WCAP 8587

"Equipment Qualification Data Packages"

Supplement 1

EQDP-ESE-1B

Veritrak Pressure Transmitters: Qualification Group A

Revision 1

Instruction Sheet

The following instructional information and checklist is being furnished to help insert the following into WCAP-8587 Supplement 1 EQDP-ESE-1B Class 3 (Non-Proprietary). Discard the old Revision 0 and insert the new Revision as listed below.

Remove (Front/Back)	Insert (Front/Back)
Revision 0	Revision 1

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.

Veritrak Pressure Transmitters: Qualification Group A

APPROVED: _____

E. P. [redacted]he, 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: 20 - 45 VDC ± 1V

1.1.2 Frequency: N/A

1.1.3 Load: 4 - 20 MA

1.1.4 Electromagnetic Interference: None.

1.1.5 Other: None

1.2 Installation Requirements: Wall mounted per Westinghouse drawing 8765D68, Rev. 5

1.3 Auxiliary Devices: None

1.4 Preventative Maintenance Schedule: Per the Westinghouse Equipment Qualification test program, the maintenance required to maintain the qualified life stated in Section 1.9 is that the cover o-ring must be replaced each time the cover is removed. This does not preclude development of preventive maintenance program designed to enhance equipment performance and identify unanticipated equipment degradation as long as this program does not compromise the qualification status of the equipment. Surveillance activities may also be considered to support the basis for/and a possible extension of the qualified life.

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]: Pressurizer Pressure

					DBE Conditions [a]			Post DBE Conditions [a]		
	Parameter	Normal Conditions	Abnormal Conditions	Cont. Test Conditions	FLB/SLB	LOCA	Seismic	FLB/SLB	LOCA	Seismic
1.7.1	Time requirement	Continuous	Included under normal	Test Duration	< 5 mins	< 5 mins	Event Duration	4 months	4 months	Continuous
1.7.2	Performance[c] requirement[d]	± 1% 0.4 sec.	Included under normal	No damage	+11% - 16% 0.4 secs	+11% - 16% 0.4 secs	±11%	+16% 0.4 secs	+16% 0.4 secs	± 1% 0.4 sec.

1.8 Environmental conditions for Section 1.7

1.8.1	Temperature (°F)	50 - 120	Included under normal	Ambient	Fig.2	Fig. 3	Ambient	Figure 4	Figure 4	Ambient
1.8.2	Pressure (psig)	-0.1/+0.3	Included under normal	70	Fig.2	Fig.3	0	Figure 4	Figure 4	0
1.8.3	Humidity (% RH)	0 - 95	Included under normal	Ambient	100	100	Ambient	100	100	Ambient
1.8.4	Radiation (R)	< 10^4_γ	Included under normal	None	< 10^4_γ < 10^5_β	< 10^6_γ < 10^7_β	None	N/A	N/A	None
1.8.5	Chemicals	None	Included under normal	None	Fig.2	Fig. 3	None	Figure 4	Figure 4	None
1.8.6	Vibration	None	Included under normal	None	None	None	None	N/A	N/A	None
1.8.7	Acceleration (g)	None	Included under normal	None	None	None	Fig. 1	N/A	N/A	None

(a) DBE is the Design Basis Event

(b) Margin is not included in the parameters of this section

(c) Reference accuracy specified. Valves shown for accuracy under DBE and Post DBE conditions include ± 1% for normal conditions which is not part of the DBE induced effect.

(d) Time response

1.7 Performance Requirements for[b]: Steamline Pressure

	Parameter	Normal Condition	Abnormal Condition	Cont. Test Condition	DBE Conditions [a] FLB	DBE Conditions [a] SLB	DBE Conditions [a] Seismic	Post DBE Conditions [a] FLB	Post DBE Conditions [a] SLB	Post DBE Conditions [a] Seismic
1.7.1	Time requirement	Continuous	Included under normal	Test Duration	< 5 min	< 5 min	Event Duration	4 months	4 months	Continuous
1.7.2	Performance[c] requirement[d]	± 1.0% 0.4 sec	Included under normal	No damage	±11% 0.4 sec	±11% 0.4 sec	±11%	± 1% 0.4 secs	± 1% 0.4 secs	± 1% 0.4 secs
1.8	Environmental conditions for Same Function[b]									
1.8.1	Temperature (°F)	50 - 120	Included under normal	Ambient	Fig.2	Fig. 2	Ambient	Fig. 2	Fig.2	Ambient
1.8.2	Pressure (psig)	-0.1/+0.3	Included under normal	70	Fig.2	Fig.2	0	Fig. 2	Fig. 2	0
1.8.3	Humidity (% RH)	0 - 95	Included under normal	Ambient	100	100	Ambient	100	100	Ambient
1.8.4	Radiation (R)	$<10^4_{\gamma}$	Included under normal	None	Included under post DBE	Included under post DBE	None	$3.9\times10^4_{\gamma}$ $6.4\times10^5_{\beta}$	$3.9\times10^4_{\gamma}$ $6.4\times10^5_{\beta}$	None
1.8.5	Chemicals	None	Included under normal	None	Fig.2	Fig. 2	None	Fig.2	Fig. 2	None
1.8.6	Vibration	None	Included under normal	None	None	None	None	None	None	None
1.8.7	Acceleration (g)	None	Included under normal	None	None	None	Fig. 1	None	None	None

(a) DBE is the Design Basis Event

(b) Margin is not included in the parameters of this section

(c) Reference accuracy specified. Values shown for accuracy under DBE and post DBE conditions include ± 1% for normal condition which is not part of the DBE induced effect.

(d) Time Response

1.7 Performance Requirements for[b]: Reactor Coolant System Pressure (WR)

	Parameter	Normal Conditions	Abnormal Conditions	Cont. 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	Included under normal	Test Duration	Event Duration	Event Duration	Event duration	4 months	4 months	Continuous
1.7.2	Performance(c) requirement(d)	± 1.0% 0.4 sec	Included under normal	No damage	± 11% 0.4 secs.	± 11% 0.4 secs.	Note e	± 11% 0.4 secs.	± 11% 0.4 secs.	± 1.0% 0.4 secs

1.8 Environmental conditions for Same Function[b]

1.8.1	Temperature (°F)	50 - 120	Included under normal	Ambient	Fig.2	Fig. 3	Ambient Conditions	Fig. 2	Fig.3	Ambient
1.8.2	Pressure (psig)	-0.1/+0.3	Included under normal	70	Fig.2	Fig.3	0	Fig. 2	Fig. 3	0
1.8.3	Humidity (% RH)	0 - 95	Included under normal	Ambient	100	100	Ambient	100	100	Ambient
1.8.4	Radiation (R)	< 10^4_γ	Included under normal	None	Included under post DBE	Included under post DBE	None	$3.9\times10^4_\gamma$ $6.4\times10^8_\beta$	$4.1\times10^7_\gamma$ $9\times10^8_\beta$	None
1.8.5	Chemicals	None	Included under normal	None	Fig.2	Fig. 3	None	Fig.2	Fig. 3	None
1.8.6	Vibration	None	Included under normal	None	None	None	None	None	None	None
1.8.7	Acceleration (g)	None	Included under normal	None	None	None	Figure 1	None	None	None

(a) DBE is the Design Basis Event

(b) Margin is not included in the parameters of this section

(c) Reference accuracy specified. Valves shown for accuracy under DBE and Post DBE conditions include ± 1% for normal allowance which is not part of the DBE induced effect.

(d) Time Response

(e) Continued operation required, no specified accuracy or time response

1.9 Qualified Life: The currently demonstrated qualified life is 14 years assuming an average ambient temperature of 40°C (104°F). The demonstrated qualified life based on an average ambient temperature of 120°F is 7.4 years. (see Table 1).

1.10 Remarks: Beta dose only applicable to transmitter seals.

SECTION 2 - QUALIFICATION BY TEST

2.0 TEST PLAN

The thermal aging and mechanical/electrical cycling tests were performed at Westinghouse Veritrak in Tempe, Arizona. The gamma irradiation of the transmitters was performed at Process Technology, West Memphis, Arkansas. Design basis event seismic simulation was performed at Westinghouse Advanced Energy Systems Division (AESD) in Large, Pennsylvania. The high energy line break simulation was performed at W Forest Hills Site in Pittsburgh, Pennsylvania.

2.1 Equipment Description: Westinghouse Veritrak Pressure Transmitters Model 76PH2

2.2 Number Tested:

2.2.1 Phase 1

7 Veritrak Units

2.2.2 Phase 2

2 Veritrak Units

2.3 Mounting: Per Westinghouse Drawing 8765D68, Rev. 5

2.4 Connections: a) Electrical Connections, Two Wires,
b) Process Connections, Capillary Tube

2.5 Aging Simulation Procedure

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

2.6 Service Conditions to be simulated by test[1]. See section 2.11 for notes.

		Normal/ Abnormal	Thermal Aging/ Electrical and Mechanical Cycling	Radiation	Containment Test	Seismic	HELB/ Post-HELB
2.6.1	Temp. (°F)	40 - 120°	104°F (10 years)	Ambient	Covered by HELB	Ambient	Fig. 4
2.6.2	Pressure (psig)	Atmos.	Atmos.	Atmos.		Atmos.	Fig. 4
2.6.3	Humidity (% RH)	0 - 95%	Ambient	Ambient		Ambient	100
2.6.4	Radiation (R)	None	None	5×10^7 γ 9×10^8 β		None	Included Under Radiation
2.6.5	Chemicals	None	None	None		None	Fig. 4
2.6.6.	Vibration	None	None	None		5 OBE's	None
2.6.7	Acceleration (g)	None	None	None		TRS >RRS Figure 1	None
2.6.8	Process Cycling	None	10^6 Mech. Cyc. 50 Elect. Cyc.	None		None	None

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	A,B,C,D,E	
2.7.1.2	Pressure	E	A,B,C,D
2.7.1.3	Moisture	A,E	B,C,D
2.7.1.4	Gas Composition		A,B,C,D,E
2.7.1.5	Seismic Acceleration	D	A,B,C,E
2.7.1.6	Time	A,B,C,D,E	
2.7.2	Category II - Input Electrical Characteristics		
2.7.2.1	Voltage	A,B,C,D,E	
2.7.2.2	Current		A,B,C,D,E
2.7.2.3	Frequency		A,B,C,D,E
2.7.2.4	Power		A,B,C,D,E
2.7.2.5	Other		A,B,C,D,E
2.7.3	Category III - Fluid Characteristics		
2.7.3.1	Chemical Composition	E	A,B,C,D
2.7.3.2	Flow Rate	E	A,B,C,D
2.7.3.3	Spray	E	A,B,C,D
2.7.3.4	Temperature		A,B,C,D,E
2.7.4	Category IV - Radiological Features		
2.7.4.1	Energy Type	C	A,B,D,E
2.7.4.2	Energy Level	C	A,B,D,E
2.7.4.3	Dose Rate	C	A,B,D,E
2.7.4.4	Integrated Dose	C	A,B,D,E

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

A: Normal/Abnormal (Type Test)

B: Thermal Aging/Mechanical Cycling/Electrical Cycling

C: Radiation

D: Seismic

E: HELB/Post-HELB

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 Inspection

2.9 Test Sequence Actual

This section identifies the actual test sequence to which the pressure transmitters were subjected. Exceptions from adherence to the preferred test sequence and justification are provided. Sections 2.8.2 and 2.8.3, operation at normal conditions and at performance extremes are covered in production tests on all units.

High energy line break and post-HELB radiation doses are included with normal dose in testing and are not combined with temperature/humidity conditions. Time response tests were performed only on the differential pressure transmitters, do to design similarities any affect to time response in the differential pressure transmitters will also appear in the pressure transmitters. Because of the possibiity of radiation induced effects on the physical properties of the oil fill in the transmitters, time response tests before and after the test sequence were performed. Because any radiation induced viscosity changes in the oil would be permanent, adverse effects on time response, if any, could be detected after concluding the test sequence. As no other mechanism resulting from test conditions would be expected to affect time response, test before and after the sequence are sufficient.

2.9.1 Test Sequence Actual (Phase 1)

2.8.1 Inspection
2.8.2 Operation (including time response)
2.8.4 Mechanical Cycling/Electrical Cycling/Accelerated Thermal Aging
2.8.4 Radiation - Normal 10 Year Dose
2.8.6 Radiation HELB/Post HELB Dose
2.8.5 Seismic Simulation/Vibration
2.8.6 Operation (Simulated High Energy Line Break Conditions)
2.8.7 Operation (Simulated Post-HELB Conditions)
2.8.2 Operation (Including Time Response)
2.8.8 Inspection

2.9.2 Test Sequence Actual (Phase 2)

2.8.1 Inspection
2.8.2 Operation
2.8.4 Accelerated Thermal Aging
2.8.4 Radiation-Normal 10 year Dose
2.8.6 Radiation HELB/Post HELB Dose
2.8.5 Seismic Simulated Vibration (See Section 2.10.3.2.3)
2.8.6 Operation (Simulated high energy line break conditions)
2.8.7 Operation (Simulated Post-HELB Conditions)
2.8.2 Operation
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 electronic pressure transmitters to perform their safety related functions described in EQDP 1.7 while exposed to the environments defined in EDQP Section 1.8.

2.10.2 Equipment Tested

2.10.2.1 Phase 1 Testing

Seven (7) Westinghouse Veritrak Model 76 PH2 Pressure Transmitters were subjected to the test environments of the sequence shown in Section 2.9.1.

2.10.2.2 Phase 2 Testing

Two (2) Westinghouse Veritrak Model 76 PH2 Pressure Transmitters modified to reflect Phase 1 concerns were subjected to the test environments of the sequence shown in Section 2.9.2.

2.10.3 Test Summary

2.10.3.1 Test Summary (Phase 1)

2.10.3.1.1 Normal Environment Testing

Operation of the pressure transmitters under normal/abnormal environment conditions is reflected by calibrations and temperature compensations performed on a production basis.

2.10.3.1.2 Simulated Aging

The units were pre-conditioned to a simulated ten year aged condition prior to subjecting them to the design basis seismic event and high energy line break simulations. The aged condition was achieved by separate phases of mechanical cycling, electrical cycling, accelerated thermal aging, and gamma radiation

dose equivalent to the ten year normal gamma dose plus the design basis accident gamma dose plus the gamma equivalent beta dose. Throughout the pre-conditioning phases the transmitter outputs were monitored and recorded.

2.10.3.1.3 Seismic Tests

The seismic testing employed multi-axis multi-frequency inputs in accordance with Reg. Guide 1.100 (IEEE-344-1975). The generic required response spectra (RRS) shown in Figures 1A, 1B, and 1C contains significant margin with respect to any single plant application referencing this program(1). Each plant should compare to the applicable RRS (A, B, or C) to assure that a 10 percent margin exists based on their actual plant location.

2.10.3.1.4 High Energy Line Break/Post HELB Simulation

Due to design concerns which appeared during Phase 1 testing, the Phase 2 test sequence was used to justify qualification.

2.10.3.2 Test Summary (Phase 2)

2.10.3.2.1 Normal Environment Testing

Operation of the pressure transmitters under normal/abnormal environment conditions is reflected by calibrations and temperature compensations performed on a production basis.

2.10.3.2.2 Simulated Aging

The units were pre-conditioned to a simulated ten year aged condition prior to subjecting them to the design basis seismic event and high energy line break simulations. The aged condition was achieved by separate phases of mechanical cycling and electrical cycling, accelerated thermal aging and gamma radiation dose equivalent to the ten year normal gamma dose plus the design basis accident gamma dose plus the gamma equivalent beta dose. Throughout the pre-conditioning phases the transmitter outputs were monitored and recorded.

2.10.3.2.3 Seismic Tests

No seismic test sequence was performed during Phase 2 testing. The test sequence from Phase 1 was considered valid.

2.10.3.2.4 High Energy Line Break/Post HELB Simulation

The pressure transmitters were subjected to the HELB simulation profile of Figure 4. Following the 300°F temperature peak, the temperature gradually declines to 225°F and is held at saturated steam conditions for 15 days, simulating a four month period of post-HELB operation.

2.10.4 Conclusion

The qualification status of Qualification Group A Pressure Transmitters is demonstrated by the completion of the simulated aging and design basis event condition testing described herein and reported in Reference 1.

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. Skeers, D. M., Drost, P. S., Black, J. P., Rygg, D. E., "Equipment Qualification Test Report Pressure Transmitters - Qualifications Group A (Seismic and Environmental Testing)" WCAP-8687 - Supplement 2 [redacted] E01B (Proprietary).

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 Pressure Transmitters - Qualification Group A.

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 (3)	ACCURACY(%) DEM	QUAL LIFE(4)	QUAL METHOD	QUAL REF	QUAL PROGRAM STATUS
RCS wide-range pressure transmitter/ PAMS/ Category a	Containment Bldg./outside missile shield	Veritrak 76PH2	Temperature		420°F	Post DBE 4 Mo.	Same	±10	Same	14 yrs.	Seq. Test	ESE-1B	Completed
			Pressure		57 psig								
			Rel. humidity		100%								
			Radiation		$5x10^7 R(\gamma)$ $9x10^8 R(\beta)$								
			Chemistry		2500 ppm H_3BO_3 NaOH 10.7 pH								
Pressurizer pressure transmitter/ RPS/ Category a	Containment Bldg./outside missile shield	Veritrak 76PH2	Temperature		420°F	Trip <5 min	Same	+10, -15	Same	14 yrs.	Seq. Test	ESE-1B	Completed
			Pressure		57 psig								
			Rel. humidity		100%								
			Radiation		$5x10^7 R(\gamma)$ $9x10^8 R(\beta)$	Post DBE	Same	+15 -15	Same	14 yrs	Seq. Test	ESE-1B	Completed
			Chemistry		2500 ppm H_3BO_3 N_aOH 10.7 pH	4 Mo.							
Steam line pressure transmitter/ RPS, PAMS/ Category a	Steam tunnel	Veritrak 76PH2	Temperature		420°F	Trip <5 min	Same	±10	Same	14 yrs.	Seq. Test	ESE-1B	Completed
			Pressure		57 psig								
			Rel. humidity		100%								
			Radiation		$5x10^7 R(\gamma)$ $9x10^8 R(\beta)$	Post DBE	Same	±10	Same				
			Chemistry		2500 ppm H_3BO_3 HaOH 10.7ph	2 weeks							

NOTES TO TABLE 1

1. For definition of the equipment category, 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. The accuracies are changes in the transmitter accuracy due to severe environments. The error during normal and abnormal conditions is 1% of span. These errors do not include drift or signal processing inaccuracies.

4. Qualified life is based on a service condition of 104°F (40°C).

5. Serial numbers qualified are defined in the test report.

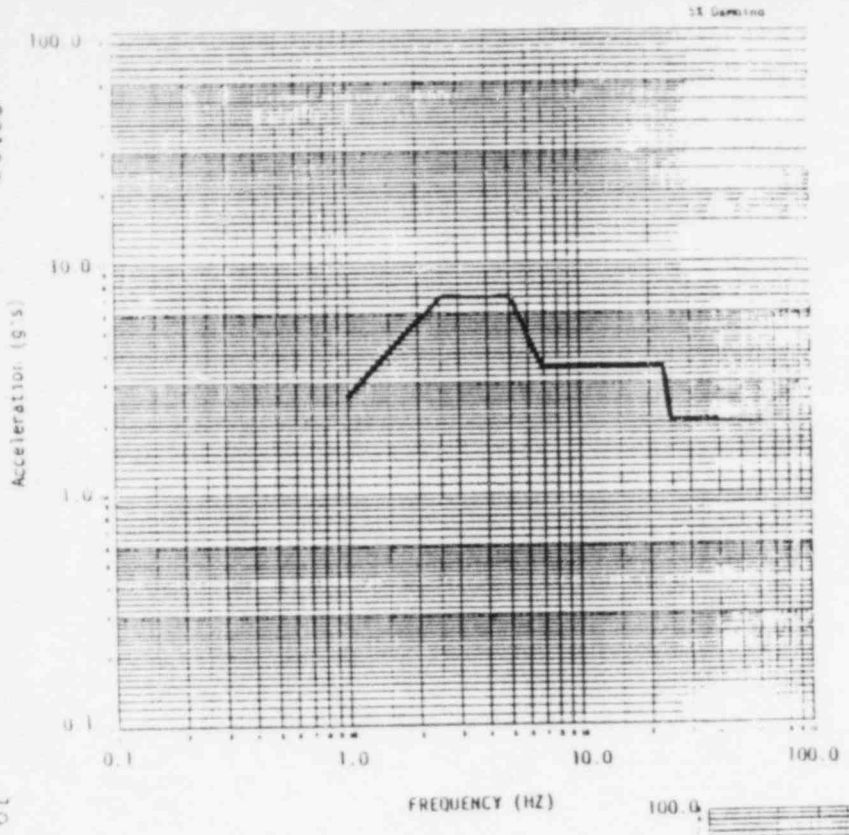


FIGURE 1A REQUIRED RESPONSE SPECTRUM FOR SAFE SHUTDOWN EARTHQUAKE (INPUT A)

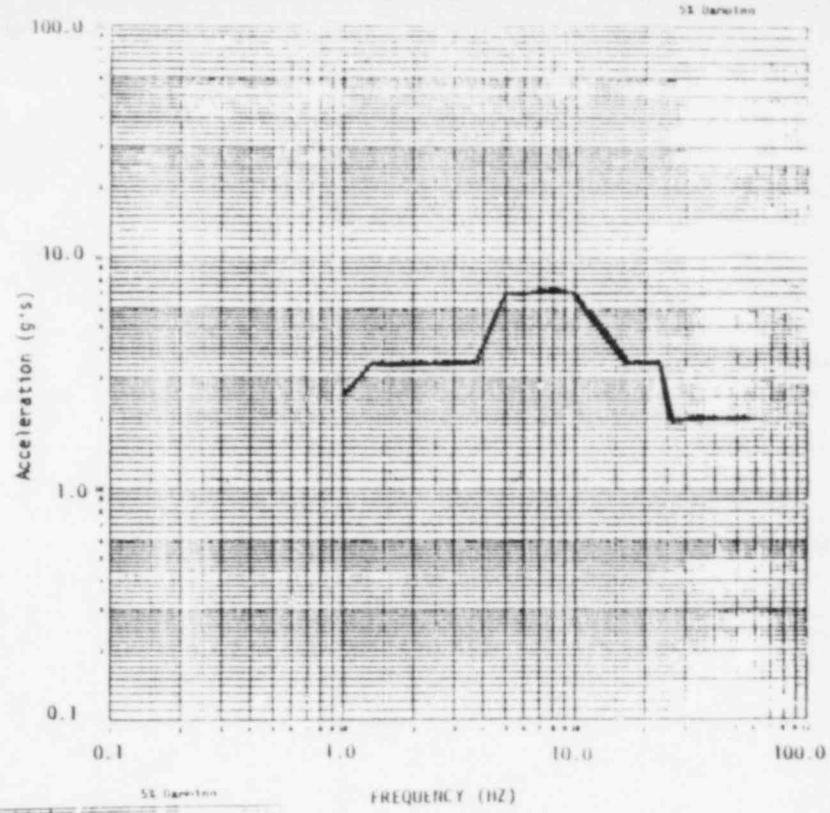


FIGURE 1B REQUIRED RESPONSE SPECTRUM FOR SAFE SHUTDOWN EARTHQUAKE (INPUT B)

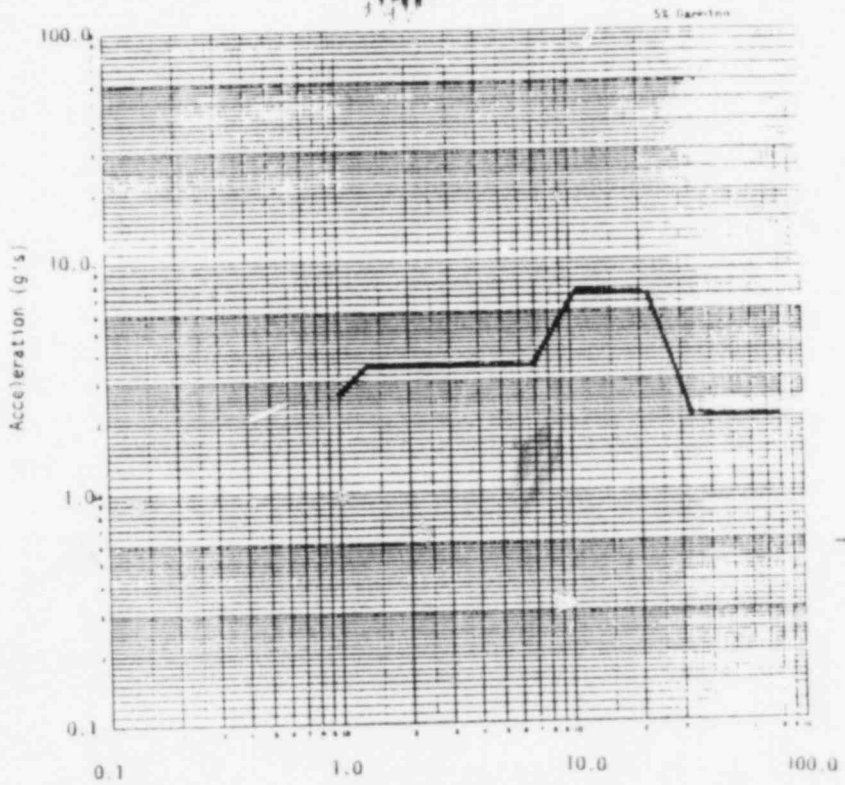
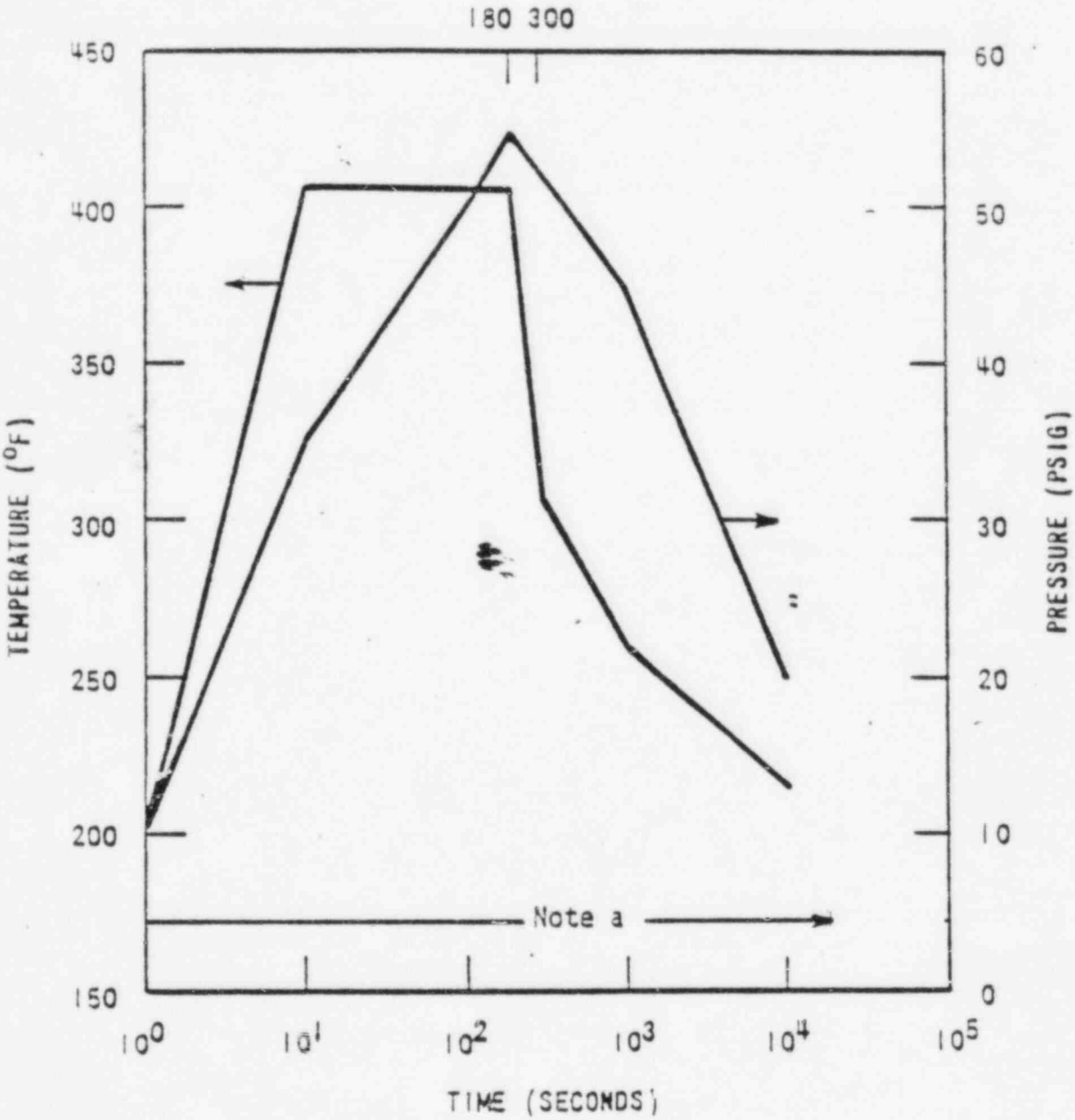
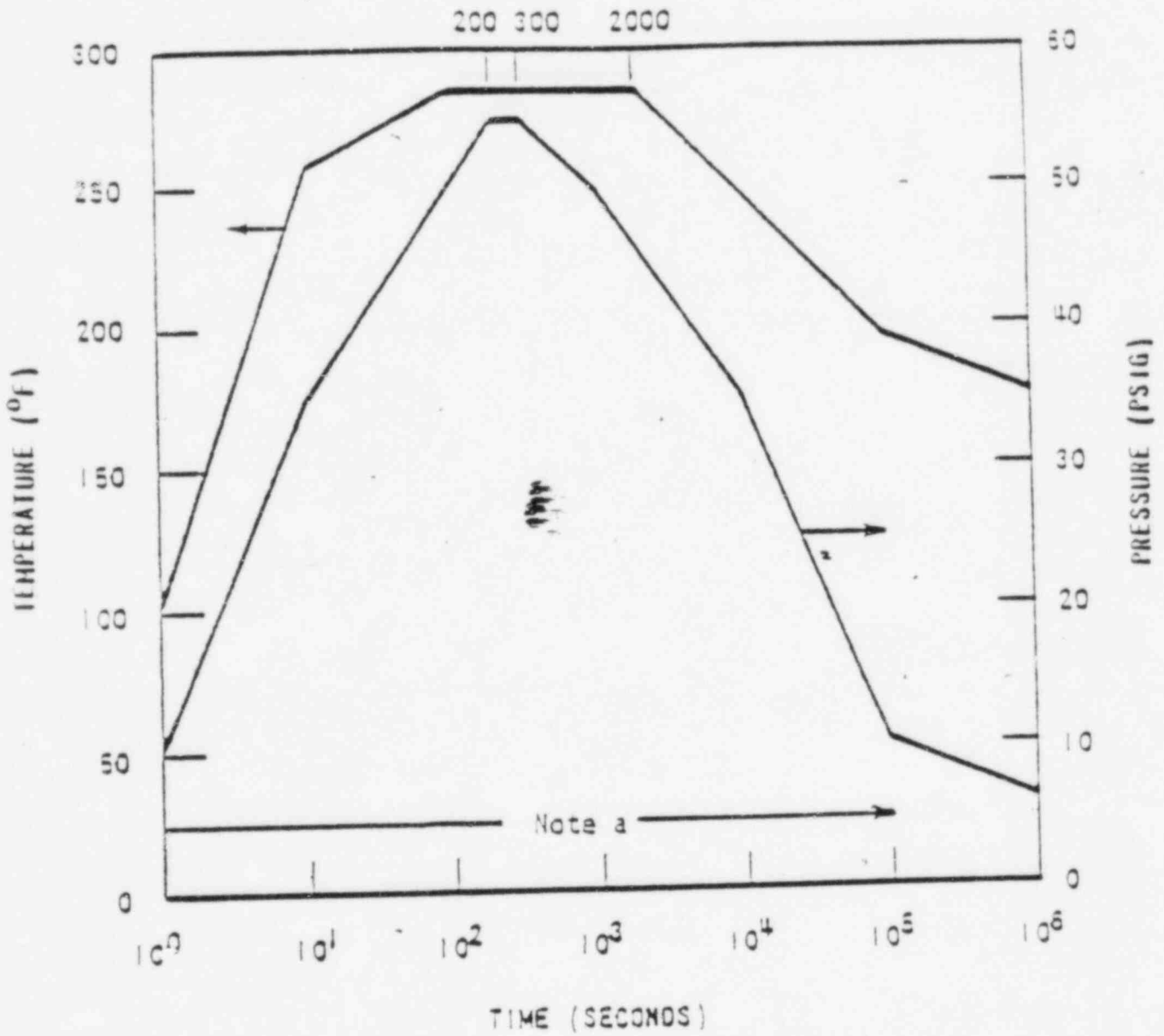


FIGURE 1C REQUIRED RESPONSE SPECTRUM FOR SAFE SHUTDOWN EARTHQUAKE (INPUT C)



Note a: Initial 24 hour containment spray solution of 2500 PPM Boron in water buffered with NaOH to yield a pH of 10.7

Figure 2. Containment Environmental Design Conditions Main Steam Line Break and Feedline Break



Note a: Initial 24 hour containment spray solution of 2500 PPM Boron in water buffered with NaOH to yield a pH of 10.7

Figure 3. Containment Environmental Design Conditions - LOCA

FIGURE 4

SLB/FLB/LOCA PROFILE