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 ± 5%

1.1.2 Frequency: 60 ± 1 Hz or 50 ± 1 Hz

1.1.3 Load: 294 watts (single rack with four drawers)

1.1.4 Electromagnetic Interference: None

1.1.5 Other: The electrical requirements are described in detail in WCAP-8255. 3

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: As a result of the completion of the Westinghouse Aging Evaluation Program (Phase 1, Short Term Aging) described in WCAP-8587 and discussed in WCAP-8687-Supplement 2, Appendix A1 (Component Aging) Reference 10 and Appendix A2 (Materials Aging) Reference 11 (Proprietary), no maintenance beyond that defined in the equipment instruction manual is required to support the qualified life defined in Section 1.9. 3

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

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1.7 Performance Requirements for[b]: Reactor Trip

	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	12 hours	N/A	N/A	N/A	event duration	N/A	N/A	Continuous
1.7.2	Performance requirement	Note c	as normal				Note c			Note c

1.8 Environmental Conditions for Same Function[b]

1.8.1	Temperature ^{0}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 1, envelope 3. However, since based on Westinghouse experience, operation at low humidity is not an equipment operating concern, the abnormal extreme for humidity shall be 95 percent RH. Also, for plants having a Class 1E HVAC for the area in which the NIS is located, the abnormal extremes are the same as the normal specified above.

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NIS PERFORMANCE REQUIREMENTS

Power Range Channel

1. Accuracy

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

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

2. Response Time

   A. Level Trip
   65 MSEC Δ Input from 5% below to 5% above setpoint

   B. Flux Rate
   0.2 sec for Δ Input of 20%

1.9 Qualified Life: The currently demonstrated qualified life (Phase 1 Short Term Aging) is 5 years based on the actual test conditions identified in Table 1. Westinghouse is planning an extension (Phase II Long Term Aging) of Subprogram C of the Aging Evaluation Program (Appendix B to WCAP-8587) to increase the demonstrated qualified life. 3

1.10 Remarks: None

SECTION 2 - QUALIFICATION BY TEST

2.0 TEST PLAN

The environmental qualification of the Power Range Channel of the Nuclear Instrumentaton System was performed at the Westinghouse Nuclear Instrumentations and Control Department Environmental Facility located at Hunt Valley, Maryland. 3

2.1 Equipment Description: Nuclear Instrumentation System Console (Power Range Channel) (See Section 2.10.2).

The two units that were tested are manufactured to the same baseline, thus the units are not different in any way that would affect the test. 3

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 and reported in Reference 10. 3

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	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).

		Required	Not Required
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

			Required	Not Required
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
3	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 individual subsections indicate the separate test sequences completed on the equipment and/or components. The justification for employing anything other than the preferred sequence is as follows; 3

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). An exact definition of the equipment tested is provided in Section 2.0 of Reference 1. 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 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. 3

Step	Notes
2.9.1 Seismic Test Sequence	
2.8.1	
2.8.2	Seismic (DBE) test sequence.
2.8.5	
2.8.8	
2.9.2 Environmental Test Sequence	
2.8.1	Environmental test sequence on similar piece of
2.8.2	equipment as permitted by IEEE 323-74 Section
2.8.3	6.3.2.(3). The two units that were tested are manufactured to the same baseline, thus the units are not different in any way that would affect the test.
3	
2.8.8	
2.9.3 Aging Test Sequence	
2.8.1	Aging is addressed by separate testing as
2.8.2	described in Subprogram C of Appendix B to
2.8.4	WCAP-8587 amd reported om References 10 and 11
3	
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 1.8.

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) has been included in Subprogram C of the Aging Evaluation Program described in Appendix B to WCAP 8587 in Reference 11. 3

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 testing required is to demonstrate equipment capabilities under normal and abnormal service conditions (temperature, humidity and A.C. Power voltage and frequency). 3

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. The seismic testing which has been performed and demonstrates the transition from IEEE-344-71 testing to IEEE-344-75 requirements is reported in Reference 12. The two units that were tested are manufactured to the same baseline, thus the units are not different in any way that would affect the test. 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.(1)

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2.10.3.3 Aging Evaluation

Subprogram C of the Westinghouse Aging Evaluation Program (Appendix B, WCAP 8587) has

incorporated a representative sample of components from the Power Range Channel of the NIS Console. This program is completed and reported in WCAP-8687 Supplement 2, Appendix A1 (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.

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2.10.4 Conclusion

The currently demonstrated qualified life of the Power Range Channel of the NIS Console is 5 years. Westinghouse is planning an extension of Subprogram C of the Aging Evaluation Program to increase the qualified life. 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.

3

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). | 3

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 (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 (Non-Proprietary) December 1971.

6. Potochnik, L. M., "Seismic Testing of Electrical and Control Equip- ment (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 Eicheldinger to Stolz dated November 22, 1977 NS-CE-1609.

9. Damerow, F. W., "Effects of Gamma Radiation Doses Below 104 Rads on the Mechanical Properties of Materials" WCAP-8587, Appendix C, (Non-Proprietary). | 3

10. Jabs, R., Parello, J., Huang, J., Yalich, M., "Equipment Qualification Test Report Short Term Component Aging Test Program," WCAP-8687, Supplement 2, Appendix A1 (Proprietary).

11. "Equipment Qualification Tet Report Materials Aging Analysis", WCAP-8687, Supplement 2, Appendix A2 (Proprietary).

12. Chang, S. M., "Seismic Evaluation of the Single Frequency Sine-Beat Test Inputs Employed During 1971 Qualification Testing," ST-STA-218 (Proprietary) 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 (Reference 7). Analysis is further employed to assure that the drawer modifications reported in (Reference 8) are adequate.

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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	ACCURACY(%) DEM	QUAL LIFE	QUAL METHOD	QUAL REF	QUAL PROGRAM STATUS
NIS console/ RPS/ Category d	Control building/ MCR	W NICD 4-Bay Console	Temperature		$120^{0}F$	12 hr.	Two	±1	≤+1	5	Seq.	ESE-10	Completed
			Pressure		Atmos.	cycles	12 hr.	PU	PU	yrs. (3)	Test		
			Rel. humidity		92%		cycles						
			Radiation		$10^{4}R(\gamma)$								
			Chemistry		None								

Notes: 1) For definition of the category letters, 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) Phase I of the Westinghouse Aging Evaluation Program as described in WCAP-8587 Appendix B has established a qualified life of at least 5 years for this equipment, Phase II of this program will extend the qualification life to a maximum of 20 years or as far as is achievable.

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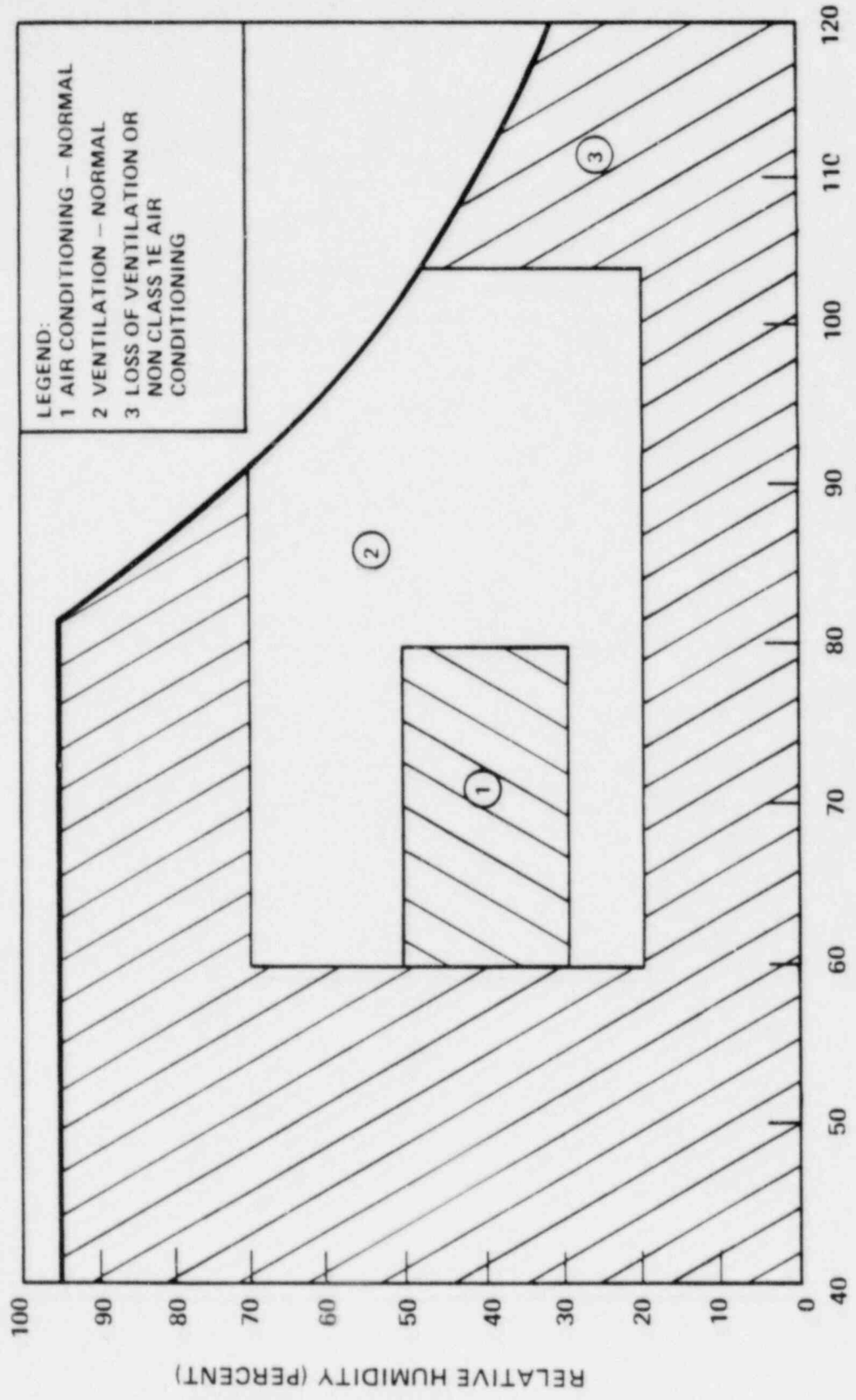
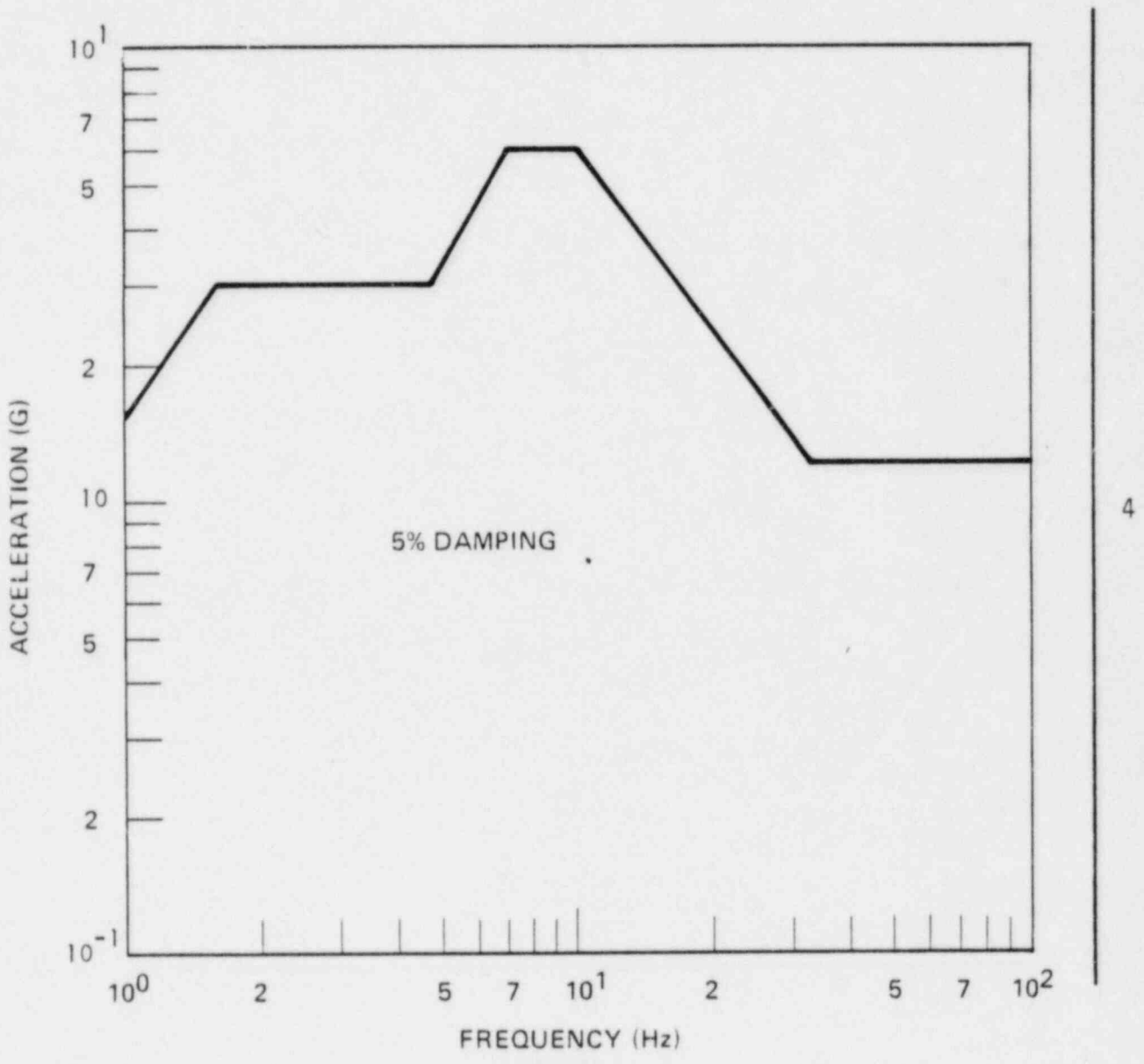


Figure 1 Temperature Versus Humidity - Enclosed Environments Outside Containment



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

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

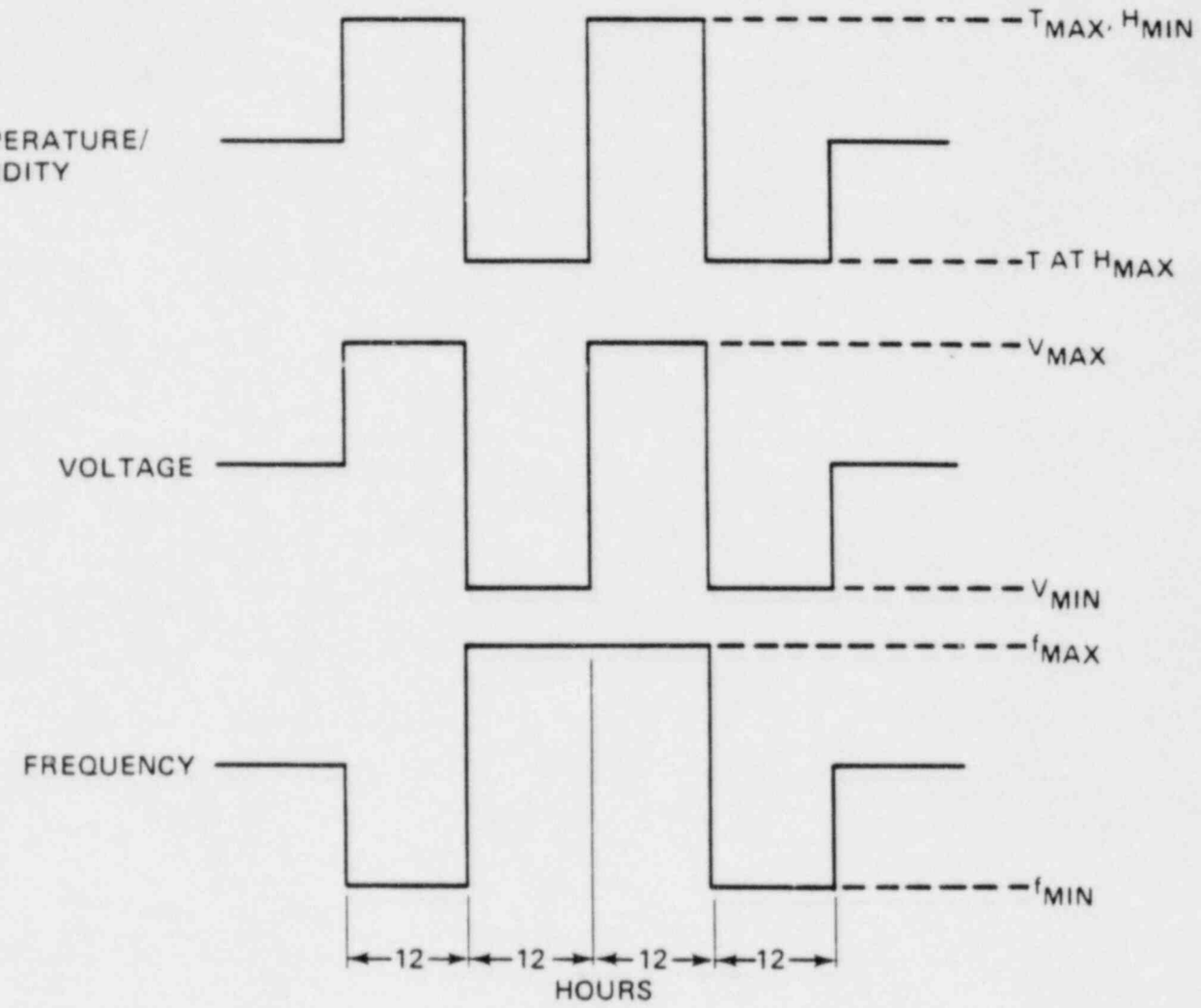


Figure 3 Verification Test Profile