence, the seismic testing on the un-aged Power Range Channel of the NIS Console, is not prejudiced by any in-service aging mechanisms.

<u>Step</u>	<u>Notes</u>
2.9.1	Seismic Test Sequence
2.8.1	} Seismic (DBE) test sequence.
2.8.2	
2.8.5	
2.8.8	
2.9.2	Environmental Test Sequence
2.8.1	} Environmental test sequence on similar piece of equipment as permitted by IEEE 323-74 Section 6.3.2.(3).
2.8.2	
2.8.3	
2.8.8	
2.9.3	Aging Test Sequence
2.8.1	} Aging to be addressed by separate testing as described in Subprogram C of Appendix B to WCAP-8587.
2.8.2	
2.8.4	
2.8.5	
2.8.8	

## 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 Nuclear Instrumentation System Console (Power Range Channel) to complete the safety-related functions described in EQDP Section 1.7 while exposed to the applicable environments defined in EQDP Section 1.3.

## 2.10.2 Equipment Tested

### 2.10.2.1 Environmental Test reported in Reference 1

See Reference 1

### 2.10.2.2 Seismic Tests reported in references 2,3,4,5 and 6

See References 2, 4, and 6

### 2.10.2.3 Seismic Tests reported in Reference 7

See Reference 7

### 2.10.2.4 Aging Evaluation Program

A representative sample of critical components from the Nuclear Instrumentation System Console (Power Range Channel) will be included in Subprogram C of the Aging Evaluation Program described in Appendix B to WCAP 8587.

## 2.10.3 Test Summary

### 2.10.3.1 Environmental Test

Westinghouse requires that the Power Range Channel of the NIS Console be located such that it does not experience a consequent adverse environment when required to operate following a high energy line break either inside or outside containment. Therefore the only environmental testing required is to demonstrate equipment capabilities under normal and abnormal extremes.

Reference 9 summarizes the results of available radiation testing of organic and inorganic

materials and justifies that, for radiation doses less than  $10^4$  rads, no deterioration in material structural properties is detectable. As a consequence, a radiation simulation is not required on this equipment, since estimated in-service radiation doses will not prejudice the capability of the equipment to perform under design basis event (i.e. seismic event) conditions.

The environmental testing reported in Reference 1 is designed to demonstrate the capability of the Nuclear Instrumentation System (NIS) Console Power Range Channel to meet the safety-related performance requirements specified in EQDP Section 1.7 when exposed to the variations in temperature, humidity, voltage and frequency specified by Figure 3. The testing successfully demonstrated the specified safety-related requirements were met. Additional margin was, included in this test by subjecting the equipment to four extra cycles of electrical and environmental extremes. This test satisfactorily demonstrates the NIS Console Power Range Channel capability to meet its safety-related functional requirements when exposed to the specified normal and abnormal environments (EQDP Section 1.7) and the permitted range of frequency and voltage variations (EQDP Section 1.1) in accordance with IEEE 323-1974 Section 6.3.2.(2) and (3).

#### 2.10.3.2 Seismic Tests

The single design basis event capable of producing an adverse environment at the equipment location is a seismic event. The

previously completed seismic testing reported in Reference 2,3,4,5 and 6 was completed on new equipment at differing seismic levels employing single axis sine beat testing in accordance with IEEE 344-1971. This original testing, together with the demonstration testing requested by the NRC employing multi-axis multi-frequency inputs as reported in Reference 7, demonstrate the capability of the Power Range Channel of the NIS Console to perform prespecified safety-related functions during and after seismic events up to and including that defined by Figure 2 in accordance with the procedures recommended by Reg. Guide 1.100 (IEEE 344-1975). During the high seismic testing reported in Reference 7 the drawer latches failed. A modification to the NIS console employed for high seismic plants has been implemented as described in Reference 8. The generic required response spectrum (Figure 2) contains significant margin with respect to any single plant application referencing this program.<sup>(1)</sup>

#### 2.10.3.3 Aging Evaluation

Subprogram C of the Westinghouse Aging Evaluation Program (Appendix B, WCAP 8587) will incorporate a representative sample of components from the Power Range Channel of the NIS Console. This program is currently in progress and will be reported in WCAP-8587 Supplement 2, Appendix A (Non-Proprietary), WCAP-8687 Supplement 2, Appendix A (Proprietary). The objective of Subprogram C is to demonstrate that during the qualified life there are no in-service aging mechanisms capable of reducing



the capability of the Power Range Channel of the NIS Console to perform during or after a seismic event. As a consequence, the seismic testing on the un-aged Power Range Channel of the NIS Console described above, is not prejudiced by any in-service aging mechanisms.

#### 2.10.4 Conclusion

The demonstrated qualified life of the Power Range Channel of the NIS Console will be established by Subprogram C of the Westinghouse Aging Evaluation Program. The results of the aging program, together with the seismic and environmental testing described herein, demonstrate the qualification of the Power Range Channel of the NIS Console employing the practices recommended by Reg. Guide 1.89 and 1.100.

#### 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. Vogeding, E. L., "Equipment Qualification Test Report Nuclear Instrumentation System (Normal and Abnormal Temperature and Humidity Testing)" WCAP 8687 Supplement 2 E10A (Proprietary) WCAP 8587 Supplement 2 E10A (Non-Proprietary) May 1980.
2. Vogeding, E. L., "Seismic Testing of Electrical and Control Equipment" WCAP-7397-L (Proprietary), January 1970, WCAP-7817 (Non-Proprietary), December 1971.
3. Potochnik, L. M., "Seismic Testing of Electrical and Control Equipment (Low Seismic Plants)" WCAP-7817 Supplement 2 (Non-Proprietary) December 1971.
4. Potochnik, L. M., "Seismic Testing of Electrical and Control Equipment (High Seismic Plants)" WCAP-7536-L (Proprietary) November 1970 WCAP-7821 (Non-Proprietary) December 1971.
5. Potochnik, L. M., "Seismic Testing of Electrical and Control Equipment (High Seismic Plants)" WCAP-7821 Supplement 2 (Non-Proprietary) December 1971.
6. Potochnik, L. M., "Seismic Testing of Electrical and Control Equipment (PG&E Plants)" WCAP-8021 (Non-Proprietary) May 1973.
7. Coslow, B. J., T. R. Croasdaile, J. B. Lipchak, S. J. Jarecki, "Seismic Operability Demonstration Testing of the Nuclear Instrumentation System Bistable Amplifier" WCAP-8830 (Proprietary) WCAP-8831 (Non-Proprietary) October, 1976.
8. Letter from Eichelinger to Stolz dated November 22, 1977 NS-CE-1609.
9. Damerow, F. W., "Effects of Gamma Radiation Doses Below  $10^4$  Rads on the Mechanical Properties of Materials" WCAP-9741 (Non-Proprietary), (Currently in Progress).

SECTION 3 AND 4 QUALIFICATION BY EXPERIENCE AND/OR ANALYSIS

Westinghouse does not employ operating experience in support of the qualification program for the Nuclear Instrumentation System (Power Range). Analysis is employed to extrapolate the seismic tests on a single cabinet to the configuration of the four-bay cabinet assembly employed for the NIS (Ref. 7). Analysis is further employed to assure that the drawer modifications reported in (Ref. 8) are adequate.

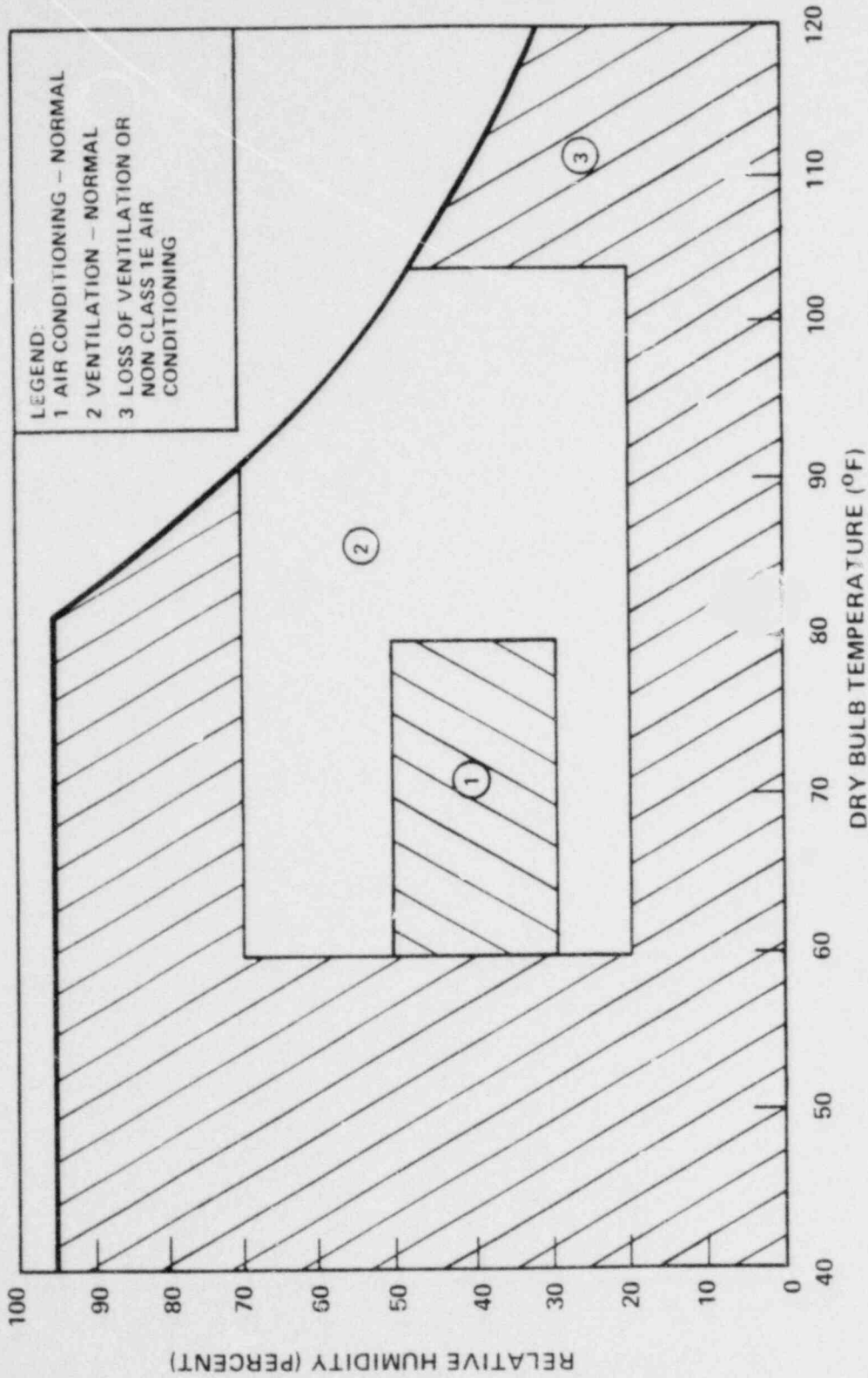
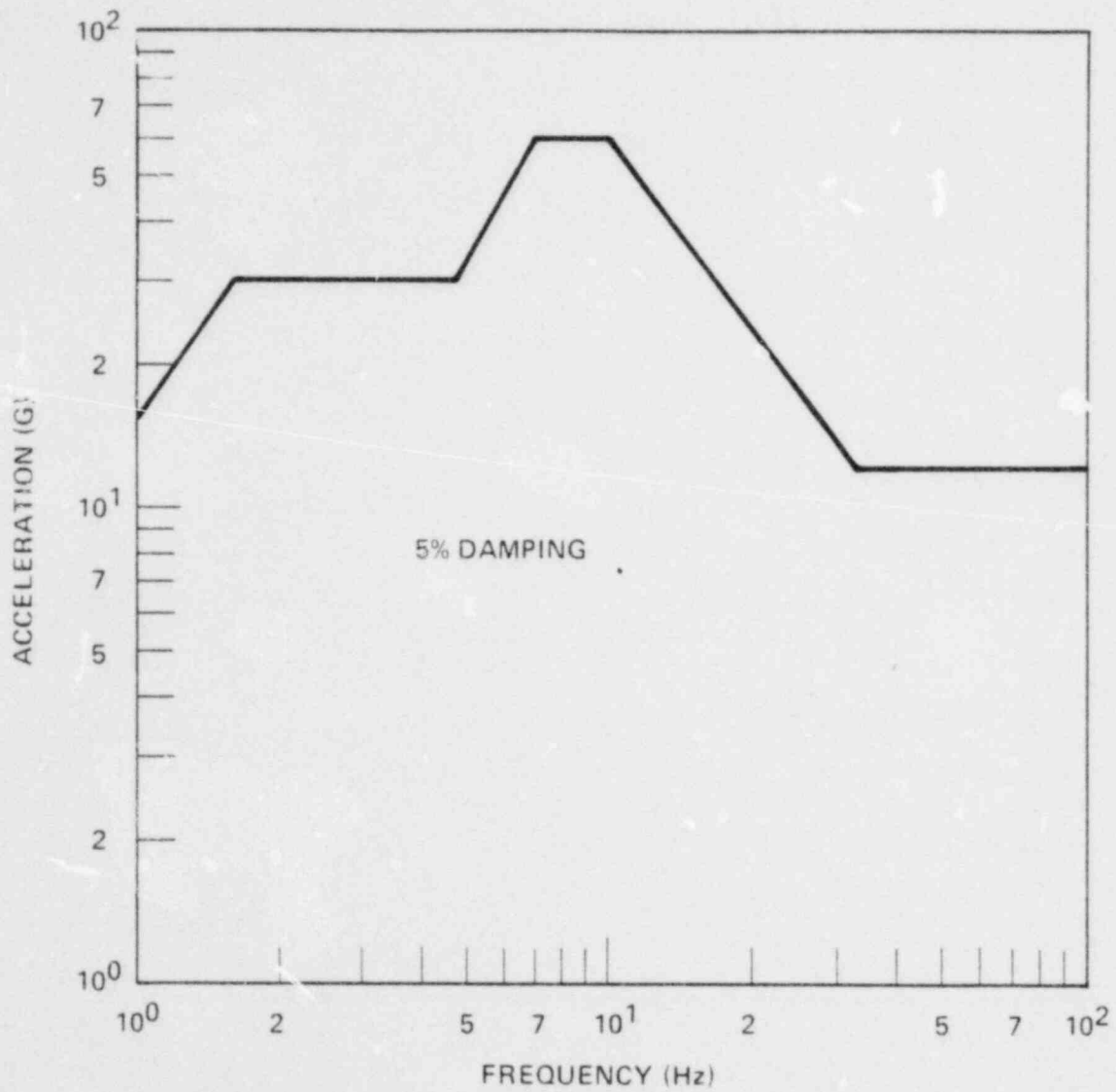


Figure 1 Temperature Versus Humidity - Enclosed Environments Outside Containment



(NOTE: OBE REQUIRED RESPONSE SPECTRUM = 0.5 SSE RRS)

Figure 2 Required Response Spectrum (RRS) for Safe Shutdown Earthquake (SSE)

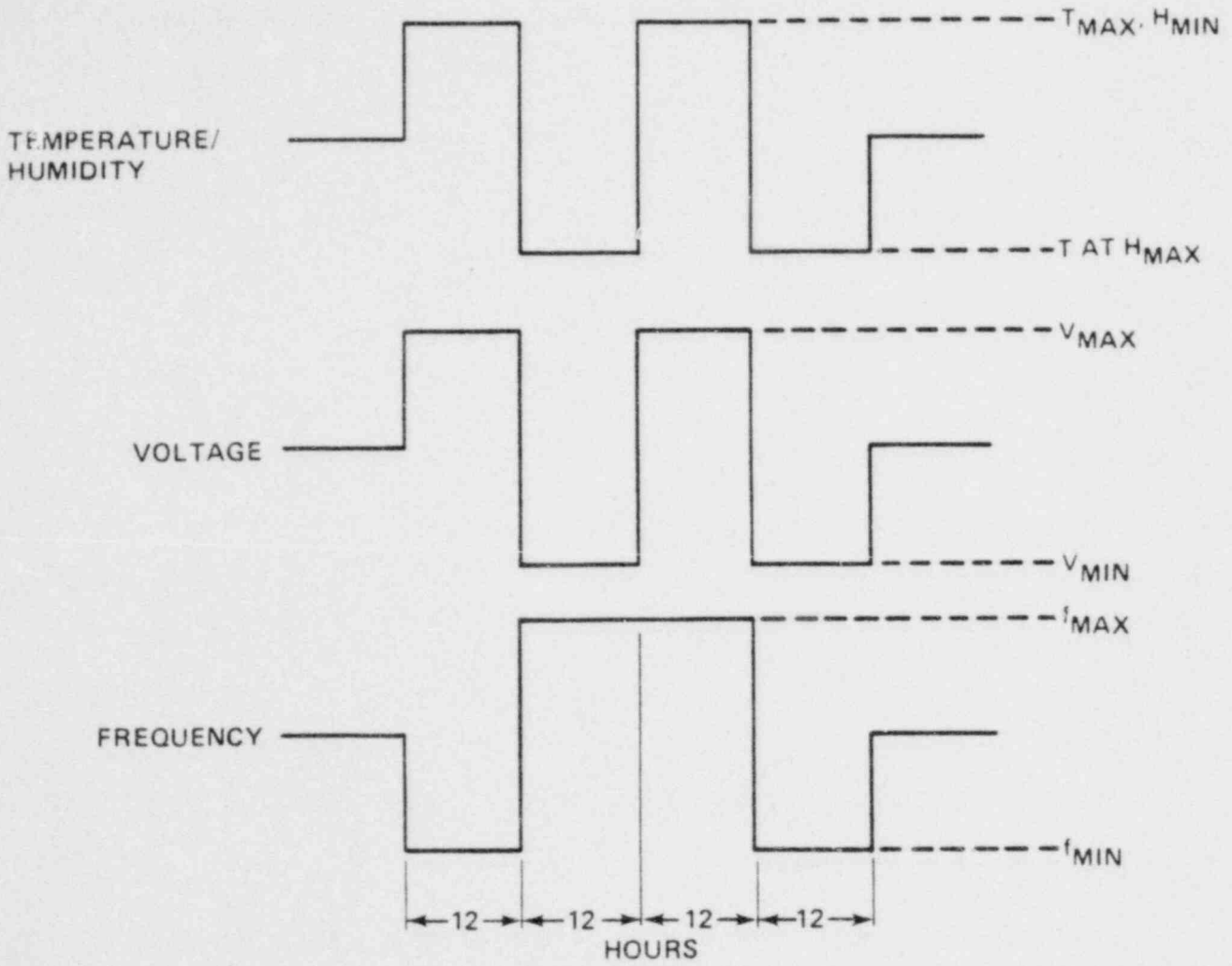


Figure 3 Verification Test Profile