WESTINGHOUSE CLASS 3

4

EQDP-ESE-18
Rev. 4 2/82

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.

Instrument Bus Power Supply (Static Inverter)

APPROVED: _____

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SECTION 1 - SPECIFICATIONS

1.0 PERFORMANCE SPECIFICATIONS

1.1 Electrical Requirements

1.1.1 Voltage: 125 VDC Nom (105-140 VDC); 460 VAC (420-500 VAC) 30.

1.1.2 Frequency: 60 Hz ± 1 Hz.

1.1.3 Load: 7.5 KVA Max.

1.1.4 Electromagnetic Interference: N/A.

1.1.5 Other: The electrical requirements are described in detail in E-Spec G676573 Revision 5. 3

1.2 Installation Requirements: W Dwg 7241D97 Revision 4,

1.3 Auxiliary Devices: None.

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 11 and Appendix A2 (Materials Aging) Reference 12 Proprietary, no maintenance beyond that defined in the equipment instruction manual is required to suppor the qualified life defined in Section 1.9. 3

1.5 Design Life: 40 year.

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

1.7 Performance Requirements for [b]; All Safety Related Functions

	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	Event duration	Event duration	Event duration	Continuous	Continuous	Continuous
1.7.2	Performance requirement	Note c	As normal		As normal	As normal	As normal	As normal	As normal	As normal

1.8 Environmental Conditions for Same Function[b]

1.8.1	Temperature (^{o}F)	60 - 104	Note d		Ambient Conditions	Ambient Conditions	Ambient	Ambient Conditions	Ambient Conditions	Ambient Conditions
1.8.2	pressure (psig)	0	0				0			
1.8.3	Humidity (% RH)	20 - 70	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				See Section 2.10.3.2			

Notes: a: DBE is the Design Basis Event.
b: Margin is not included in the parameters of this section.
c: Output 118 VAC +2%, 60 Hz + 1.0 Hz, 5% Harmonic Distortion to 2/3 full rated load. Full load power factor 0.8.
d: Figure 1, Envelope 3. However, for plants having Class 1E HVAC for the area in which the inverters are located, the abnormal extremes are the same as the normal specified above.

1.9 Qualified Life: The currently demonstrated qualified life (Phase I, 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 Static Inverter was performed at Westinghouse Power Electric and Drive Systems (PEDS), Buffalo, N.Y., which is also the manufacturer of the equipment.

3 2.1 Equipment Description: 7.5 KVA Instrument Bus Inverter (see Section 2.10.2). Th two units that were tested are manufactured to the same baseline, 3017D68 Revision 8; thus the units are not different in anyway that would affect the test. Model number used during environmental testing was S030K22D3-1, and during seismic testing was S030K1812.

2.2 Number Tested: Type Test on one (1) unit

2.3 Mounting: see Section 1.2

2.4 Connections: 460 VAC, 60 Hz, 3ϕ; 125 VDC; 118 VAC, 60 Hz, 1ϕ.

3 2.5 Aging Simulation Procedure: By a separate component test program as described in Subprogram C of Appendix B to WCAP-8587 and reported in Reference 11.

2.6 Service Conditions to be Simulated by Test(1)

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

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	B	A
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

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 IV - 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, Normal and Abnormal Conditions

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 Seismic
2.8.6 Operation (Simulated High Energy Line Break Conditions)
2.8.7 Operation (Simulated Post HELB Conditions)
2.8.8 Inspection

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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 Static Inverters are not exposed to the HELB environment due to their 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 Static Inverter. The aging tests demonstrate that during the qualified life there are no in-service aging mechanisms capable of reducing the capability of the Static Inverter to perform during or after a seismic event. As a consequence, the seismic testing on the un-aged Static Inverter is not prejudiced by any in-service aging mechanisms.

Step		Notes
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
	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).

Step	Notes
2.9.3 Aging Test Sequence	
2.8.1 2.8.2	A_g' is addressed by separate testing as described in Subprogram C of Appendix B to WCAP-8587 and reported in References 11 and 12. 3
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 Static Inverter 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 for a description of the equipment.

2.10.2.2 Seismic Tests Reported in References 2,3,4,5,6,7, and 8

See Reference 2 and 5 for a description of the equipment.

2.10.2.3 Seismic Tests Reported in Reference 9

See page 4-5 of Reference 9 for a discription of the equipment.

2.10.2.4 Aging Evaluation Program

3 A representative sample of critical components from the Static Inverter is included in Subprogram C of the Aging Evaluation Program described in Appendix B to WCAP 8587 and reported in Reference 11.

2.10.3 Test Summary

3 Voltage, frequency, harmonic distortion and power tests were performed before, during and after the seismic and environmental testing to confirm that the equipment had not degraded substantially as the result of the test. These tests confirmed satisfactory operation.

2.10.3.1 Environmental Test

Westinghouse requires that the Static Inverters be located such that they do 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 capability under normal and abnormal service conditions (temperature, humidity and AC power voltage and frequency).

Reference 10 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 Static Inverter 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 3. 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 environ- mental extremes as described by EQDP Figure 3. This test is considered to satisfactorily demonstrate the Static Inverter 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 2,3,4,5,6,7 and 8 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 Reference 9, demonstrate the capability of the Static Inverter to perform prespecified safety-related functions during and after seismic events up to and including those required for plants in areas of high seismic activity (Ref. 5,6,7,8) in accordance with the procedures recommended by Reg. Guide 1.100 (IEEE 344-1975). The seismic testing which has been performed and demonstrates the transition from

4

4 IEEE-344-71 testing to IEEE-344-75 requirements is reported in Reference 13. The generic seismic test level contains significant margin with respect to any single plant application referencing this program.(1)

2.10.3.3 Aging Evaluation

3 Subprogram C of the Westinghouse Aging Evaluation Program (Appendix B, WCAP 8587) has incorporated a representative sample of components from the Static Inverter. 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 Static Inverter to perform during or after a seismic event. As a consequence, the seismic testing on the Static Inverter described above, is not prejudiced by any in-service aging mechanism.

2.10.4 Conclusion

3 The currently demonstrated qualified life of the Static Inverter is 5 years. Westinghouse is planning an extension of Subprogram C of the Westinghouse Aging Evaluation Program to increase the demonstrated qualified life. The results of the aging program, together with the seismic and environmental testing described herein, demonstrate the qualification of the Static Inverter employing the practises recommended by Reg. Guide 1.89 and 1.100.

2.11 Part 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. Yalich, M., "Equipment Qualification Test Report Instrument Bus Power Supply (Static Inverter) (Normal and Abnormal Temperature and Humidity Testing)" WCAP-8687 Supplement 2 E-18A (Proprietary). | 3

2. Vogeding, E. L., "Seismic Testing of Electrical and Control Equipment" WCAP-7399-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. Vogeding, E. L., "Seismic Testing of Electrical and Control Equipment for Low Seismic Plants", WCAP-7817 Supplement 7 (Non-Proprietary), September 1976.

5. 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.

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

7. Figenbaum, E. K., "Seismic Testing of Electrical and Control Equipment Static Inverter and Instrument Bus Distribution Panel" WCAP7821 Supplement 2 Addendum 1 (Non-Proprietary), October 1975.

8. Vogeding, E. L., "Seismic Testing of Elecltrical and Control Equipment for High Seismic Plants," WCAP-7821 Supplement 5 (Non-Proprietary), September 1976.

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

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

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

12. "Equipment Qualification Test Report Materials Aging Analyses", WCAP-8687, Supplement 2, Appendix A2 (Proprietary).

13. Chang, S. M., "Seismic Evaluation of the Single Frequency Sine-Beat 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 or analysis in support of the qualification program for the Static Inverter.

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
Instrument bus power supply/ RPS, ESF/ Category d	Control building/	W PED(4) 30K22D3 30K1812 7.5 kva	Temperature Pressure Rel. humidity Radiation Chemistry		120°F Atmos. 95% 10^4R(γ) None	12 hr. cycles	Two 12 hr. cycles	N/A	N/A	5 yrs. (3)	Seq. Test	ESE-18	Completed

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.
4. Different Model numbers denote insignificant variation in the inverter.

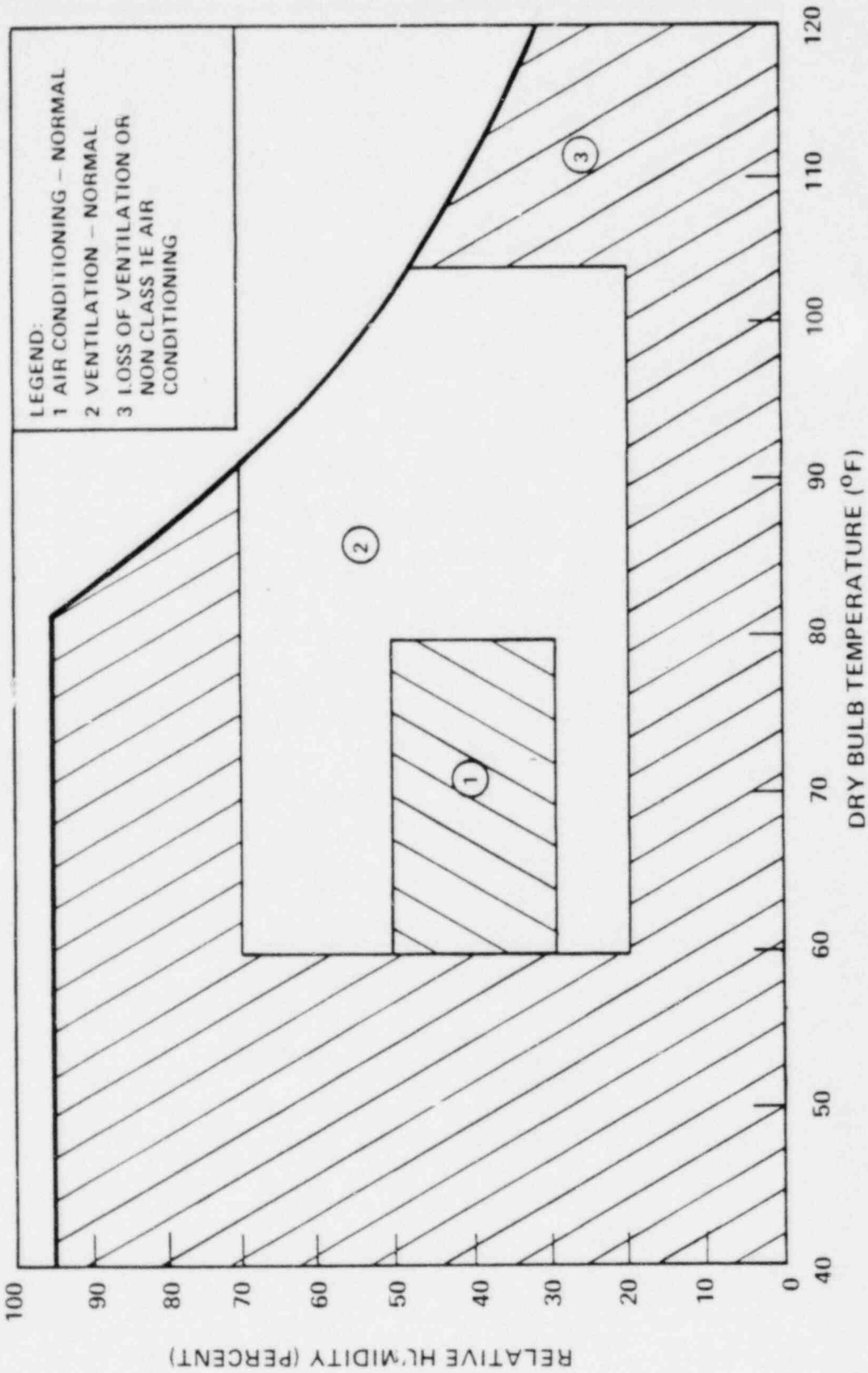

Figure 1. Temperature Versus Humidity - Enclosed Environments Outside Containment

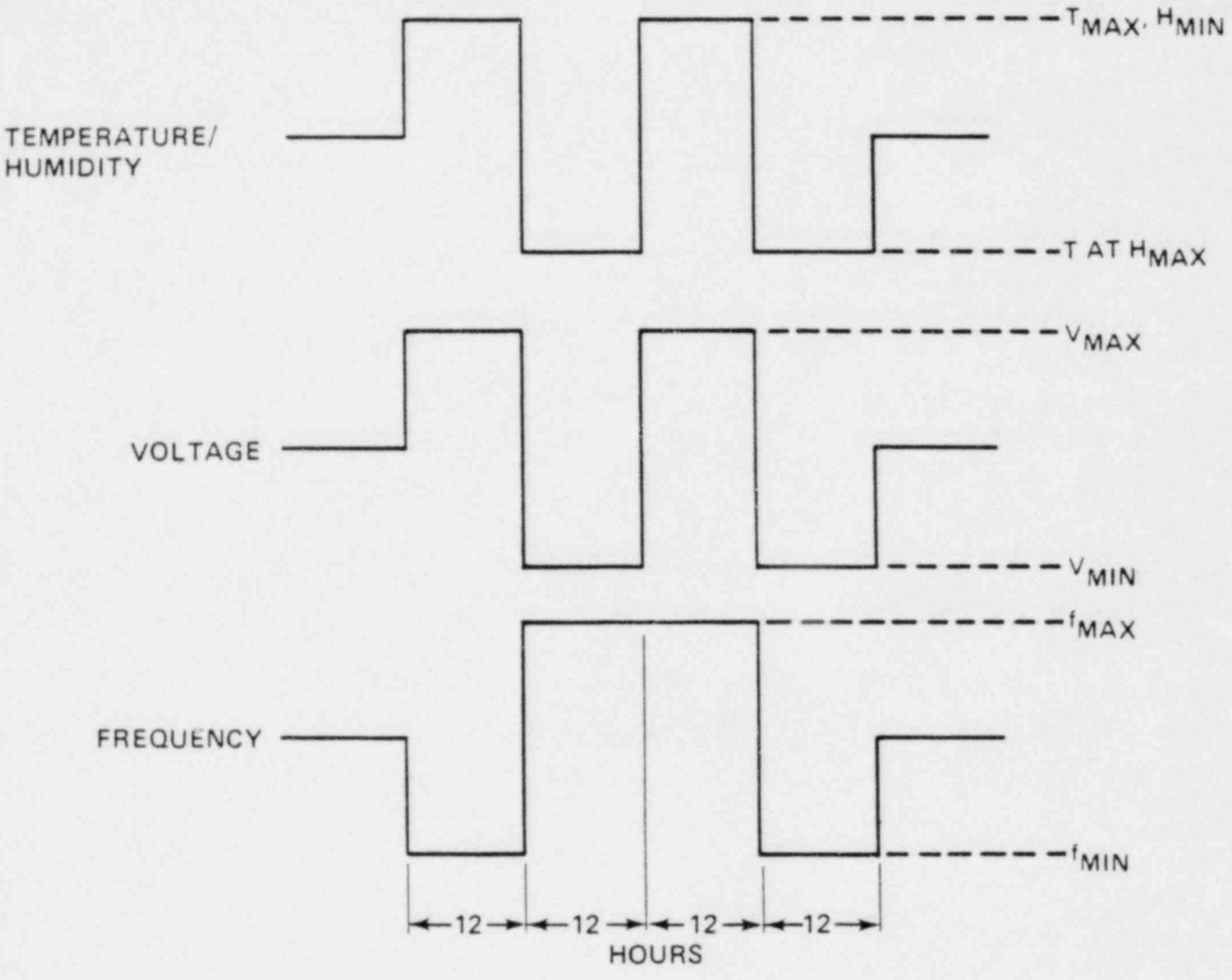

Figure 2. Verification Test Profile