WCAP 8587

"Equipment Qualification Data Packages"

Supplement 1

EQDP-ESE-1A

Pressure Transmitters: Qualification Group A

Revision 4

Instruction Sheet

The following instructional information and checklist is being furnished to help insert the following into WCAP-8587 Supplement 1 EQDP-ESE-1 Class 3 (Non-Proprietary). Discard the old sheet and insert the new sheets as listed below. Revised information is indicated by a bar and number 4 on the outside margin of the page.

Remove (Front/Back)	Insert (Front/Back)
Cover sheet/--	Cover sheet/--
page 2/3	page 2/3
4/5	4/5
8/9	8/9
10/11	10/11
12/13	12/13
16/--	16/--
18/--	18/--
21/--	21/--

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.

Pressure Transmitters: Qualification Group A

APPROVED: _____

E. P. Ra[illegible], 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: 15 - 52 VDC ± 1V

1.1.2 Frequency: N/A

1.1.3 Load: 4 - 20 ma or 10 - 50 ma

1.1.4 Electromagnetic Interference: None.

1.1.5 Other: None

1.2 Installation Requirements: Wall mounted per Westinghouse drawing 8765D46 Revision 3

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. 4

1.5 Design Life: 40 years

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

I.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
I.7.1	Time requirement	Continuous	Included under normal	Test Duration	< 5 min	< 5 min	Event Duration	4 months	4 months	Continuous
I.7.2	Performance(c) requirement(d)	± 1.0% 0.4 sec		No damage	±11% 0.4 sec	±11% 0.4 sec	±11% 0.4 sec	± 1% 10 secs	± 1% 10 secs	± 1% 0.4 secs

I.8 Environmental conditions for Same Function[b]

I.8.1	Temperature (°F)	50 - 120	Included under normal	Ambient	Fig.2	Fig. 2	Ambient	Fig. 2	Fig.2	Ambient
I.8.2	Pressure (psig)	-0.1/+0.3		70	Fig.2	Fig.2	0	Fig. 2	Fig. 2	0
I.8.3	Humidity (% RH)	0 - 95		Ambient	100	100	Ambient	100	100	Ambient
I.8.4	Radiation (R)	$<10^4_\gamma$		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
I.8.5	Chemicals	None		None	Fig.2	Fig. 2	None	Fig.2	Fig. 2	None
I.8.6	Vibration	None		None	None	None	None	None	None	None
I.8.7	Acceleration (g)	None		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		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		70	Fig.2	Fig.3	0	Fig. 2	Fig. 3	0
1.8.3	Humidity (% RH)	0 - 95		Ambient	100	100	Ambient	100	100	Ambient
1.8.4	Radiation (R)	$< 10^4$ r		None	Included under post DBE	Included under post DBE	None	3.9×10^4 r 6.4×10^5 β	4.1×10^7 r 9×10^8 β	None
1.8.5	Chemicals	None		None	Fig.2	Fig. 3	None	Fig.2	Fig. 3	None
1.8.6	Vibration	None		None	None	None	None	None	None	None
1.8.7	Acceleration (g)	None		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. Values 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

1.7 Performance Requirements for[b]: Pressurizer Pressure

	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	< 5 mins	< 5 mins	Event Duration	4 months	4 months	Continuous
1.7.2	Performance[c] requirement[d]	± 1% 0.4 sec.		No damage	+11% - 16% 0.4 secs	+11% - 16% 0.4 secs	±1%	±16%	±16%	± 1% 0.4 secs

1.8 Environmental conditions for Section 1.7

1.8.1	Temperature (°F)	50 - 120	Included under Normal	Ambient	Fig.2	Fig. 3	Ambient	Fig. 2	Fig. 2	Ambient
1.8.2	Pressure (psig)	-0.1/+0.3		70	Fig.2	Fig.3	0	Fig. 2	Fig. 3	0
1.8.3	Humidity (%RH)	0 - 95		Ambient	100	100	Ambient	100	100	Ambient
1.8.4	Radiation (R)	< 10^4_γ		None	< 10^4_γ < 10^5_β	< 10^6_γ < 10^7_β	None	$3.9\times10^4_\gamma$ $6.4\times10^5_\beta$	$4.1\times10^7_\gamma$ $9\times10^8_\beta$	None
1.8.5	Chemicals	None		None	Fig.2	Fig. 3	None	Fig. 2	Fig. 2	None
1.8.6	Vibration	None		None	None	None	None	None	None	None
1.8.7	Acceleration (g)	None		None	None	None	Fig. 1	None	None	None

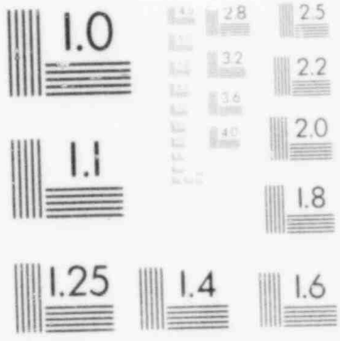
[a] DBE is the Design Basis Event

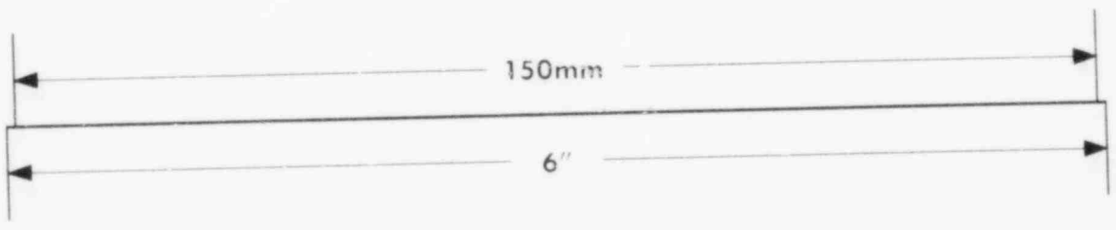
[b] Margin is not included in the parameters of this section

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

[d] Time response

IMAGE EVALUATION
TEST TARGET (MT-3)





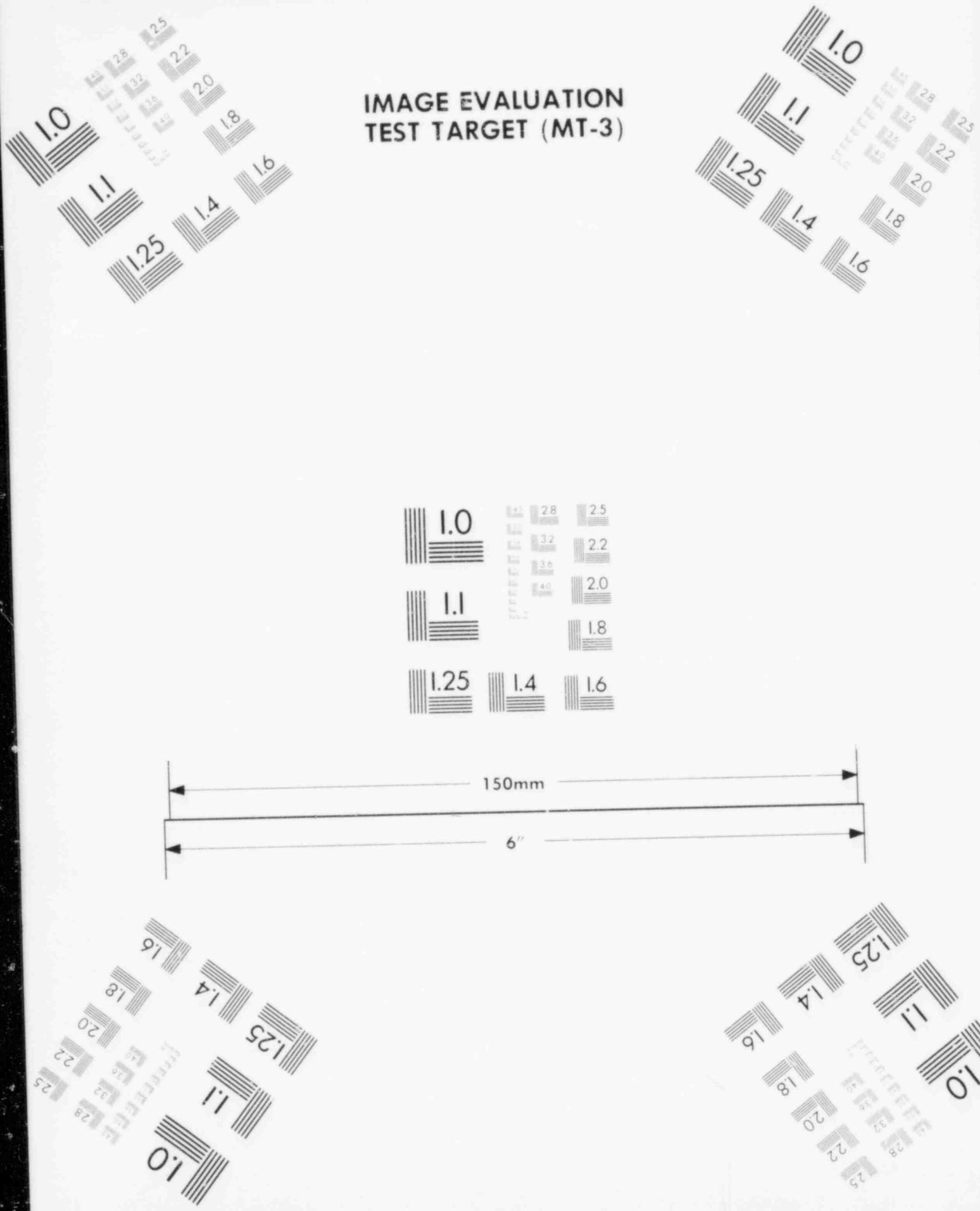


IMAGE EVALUATION
TEST TARGET (MT-3)
1.0
1.1
1.25
1.4
1.6
1.8
2.0
2.2
2.5
2.8
3.2
3.6
4.0
150mm
6"

2.6 Service Conditions to be simulated by test(1). See section 2.11 for notes.

		Normal/ Abnormal	Thermal Aging/ 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 Normal
2.6.5	Chemicals	None	None	None		None	Fig. 4
2.6.6.	Vibration	None	None	None		5 OBE's	None
2 6.7 N/A	Acceleration (g)	None	None	None		TRS > RRS	None
2.6.8	Process Cycling	None	10^6	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		

3

A: Normal/Abnormal (Type Test)
B: Thermal Aging/Mechanical 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. 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.

3

2.8.1 Inspection
2.8.2 Operation (including time response)
2.8.4 Mechanical Cycling/Accelerated Thermal Aging

design basis seismic event and high energy line break simulations. The aged condition was achieved by separate phases of mechanical 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.

2.10.3.3 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 (Figures 1a thru 1c) contains significant margin with respect to any single plant application referencing this program[1]. Each plant should compare to the required response spectra (RRS) to assure that a 10 percent margin exists based on their actual plant location.

4

2.10.3.4 High Energy Line Break/Post HELB Simulation

The pressure transmitters were subjected to the HELB simulation profile of Figure 4. Following the 420°F temperature peak, the temperature gradually declines to 250°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.

2.8.4 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) 3
2.8.7 Operation (Simulated Post-HELB Conditions)
2.8.2 Operation (including time response)
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 EQDP Section 1.8.

2.10.2 Equipment Tested

Three ITT Barton Model 763 Pressure Transmitters were subjected to the test environments of the sequence shown in Section 2.9.

2.10.3 Test Summary

2.10.3.1 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. 3

2.10.3.2 Simulated Aging

The units were pre-conditioned to a simulated ten year aged condition prior to subjecting them to the

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 (3) REQ	ACCURACY (3) DEM	QUAL LIFE (4)	QUAL METHOD	QUAL REF	QUAL PROGRAM STATUS
RCS wide-range pressure transmitter/ PAMS/ Category a	Containment Bldg./outside missile shield	Barton 763 (5)	Temperature Pressure Rel. humidity Radiation Chemistry		420°F 57 psig 100% 5×10^7 R(γ) 9×10^8 R(β) 2500 ppm H_3BO_3 NaOH 10.7 pH	Post DBE 4 Mo.	Same	+10	Same	10 yrs.	Seq. Test	ESE-1	Completed
Pressurizer pressure transmitter/ RPS/ Category a	Containment Bldg./outside missile shield	Barton 763 (5)	Temperature Pressure Rel. humidity Radiation Chemistry		420°F 57 psig 100% 5×10^7 R(γ) 9×10^8 R(β) 2500 ppm H_3BO_3 NaOH 10.7 pH	Trip <5 min Post DBE 4 Mo.	Same	+10 , -15 +15	Same Same	10 yrs.	Seq. Test	ESE-1	Completed
Steam line pressure transmitter/ RPS, PAMS/ Category 1	Safeguards building/ steam tunnel	Barton 763 (5)	Temperature Pressure Rel. humidity Radiation Chemistry		420°F 57 psig 100% 5×10^7 R(γ) 9×10^8 R(β) 2500 ppm H_3BO_3 NaOH 10.7ph	Trip <5 min Post DBE 2 weeks	Same	+10	Same	10 yrs.	Seq. Test	ESE-1	Completed

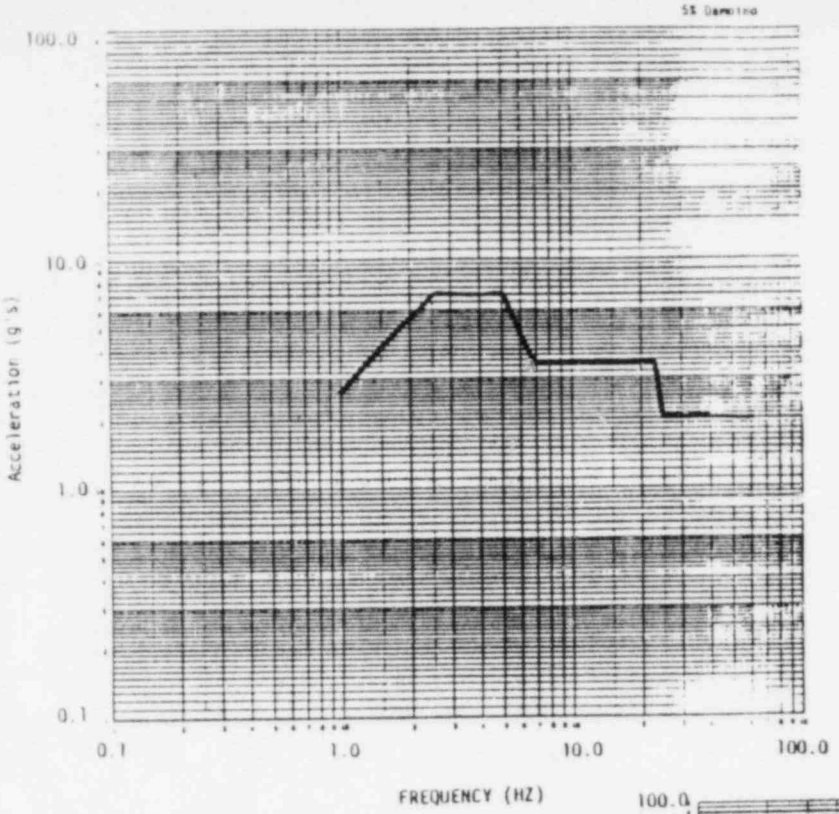


FIGURE 1A REQUIRED RESPONSE SPECTRUM

FOR SAFE SHUTDOWN EARTHQUAKE (INPUT A)

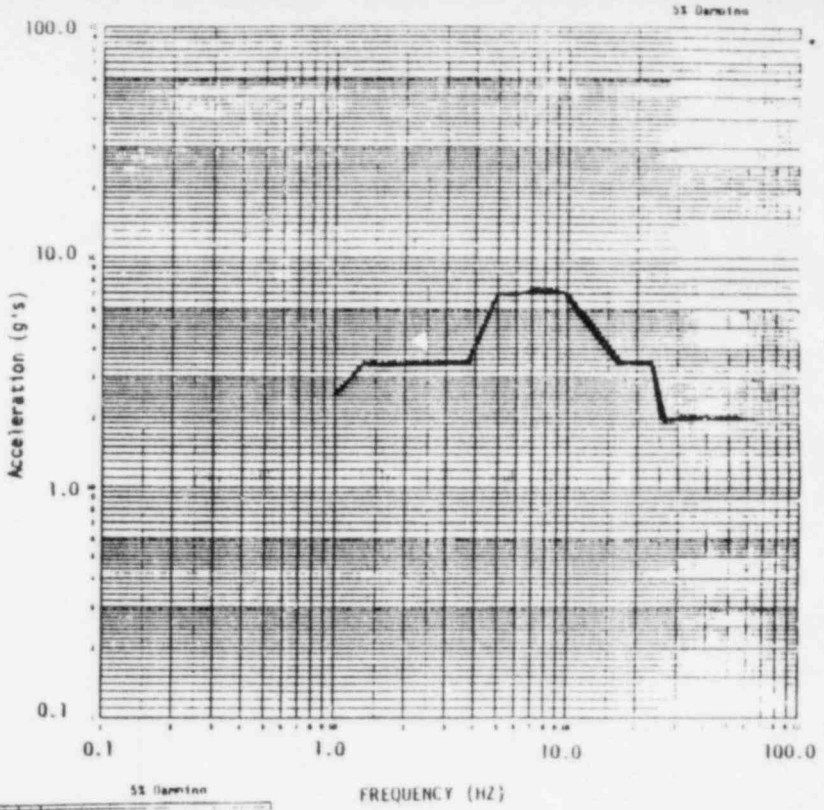


FIGURE 1B REQUIRED RESPONSE SPECTRUM

FOR SAFE SHUTDOWN EARTHQUAKE (INPUT B)

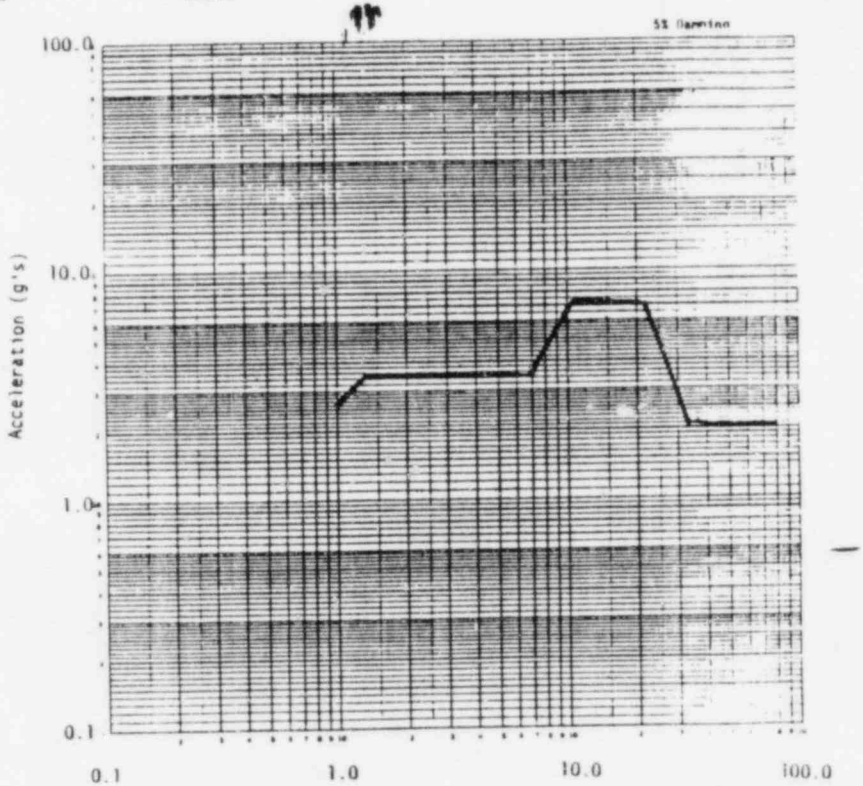
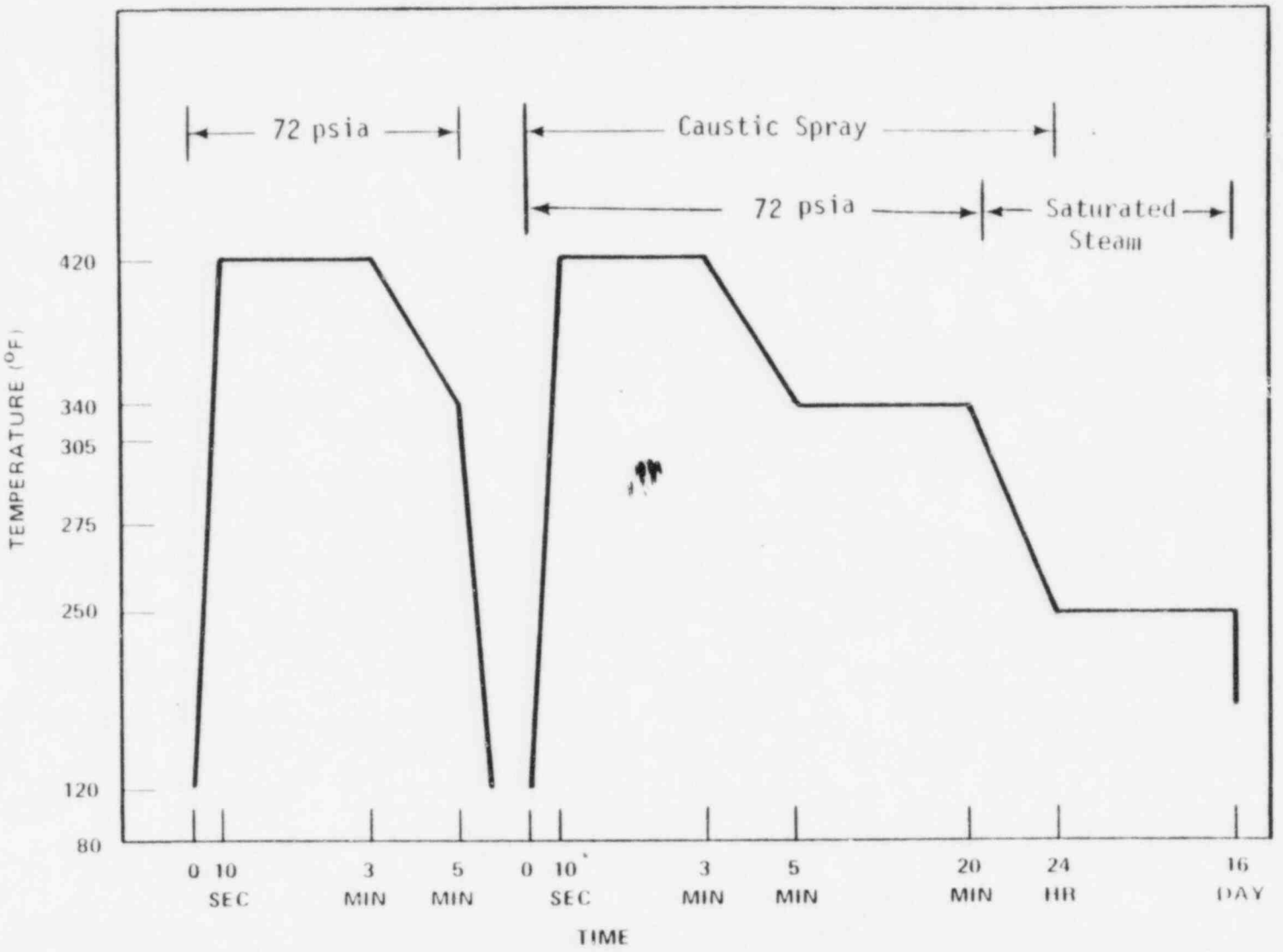


FIGURE 1C

REQUIRED RESPONSE SPECTRUM FOR

SAFE SHUTDOWN EARTHQUAKE (INPUT C)



*Time between temperature transients must be at least one hour or until test units return to a steady state output. Time above 340°F must be five minutes or less.

Figure 4. Test Envelope for In-Containment - HELB