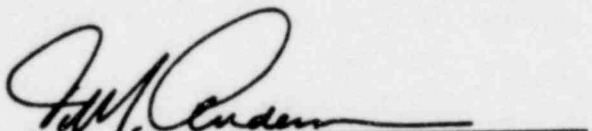
EQUIPMENT QUALIFICATION DATA PACKAGE

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.

Solid State Protection System (SSPS) Two Train & Safeguard Test Cabinet (Three and Four Bay)

APPROVED: 

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PART 1 - SPECIFICATIONS

1.0 PERFORMANCE SPECIFICATIONS

1.1 Electrical Requirements

1.1.1 Voltage: 120 VAC ±10% Single Phase, 105 - 140 VDC

1.1.2 Frequency: 60 or 50 Hz ± 5%

1.1.3 Load: Steady state - 10 amp; In Rush - 35 amp

1.1.4 Electromagnetic Interference: ±0.5% (P-P) of output span in frequency range which could affect down stream modules: demonstrated per MIL - N 19900B-1960 Sec. 4.6.11

1.1.5 Other: AC Power from Instrument Bus Inverter

1.2 Installation Requirements: Westinghouse Drawing 7245D75 Revision 10

1.3 Auxiliary Devices: None

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

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

1.7 Performance Requirements for Function[b]:

	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 d	As normal				As normal			As normal

1.8 Environmental conditions for Same Function[b]

1.8.1	Temperature (^{o}F)	60 - 80	Note c				Ambient			Ambient
1.8.2	Pressure (psig)	0	0				0			0
1.8.3	Humidity (% RH)	30 - 50	Note c				Ambient			Ambient
1.8.4	Radiation (R)	< 400	None				None			None
1.8.5	Chemicals	None	None				None			None
1.8.6	Vibration	None	None				None			None
1.8.7	Acceleration(g)	None	None				See Sec. 2.10.3.2			

Notes: a. DBE is the Design Basis Event.

b. Margin is not included in the parameters of this section.

c. Figure 1, envelope 3 with an upper limit of 88% RH. However, for plants having a Class 1E HVAC for the area in which the SSPS is located, the abormal extremes are the same as the normal specified above.

d. Initiate reactor trip or safeguards actuation on demand.

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

PART 2 - QUALIFICATION BY TEST

2.0 TEST PLAN

2.1 Equipment Description: Three Bay configuration of the Two Train Solid State Protection System, and Safeguards Test Cabinet (see Section 2.10.2)

The Three Bay configuration is made up of component parts, sub-assemblies, power supplies and printed circuit boards which are identical to those employed in the Four Bay configuration, in so far as part number, function and circuit configuration. Since the Four Bay configuration can be shown to have almost identical response characteristics to the Three Bay configuration (EQDP-Part 4), the Three Bay tests automatically qualify the Four Bay configuration.

2.2 Number Tested: Type test on one (1) representative train

2.3 Mounting: Westinghouse Drawing 7245D75 Revision 10

2.4 Connections: Terminal blocks (Power & Output); connector (input)

2.5 Aging Simulation Procedure:

As described in Subprogram C of Appendix B to WCAP-8587

		Normal	Abnormal	Cont. Test	Seismic	HELB	Post-HELB
2.6.1	Temp. (^{O}F)	Ambient	Figure 2	N/A	Ambient	N/A	N/A
2.6.2	Pressure (psig)	0	0		0		
2.6.3	Humidity (% RH)	Ambient	Figure 2		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		See 2.10.3		

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	B	A
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
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		

A: Seismic Test

B: Operational Test, Abnormal Conditions

2.8 Test Sequence Preferred

This section identifies the preferred test sequences 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 Disassembly and Inspection

2.9 Test Sequence Actual

This section identifies the actual test sequence(s) which, in total, consitutes 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;

2.9.1 Three Bay SSPS Actual Test Sequence

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 SSPS is not exposed to the HELB environment due to its location. The abnormal extremes test of Section 2.9.1.2 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 SSPS. The aging tests will demonstrate that during the qualified life there are no in-service aging mechanisms capable of reducing the capability of the SSPS to perform during or after a seismic event. As a consequence, the seismic testing on the un-aged SSPS is not prejudiced by any in-service aging mechanisms.

Step	Notes
2.9.1.1 Seismic Test Sequence	
2.8.1	Seismic (DBE) test sequence
2.8.2	(Three Bay SSPS only)
2.8.5	
2.8.8	
2.9.1.2 Environmental Test Sequence	
2.8.1	Environmental test sequence
2.8.2	on similar piece of equipment
2.8.3	as permitted by IEEE-323
2.8.8	1974 Section 6.3.2(3)
2.9.1.3 Aging Test Sequence	
2.8.1	Aging to be addressed by separate testing
2.8.2	as described in Subprogram C of Appendix B
2.8.4	to WCAP-8587
2.8.5	
2.8.8	

2.9.2 Safeguards Test Cabinet Actual Test Sequence

The DBE is simulated by the Environmental and Seismic Test Sequence of Section 2.9.2.2. The HELB Tests (Sections 2.8.6 and 2.8.7) have been excluded since the Safeguards Test Cabinet is not exposed to the HELB environment due to its location. The aging test employs the preferred sequence test (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 Safeguards Test Cabinet. The aging tests will demonstrate that during the qualified life there are no in-service aging mechanisms capable of reducing the capability of the Safeguards

Test Cabinet to perform during or after a seismic event. As a consequence, the seismic testing on the unaged Safeguards Test Cabinet is not prejudiced by any in-service aging mechanisms.

2.9.2.1 Production Test Sequence

2.8.1
2.8.2 System test performed on
2.8.8 all production units

2.9.2.2 Environmental and Seismic Test Sequence

2.8.1
2.8.3 Abnormal environment and seismic
2.8.5 simulation
2.8.8

2.9.2.3 Aging Test Sequence

2.8.1
2.8.2 Aging to be addressed by separate
2.8.4 testing as described in Subprogram C
2.8.5 of Appendix B to WCAP-8587
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 Three Bay Two Train Solid State Protection System and Safeguards Test Cabinet to complete the

safety related functions described in EQDP Section 1.7 while exposed to the applicable environment defined in EQDP Section 1.8.

2.10.2 Equipment Tested

2.10.2.1 Three Bay SSPS

2.10.2.1.1 Three Bay SSPS Seismic Tests are reported in References 3, 4, 5, 6, 7, 11 and 12.

2.10.2.1.2 Environmental Test reported in Reference 1.

2.10.2.1.3 Aging Evaluation Program

A representative sample of critical components from the SSPS will be included in Subprogram C of the Aging Evaluation Program described in Appendix B to WCAP 8587.

2.10.2.2 Safeguards Test Cabinet

2.10.2.2.1 Seismic Tests are reported in Reference 2.

2.10.2.2.2 Environmental Tests are reported in Reference 1.

2.10.2.2.3 Aging Evaluation Program

A representative sample of critical components from the Safeguards Test Cabinet 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 SSPS

2.10.3.1.1 Seismic Tests (Three Bay SSPS only)

Westinghouse requires that the Three Bay Two Train Solid State Protection System 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. 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 3, 4, 5, 6, and 7 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 requested by the NRC employing multi-axis multi-frequency inputs as reported in References 8, 9, and 10, demonstrate the capability of the Three

Bay SSPS to perform its prespecified safety-related functions, during and after seismic events up to and including those required for plants in areas of high seismic activity, (Reference 7) in accordance with Reg. Guide 1.100 (IEEE- 344-1975). The generic seismic test levels contain significant margin with respect to any single plant application referencing this program.(1)

2.10.3.1.2 Environmental Test

Westinghouse requires that the SSPS 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 13 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 was designed to demonstrate the capability of the (Two Train) SSPS and Safeguards Test Cabinet 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 EQDP Figure 2. The test successfully demonstrated the specified safety related requirements. However, the specified maximum humidity of 95% was not maintained. During the high temperature test a humidity of 88% RH was maintained, which justifies equipment acceptability up to and including 88% RH.

Additional margin was included in this test by submitting the equipment to a double cycle of electrical and environmental extremes as described by EQDP Figure 2. This test is considered to satisfactorily demonstrate the SSPS capability to meet its safety-related functional requirements when exposed to

specified normal and simulated abnormal environments (EQDP Section 1.7) and permitted range of frequency and voltage variations (EQDP Section 1.1) in accordance with IEEE-323-1974 Section 6.3.2.(2) and (3).

2.10.3.1.3 Aging Evaluation

Subprogram (of the Westinghouse Aging Evaluation Program (Appendix B, WCAP-8587) will incorporate a representative sample of components from the Solid State Protection System. 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 SSPS to perform it's safety-related function during or after a seismic event. As a consequence, the seismic testing on the full Solid State Protection System described above, is not prejudiced by any in-service aging mechanism.

2.10.3.2 Safeguards Test Cabinet

2.10.3.2.1 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 2 was completed on new equipment employing multi-axis multi-frequency inputs in accordance with Reg. Guide 1.100 (IEEE-344-1975). The generic required response spectrum (Figure 3) contains significant margin with respect to any single plant application referencing this program.(1)

2.10.3.2.2 Environmental Test

Westinghouse requires that the Safeguards Test Cabinet 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 capability under normal and abnormal environmental extremes.

Reference 13 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 Safeguards Test Cabinet 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 2. The testing successfully demonstrated the specified safety related requirements. Additional margin, was, furthermore, included in this test by submitting the equipment to a double cycle of electrical and environmental extremes as described by Figure 2. This test is considered to satisfactorily demonstrate the Safeguards Test Cabinets capability to meet its safety-related functional requirements when exposed to the specified 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).

2.10.3.2.3 Aging Evaluation

Subprogram C of the Westinghouse Aging Evaluation Program (Appendix B, WCAP-8587) will incorporate a representative sample of components from the Safeguards Test Cabinet. 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 Safeguards Test Cabinet to perform during or after a seismic event. As a consequence the seismic testing on the full Safeguards Test Cabinet described above, is not prejudiced by an in-service aging mechanism.

2.10.4 Conclusion

The demonstrated qualified life of the SSPS and Safeguards Test Cabinet will be established by Subprogram C of the Westinghouse Aging Evaluation Program. The results of the aging program, the seismic and environmental testing described herein, together with the seismic analysis of Section 4, demonstrate: the qualification of the Three Bay and Four Bay SSPS and Safeguards Test Cabinet employing the practices recommended by Reg. Guide 1.89 and 1.100.

2.11 Section 2 Notes

(1) The generic tests proposed 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. Potochnik, L. M., "Environmental Qualification of the Two Train Solid State Protection System" WCAP-8587, Supplement 2 ESE-16A (Proprietary) WCAP-8587, Supplement 3 ESE-16A (Non-Proprietary), May 1980.

2. Tang, D., E. L. Vogeding, "Equipment Qualification Seismic Test Report, Three Train Solid State Protection System", WCAP-8687 Supp 2-E17 (Proprietary); WCAP-8587-Supp 2-E17A (Non- Proprietary), (Currently in Progress)

3. Potochnik, L. M., "Seismic Testing of Electrical and Control Equipment (Low Seismic Plants)" WCAP-7817, Supplement 2 (Non-Proprietary), December 1971.

4. Vogeding, E. L., "Seismic Testing of Electrical and Control Equipment (Westinghouse Solid State Protection System (Low Seismic Plants)" WCAP-7817 Supplement 3, (Non-Proprietary), December 1971.

5. Potochnik, L. M., "Seismic Testing of Electrical and Control Equipment (High Seismic Plants)" WCAP-7821, Supplement 1 (Non-Proprietary), December 1971.

6. Potochnik, L. M., "Seismic Testing of Electrical and Control Equipment (High Seismic Plants)" WCAP-7821, Supplement 2 (Non-Proprietary), December 1971.

7. Potochnik, L. M., "Seismic Testing of Electrical and Control Equipment (PG&E Plants)" WCAP-8021 (Non-Proprietary), May 1973.

8. Jarecki, S. J., Vogeding, E. L., "Multi-Frequency and Direction Seismic Testing of Relays WCAP 8673 (Proprietary) WCAP-8674 (Non-Proprietary), December 1975.

9. Jarecki, S. J., Vogeding, E. L., "Seismic Qualification of the Rotary Relay for Use in the Solid State Protection System" WCAP-8694 (Proprietary) WCAP-8655 (Non-Proprietary), January 1976.

10. Fischer, E. G., S. J. Jarecki, "Qualification of Westinghouse Seismic Testing Procedure for Electrical Equipment Tested Prior to May 1974", WCAP 8373 (Non-Proprietary), August 1974.

11. Vogeding, E. L., "Seismic Testing of Electrical and Control Equipment," WCAP-7397-L (Proprietary), January 1970, WCAP-7817 (Non-Proprietary), December 1971.

12. 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.

13. Damerow, F. W., "Effects of Gamma Radiation Doses Below 10^4 Rads on the Mechanical Properties of Materials," WCAP-8587 Appendix C (Non-Proprietary).

PART 3 - QUALIFICATION BY EXPERIENCE

Westinghouse does not employ operating experience in support of the Qualification Program for the Two Train SSPS and Safeguards Test Cabinet.

PART 4 - QUALIFICATION BY ANALYSIS

4.0 COMBINED ANALYSIS AND TEST FOR QUALIFICATION OF THE FOUR BAY SOLID STATE PROTECTION SYSTEM (SSPS)

4.1 Environmental Qualification and Aging

The component parts, sub-assemblies, power supplies and printed circuit boards of the Four Bay configuration of the Two Train Solid State Protection System are identical to those used for the Three Bay configuration of the system. Thus, the environmental testing, and the aging program tests and results referenced in the main body of this EQDP for the Three Bay configuration are equally applicable to the Four Bay configuration.

4.2 Seismic Qualification

A finite element analysis was performed using the Westinghouse WECAN computer code which shows that the in-equipment (device) response spectra envelopes for the Four Bay SSPS are comparable to those for the Three Bay Configuration (see Section 2 for discussion of tests) and the effects of the overturning moments of the Four Bay SSPS are enveloped by those of the Three Bay SSPS. This analysis reported in Reference 1 along with the testing of the Three Bay SSPS discussed in Section 2 demonstrate: the qualification of the Four Bay SSPS employing the practices recommended by Reg. Guide 1.100.

4.3 References

1. Tang, D., Chang, S. M., E. L. Vogeding, "Equipment Qualification Combined Analysis and Test Report Four-Bay Cabinet fo the Expanded Two-Train Solid State Protection System (SSPS) (Seismic Design Verification Analysis and Design)" WCAP-8687 Supp. 2 E16B (Proprietary) WCAP-8587 Supp. 2 E16B (Non-Proprietary), January 1981.

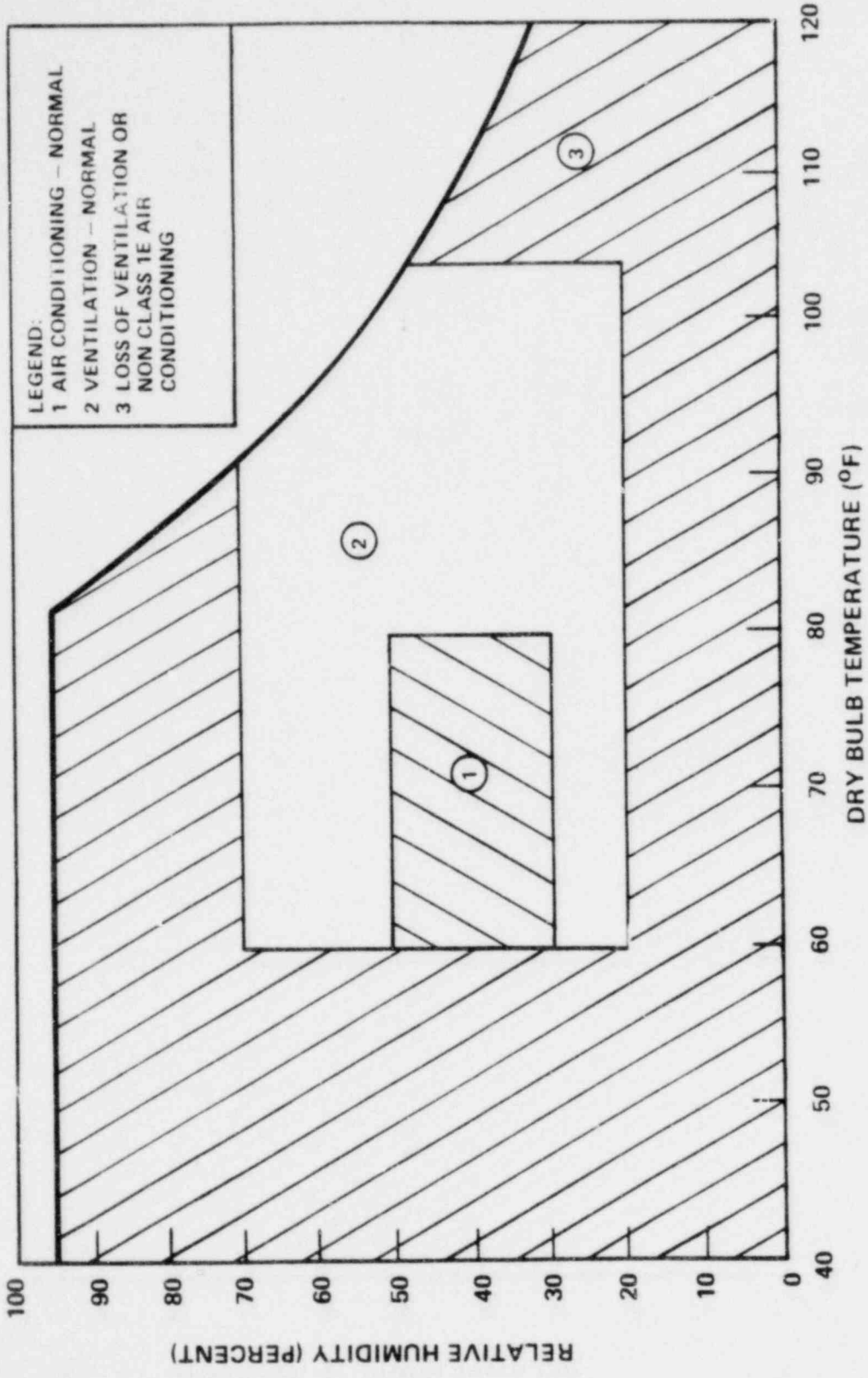

Figure 1 Temperature Versus Humidity - Enclosed Environments Outside Containment

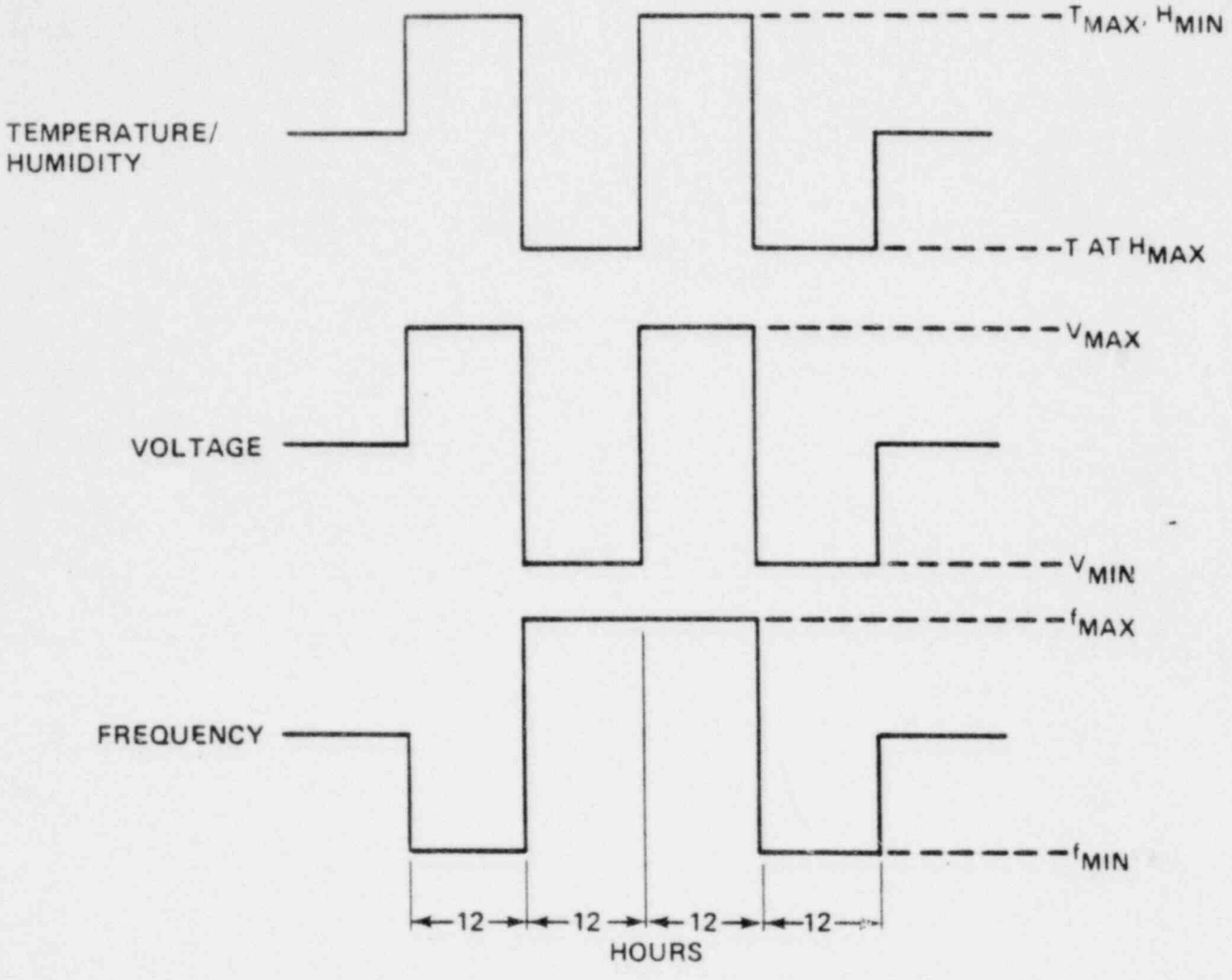

Figure 2 Verification Test Profile

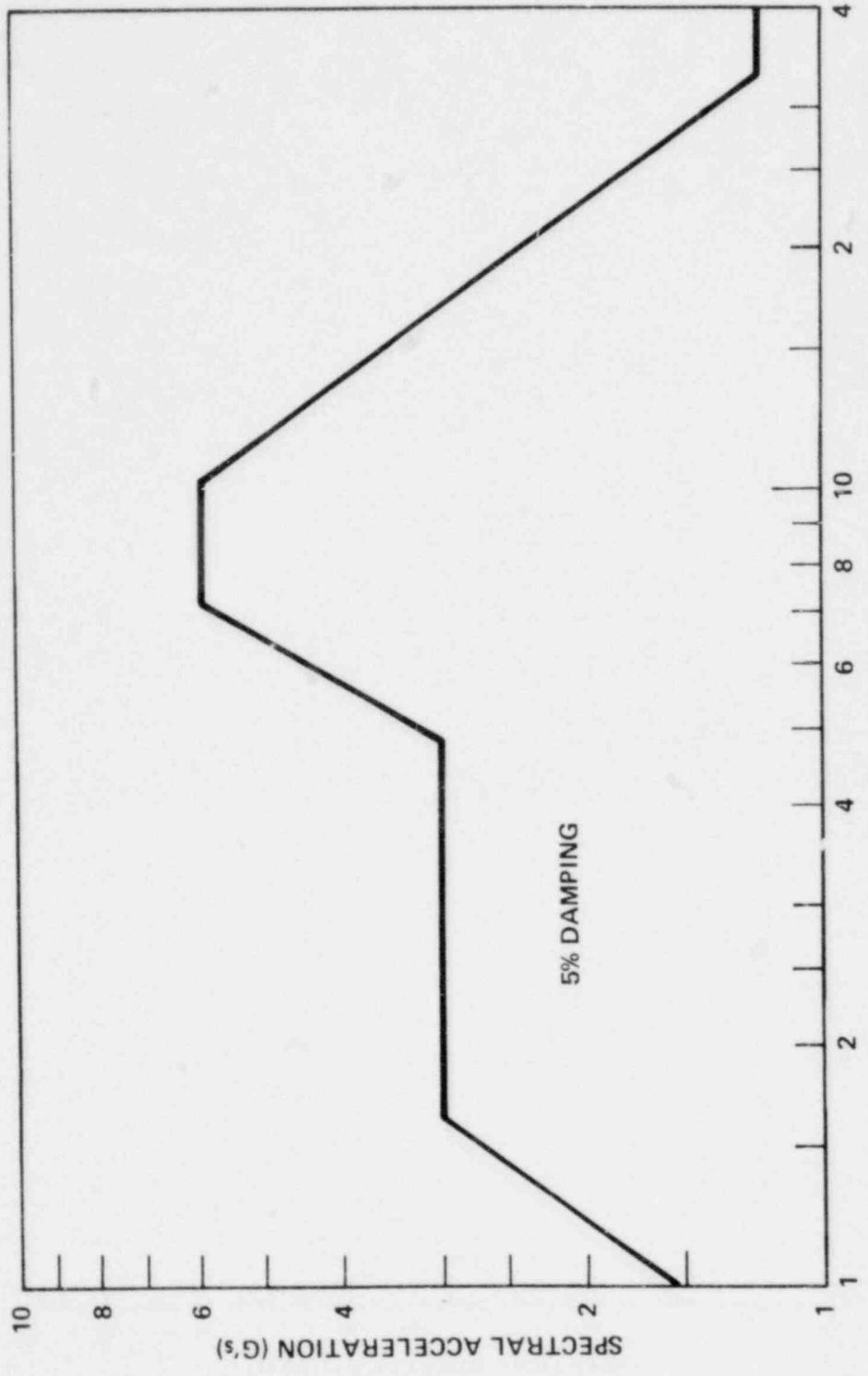

Figure 3 Refined Response Spectrum for Safe Shutdown Earthquake