

WCAP 8587

"Equipment Qualification Data Packages"

Supplement 1

EQDP-ESE-4

Differential Pressure Transmitters: Qualification Group B

Revision 6

Instruction Sheet

The following instructional information and checklist is being furnished to help insert the following into WCAP-8587 Supplement 1 EQDP-ESE-4 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 6 on the outside margin of the page.

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March, 1983

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.

Differential Pressure Transmitters: Qualification Group B

APPROVED: _____

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SECTION 1 - SPECIFICATIONS

1.0 PERFORMANCE SPECIFICATIONS

1.1 Electrical Requirements

1.1.1 Voltage: 40 VDC $\pm$ 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: Mounted as per References 1 and 3.

1.3 Auxiliary Devices: Pressure Sensors (included in the Barton test program) and Containment Pressure Sensor(EQDP-ESE-21)

1.4 Preventative Maintenance Schedule: Per the Westinghouse Equipment Qualification test program, no preventive maintenance is required to support the equipment qualified life. This does not preclude development of a 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) Reactor Vessel Level Instrumentation System

Parameter	Normal Conditions	Abnormal Conditions	Containment Test Conditions	DBE Conditions ^(a)			Post DBE Conditions ^(a)		
				FLB/SLB	LOCA	Seismic	FLB/SLB	LOCA	Seismic
1.7.1 Time requirement	Continuous	Included under normal	N/A	Event Duration	Event Duration	N/A	N/A	Continuous	Continuous
1.7.2 Performance (c) requirement	$\pm 1\%$ 3.2 Sec				$\pm 1\%$ 3.2 Sec			$\pm 1\%$ 3.2 Sec	$\pm 1\%$ 3.2 Sec

1.8 Environmental Conditions for Same Function^(b)

1.8.1 Temperature (°F)	50 - 120	Included under normal						Ambient Conditions	Ambient Conditions
1.8.2 Pressure (psig)	0								
1.8.3 Humidity (% RH)	0 - 95								
1.8.4 Radiation (R)	<400								
1.8.5 Chemicals	None								
1.8.6 Vibration	None								
1.8.7 Acceleration (g)	None								

- Notes:
- (a) DBE is the Design Basis Event
 - (b) Margin is not included in the parameters specified in this section
 - (c) Reference accuracy and time response for system, including sensor and hydraulic isolator, specified.
 - (d) Continued operation required, no specified accuracy

1.7 Performance Requirements for^(b): Boric Acid Tank Level, Condensate Storage Tank Level, Refueling Water Storage Tank Level

Parameter	Normal Conditions	Abnormal Conditions	Containment Test Conditions	DBE Conditions ^(a)			Post DBE Conditions ^(a)		
				FLB/SLB	LOCA	Seismic	FLB/SLB	LOCA	Seismic
1.7.1 Time requirement	Continuous	Included under normal	N/A	Event Duration	Event Dura.	Event Duration	Continuous	Continuous	Continuous
1.7.2 Performance (c) requirement	$\pm 1\%$ 1 Sec			$\pm 1\%$ 10 Sec	$\pm 1\%$ 10 Sec	Note d	$\pm 1\%$ 10 Sec	$\pm 1\%$ 10 Sec	$\pm 1\%$ 1 Sec

1.8 Environmental Conditions for Same Function^(b)

1.8.1 Temperature ($^{\circ}\text{F}$)	50 - 120	Included under normal		Ambient Conds.	Ambient Conds.	Ambient Conds.	Ambient Conditions	Ambient Conditions	Ambient Conditions
1.8.2 Pressure (psig)	0								
1.8.3 Humidity (% RH)	0 - 95								
1.8.4 Radiation (R)	<400								
1.8.5 Chemicals	None								
1.8.6 Vibration	None								
1.8.7 Acceleration (g)	None								

Notes: (a) DBE is the Design Basis Event

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

(c) Reference accuracy and time response for system including pressure sensor specified

(d) Continued operation required, no specified accuracy

1.7 Performance Requirements for (b): Containment Pressure

Parameter	Normal Conditions	Abnormal Conditions	Containment Test	DBE Conditions (a)			
				FLB/SLB	LOCA	Seismic	Post DBE Conditions (a)
1.7.1 Time requirement	Continuous	Included under normal	N/A	<5 min	<5 min	N/A	Continuous
1.7.2 Performance (c) requirement	$\pm 1.0\%$ 1 Sec			$\pm 1\%$ 1 Sec	$\pm 1\%$ 1 Sec		Continuous + 1% 10 Sec + 1% 1 Sec

1.8 Environmental conditions for Same Function (b)

1.8.1 Temperature ($^{\circ}\text{F}$)	50 - 120	Included under normal	Ambient conditions	Ambient conditions	Ambient conditions
1.8.2 Pressure (psig)	0				
1.8.3 Humidity (% RH)	0 - 95				
1.8.4 Radiation (R)	<400				
1.8.5 Chemicals	None				
1.8.6 Vibration	None				
1.8.7 Acceleration (g)	None				

Notes: (a) DBE is the Design Basis Event

(b) Margins are not included in the parameters in this section

(c) Reference accuracy and time response specified for use with containment pressure sensor (EQDP-ESE-21)

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1.9 Qualified Life: The Westinghouse Aging Evaluation Program has demonstrated a qualified life of five (5) years. The qualified life due to radiation service is dependent on the location of the transmitter (Example: 10^4 R/year yields a 10 year qualified life). Also see Table 1.

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1.10 Remarks: None

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SECTION 2 - QUALIFICATION BY TEST

2.0 TEST PLAN

2.1 Equipment Description: Barton and Veritrak Differential Pressure Transmitters (See Section 2.10.2)

2.2 Number Tested: Four (4) Barton units
Six (6) Veritrak units

2.3 Mounting: As described in References 1 and 3.

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

2.5 Aging Simulation Procedure

By a separate component test program as described by Subprogram C of Appendix B to WCAP-8587

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	<u>Required</u>	<u>Not Required</u>
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: Operational Test, Normal and Abnormal Conditions
 B: Seismic Testing

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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 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

4 | 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. Ninety five percent humidity, noise rejection and response time testing has been successfully performed via type testing. Auditable results for all tests are maintained by W and owners receive calibration/production unit data. The justification for employing anything other than the preferred sequence is as follows:

4 | The DBE is simulated by the Seismic Test sequence of Section 2.9.2. Since no mechanism exists which would degrade time response and not affect calibration, after a seismic event, the calibration check is sufficient to identify potential changes in time response. The HELB Tests (Section 2.8.6 and 2.8.7) have been excluded since the Group B Differential Pressure Transmitters are not exposed to the HELB environment due to their location. The production test of Section 2.9.1 is performed on all production units to verify their performance at normal and abnormal

temperatures of 80°F and 130°F respectively. The Abnormal Extremes Test of Section 2.9.3 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, Abnormal Extremes and mechanical cycling Sections 2.8.6, 2.8.7, and 2.8.3) on a representative sample of components from the Group B Differential Pressure Transmitters. Mechanical cycling has been included in the Group A Program and is referenced to as a type test for the Group B program. The Aging Tests will demonstrate that during the qualified life there are no in-service aging mechanisms capable of reducing the capability of the Group B Differential Pressure Transmitters to perform during or after a seismic event. As a consequence, the seismic testing on the un-aged Group B Differential Pressure Transmitters, is not prejudiced by any in-service aging mechanisms.

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<u>Step</u>	<u>Notes</u>
2.9.1	Production Test Sequence
2.8.1	Calibration performed at 80°F and 130°F
2.8.2	completes a performance test on all
2.8.3	production units
2.8.8	
2.9.2	Seismic Test Sequence
2.8.1	
2.8.2	Seismic (DBE) test sequence
2.8.5	
2.8.8	
2.9.3	Environmental Test Sequence
2.8.1	Environmental type test sequence on similar
2.8.2	piece of equipment as permitted by
2.8.3	IEEE-323-74 Section 6.3.2(3).
2.8.8	

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2.9.4 Aging Test Sequence

- 2.8.1 Aging to be addressed by separate testing as
- 2.8.2 described in Subprogram C of Appendix B to
- 2.8.4 WCAP-8587
- 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 Differential Pressure Transmitters (Qualification Group B) to complete their 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 Normal Environment Testing

The normal environment calibration tests are performed on each production transmitter.

2.10.2.2 Seismic Testing

Four Barton Differential Pressure Transmitters (Qualification Group B) were tested. For more details see Table 1 of Reference 1.

Six Veritrak Differential Pressure Transmitters (Qualification Group B) were tested. For more details see Tables 1 and 2 of Reference 3.

2.10.2.3 Aging Evaluation Program

A representative sample of critical components from the Differential Pressure Transmitters will be included in the Aging Evaluation Program described in Appendix B to WCAP 8587.

2.10.3 Test Summary

2.10.3.1 Normal and Abnormal Environment Testing

Westinghouse requires that the Qualification Group B Differential Pressure Transmitters 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 environmental testing required is to demonstrate equipment capabilities under normal and abnormal extremes.

Reference 2 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.

Westinghouse requires a calibration at 80°F and 130°F on every production unit. Peak to peak

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noise, time response and ability to meet performance requirements at 95% RH have been verified by type test. The ability to survive a containment pressure test will be verified by analysis.

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 seismic testing reported in References 1 and 3 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 spectra (Figure 1) 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.

2.10.3.3 Aging Evaluation

The Westinghouse Aging Evaluation Program (Appendix B, WCAP 8587) will incorporate a representative sample of components from the Qualification Group B Differential Pressure Transmitters. The objective of the program is to demonstrate that during the qualified life there are no in-service aging mechanisms capable of reducing the capability of the Qualification Group B Differential Pressure Transmitters to perform during or after a seismic event. As a consequence, the seismic testing on the un-aged transmitters described above, is not prejudiced by any in-service aging mechanism.

2.10.4 Conclusion

The demonstrated qualified life of the Qualification Group B Differential Pressure Transmitters will be established by the Westinghouse Aging Evaluation Program. The results of the aging program, together with the seismic and environmental testing described herein, demonstrate the qualification of the Group B Differential Pressure Transmitters employing the practices recommended by Reg. Guide 1.89 and 1.100.

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. McElhaney, D. L., R. B. Miller "Equipment Qualification Test Report Differential Pressure Transmitters Qualification Group B (Seismic Design Verification Testing)" WCAP-8687 Supp. 2 E04A (Proprietary), WCAP-8587 Supp. 2 E04A (Non-Proprietary).
2. WCAP-8587 (Non-Proprietary), Appendix C "Effects of Gamma Radiation Doses Below 10^4 Rads on the Mechanical Properties of Materials"
3. Skeers, D. M., "Equipment Qualification Test Report Differential Pressure Transmitters Qualification Group B (Seismic Design Verification Testing) WCAP-8687 Supp. 2 E04B (Proprietary), WCAP-8587 Supp. 2 E04B (Non-Proprietary).

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SECTION 3 QUALIFICATION BY EXPERIENCE

Westinghouse does not employ operating experience in support of the qualification program for the Differential Pressure Transmitters - Qualification Group B.

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SECTION 4 QUALIFICATION BY ANALYSIS

A review of materials utilized in Barton Model 752 and Veritrak Model 76DP1 differential pressure transmitters has been performed. Since teflon is not used in these transmitters a radiation life of 10^5 R is applicable based on the radiation analysis documented in Reference 2.

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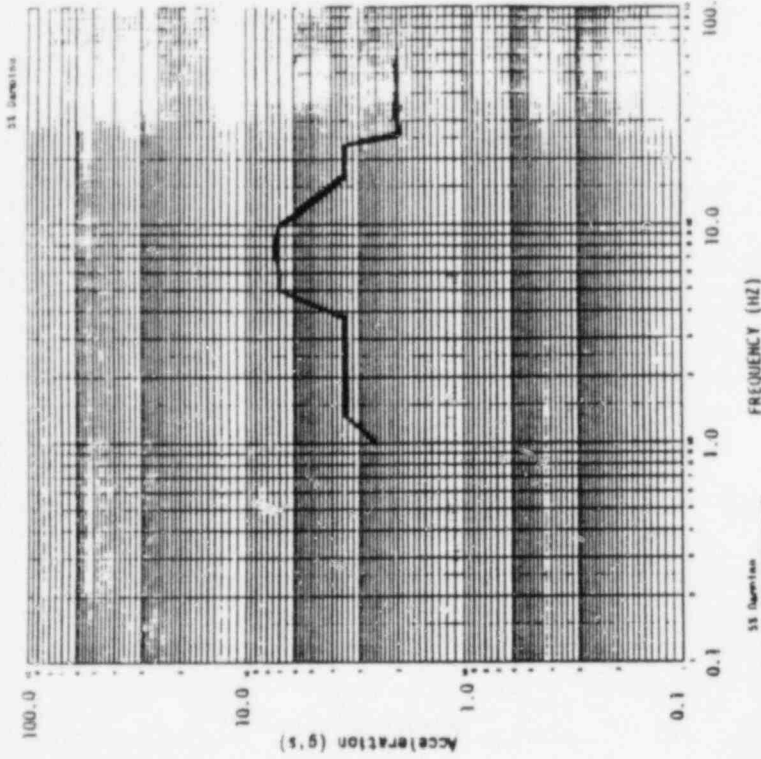


FIGURE 1A REQUIRED RESPONSE SPECTRUM
FOR SAFE SHUTDOWN EARTHQUAKE (INPUT A)

FREQUENCY (HZ)

55 Dampers

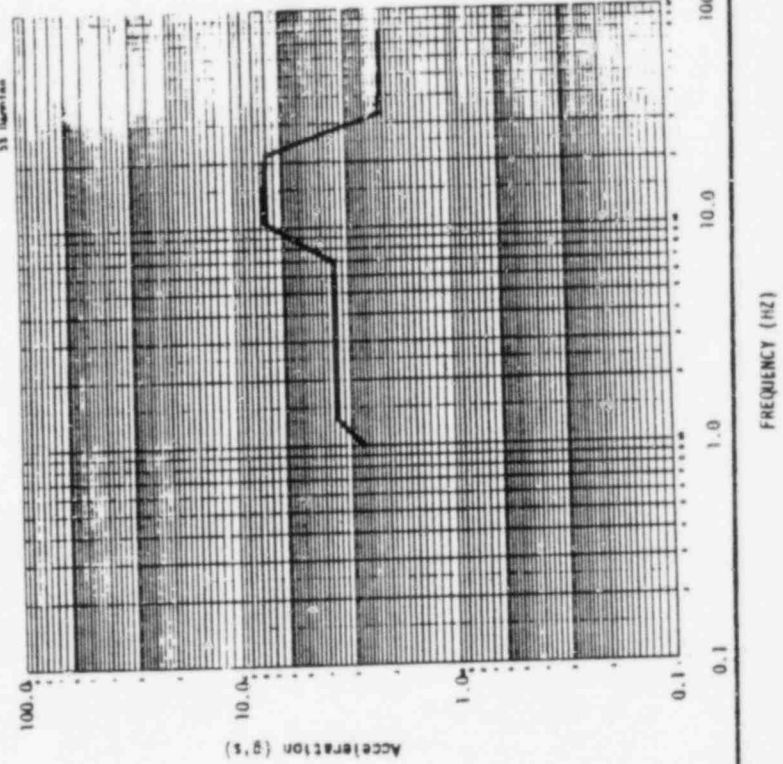


FIGURE 1B REQUIRED RESPONSE SPECTRUM FOR
SAFE SHUTDOWN EARTHQUAKE (INPUT B)

FREQUENCY (HZ)

55 Dampers

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

FREQUENCY (HZ)

55 Dampers

TABLE 1 (Sheet 1 of 2)

ACTUAL QUALIFICATION TEST CONDITIONS

EQUIPMENT (1) SYSTEM/CATEGORY	LOCATION STRUCTURE/AREA	MANUFACTURER TYPE/MODEL	ABNORMAL/ACCIDENT ENVIRONMENTAL EXTREMES		OPERABILITY		ACCURACY(%)		QUAL LIFE	QUAL METHOD	QUAL REF	QUAL PROGRAM STATUS
			PARAMETER	SPECIFIED (2)	QUALIFIED (3)	REQ	DEM	REQ	DEM			
RCS flow transmitter/ RPS/ Category c (5)	Containment Bldg./outside missile shield	Barton 752 and Veritrak 76DP1	Temperature Pressure Rel. humidity Radiation Chemistry	130°F atmos. 95 $10^5 R(y)$ None		Contin- uous	Con- tin- uous	+1	<+1	5 yrs. (4)	Seq. Test 4	ESE- Completed
Containment pressure transmitter/ RPS-PAM/ Category d	Safeguards building	Barton 752 and Veritrak 76DP1	Temperature Pressure Rel. humidity Radiation Chemistry	130°F Atmos. 95 $10^5 R(y)$ None		Conti- nuous	Con- tinu- ous	+1	+1	5 yrs. (4)	Seq. Test 4	ESE- Completed
Boric acid level transmitter/ PAM/ Category d	Auxiliary building	Barton 752 and Veritrak 76DP1	Temperature Pressure Rel. humidity Radiation Chemistry	130°F Atmos. 95 $10^5 R(y)$ None		Conti- nuous	Con- tinu- ous	+1	+1	5 yrs. (4)	Seq. Test 4	ESE- Completed
Refueling water storage tank level transmitter/ PAM/ Category d	Auxiliary building	Barton 752 and Veritrak 76DP1	Temperature Pressure Rel. humidity Radiation Chemistry	130°F Atmos. 95 $10^5 R(y)$ None		Conti- nuous	Con- tinu- ous	+1	+1	5 yrs. (4)	Seq. Test 4	ESE- Completed

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TABLE 1 (Sheet 2 of 2)

ACTUAL QUALIFICATION TEST CONDITIONS

EQUIPMENT (1) SYSTEM/CATEGORY	LOCATION STRUCTURE/AREA	MANUFACTURER TYPE/MODEL	ABNORMAL/ACCIDENT ENVIRONMENTAL EXTREMES		OPERABILITY		ACCURACY(%)		QUAL LIFE	QUAL METHOD	QUAL REF	QUAL PROGRAM STATUS
			PARAMETER	SPECIFIED (2)	QUALIFIED (3)	REQ	DEM	REQ	DEM			
Containment pressure transmitter/ CPS, PAM/ Category d	Safeguards building	Barton	Temperature	130°F		Conti-	Con-	+1	+1	5	Seq.	ESE- 4 Completed
		752	Pressure	Atmos.		nuous	tinu-			yrs.	Test	
		and	Rel. humidity	95			ous			(4)		
		Veritrak	Radiation	<10 ⁵ R(y)								
Boric acid tank level/ PAM/ Category d	Auxiliary building	76DP1	Chemistry	None								
		Barton	Temperature	130°F		Conti-	Con-	+1	+1	5	Seq.	
		752	Pressure	Atmos.		nuous	tinu-			yrs.	Test	
		and	Rel. humidity	95			ous			(4)		
		Veritrak	Radiation	<10 ⁵ R(y)								
		76DP1	Chemistry	None								

NOTES

- 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.
- Plant specific environmental parameters are to be inserted by the applicant.
- The values listed represent the design conditions plus margin. For completed programs, the values listed were met in the test. Any variations from the values listed were in a conservative direction or were not considered significant.
- Phase I of the Westinghouse Aging Evaluation Program as described in WCAP-8587 Appendix B will establish 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.
- The reactor coolant flow transmitter is only required to perform a safety function for contained faults. There are no adverse environments present when this instrument must perform its safety function. As a consequence a qualification Group B flow transmitter is normally employed. Where, at the specific request of the utility, Westinghouse supplies a Group A qualified flow transmitter for this function the parameters specified in the table associated with EQDP-ESE-3 are applicable except for HELB inaccuracies.