Attachment 3

Non-proprietary Weed Instrument Qualification Report 16690-QTR, "Qualification Test Report For Environmental and Seismic Qualification of Weed Instrument Model DTN2010 Pressure Transmitters," Revision 0

BECHTEL POWER CORPORATION	Job Number: 25402

SUPPLIER DOCUMENT REVIEW STATUS

STATUS CODE:

1 ☐ Work may proceed.

1C ☐ Work may proceed. Editorial comments need only be incorporated if revised for other purposes.

2 ☐ Revise and resubmit. Work may proceed subject to incorporation of changes indicated.

3 ☐ Rejected. Revise and resubmit.

4 ☒ Review not required. Work may proceed.

PO 234955

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	NA	NA	MC	NA	NA	NA	NA	NA	NA	NA

Status By:	DATE
M. S. Clark [signature]	8/30/11

QUALIFICATION TEST REPORT FOR ENVIRONMENTAL AND SEISMIC QUALIFICATION OF WEED INSTRUMENT MODEL DTN2010 PRESSURE TRANSMITTERS

Non-Proprietary Version of
Qualification Test Report No.: 16690-QTR Rev 0

Document No.: 3077-390572-001 Rev. 0

Commercial References:
Tennessee Valley Authority, Watts Bar 2
PO: 234955-25402-011-MRA-JQ08-00001
For Equipment Purchased on PO: 00038593/76125, SO: 383351

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APPROVALS

REV	ECO	REVISION DESCRIPTION	BY	APPROVED			DATE
0	N/A	Initial Release	RA	Rwa	AF	JMM	8/10/11

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1. Overview

1.1. Purpose

This document is a NON-PROPRIETARY summary of qualification report 16690-QTR used for the purpose of environmentally and seismically qualifying Weed Instrument Model DTN2010 Pressure (PA/PG) and Differential Pressure (DP) Transmitters to IEEE 323 and 344 standards with specific focus on CANDU style reactor applications. For the full CANDU Qualification test report and results see the RCM Technologies Canada Corp, Qualification Report 16690-QTR, Rev 00, Dec 2002.

The testing was performed by Weed Instrument and RCM Technologies Canada Corp., Mississauga, Ontario on behalf of Weed Instrument Company Inc., Round Rock, Texas under P.O. 69904.

1.2. Scope

It is the intention of this document to summarize the Qualification report of the testing that was conducted on the subject Pressure Transmitters to satisfy the requirements of the following specification for qualification by type testing:

> 3129-RD0288-001, Rev 0, "*Nuclear Qualification Test Plan for Weed Model DTN/2010 Series Pressure and Differential Pressure Transmitters*".

This qualification test program is intended to demonstrate that the pressure transmitters are capable of performing their safety related function(s) at any time over their qualified life while installed in the plant and exposed to the specified normal service and accident conditions.

1.3. Testing Summary

A total of 14 transmitters, including both Pressure and Differential Pressure units, were tested as part of this Qualification Program. See section 4 for details.

Upon completion of the test program it was demonstrated that the DTN2010 transmitters are qualified to the requirements set forth in Test Plan 3129-RD0288-001. The transmitters have a qualified life of 40 years at a service temperature of 35°C (95°F) or 11 years at a service temperature of 49°C (120°F). During temperature aging, 20,000 full range pressure cycles were applied to simulate a life cycle of pressure changes. The transmitters were also exposed to radiation in two groups, one to 10 Mrad TID and the other to 31 Mrad TID. This included both the normal and accident radiation levels. They were then subjected to thermal aging, seismic testing, and LOCA/MSLB accident conditions.

Upon completion of all tests, the DP transmitters were hydro tested to verify the integrity of the O-ring seals. Based on the anomalies observed, the maximum working pressure rating of the transmitters is 3000 psi for applications up to 10 Mrad TID radiation and 2400 psi for applications of 34 Mrad TID.

The table 1 lists the root sum square of the average zero and span errors. Maximum acceptable error values were not defined due to the generic nature of the qualification program. The accuracy requirement for the safety related function for each specific application must be addressed by the end user.

Table 1: Test Result Summary

Test Stage	Average Magnitude (% of Span)		Worst Case Magnitude (% of Span)		RRS of Zero & Span Averages
	Zero	Span	Zero	Span	(% of Span)
Post 2-Year Thermal Aging	0.18	0.14	0.48	0.60	0.23
Post-Radiation (11 Mrad)	0.60	0.06	0.98	0.10	0.61
Post-Radiation (34 Mrad)[1]	0.89	0.18	2.15	0.35	0.91
Post 40-Year Thermal Aging	0.63	0.29	1.43	1.30	0.69
RCM Baseline	0.75	2.03	3.90	7.80	2.17
Post-Seismic[2]	0.12	0.12	0.35	0.25	0.17
Post-LOCA	0.89	0.27	2.25	0.42	0.93
Post-MSLB	0.16	0.68	0.30	0.70	0.69
Post Negative Pressure Test	0.07	0.21	0.18	0.23	0.22

Notes:
[1] Data from Specimen #6 excluded for this test only because Q3 failed during the test. Q3 was replaced and the transmitter continued with the remainder of the tests
[2] Data from Specimen #10 was excluded after post-Seismic due to a defective sensor following MSLB

The details of each test are presented in section 7.

1.4. General Operation / Function Description

The DTN2010 series of pressure transmitters are similar in fit, form and function to Model N97 transmitters which have previously been qualified for PWR, Harsh Environment, outside containment applications.

Each pressure and differential pressure transmitter contains a strain gauge measurement sensor. On pressure (PA/PG) transmitters, the sensor is in direct contact with the process. On the differential pressure (DP) transmitters, a push-rod links movement of an isolation diaphragm to the sensor. The process is connected to the capsule and diaphragm through a pair of flanges that are bolted to the capsule and sealed with an EPM o-ring. The movement of the sensor causes the electrical resistance of the sensor to change. This resistance change is converted to a voltage, electronically corrected for temperature effects, and converted to 4-20 mA or 10-50 mA output scale.

1.5. % Error (shift) Determination

The error calculation performed by Weed Instrument Company is the comparison of data taken from each transmitter before and after each test. The data presented in the above summary (Table 1) is based on the calculations performed per the method used by Weed Instrument Company.

2. REFERENCES

Weed Instrument Co., Inc. Documents

- 3129-RD0288-001, Rev 0, "Nuclear Qualification Test Plan for Weed Model DTN/2010 Series Pressure and Differential Pressure Transmitters"

IEEE Documents

- IEEE 323-1974 & 1983 "IEEE Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations"
- IEEE 344-1975 & 1987 "IEEE Recommended Practices for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations"

RCM Documents

- 16690-QTP Rev. 01, "Qualification Test Procedure for Environmental and Seismic Qualification of Weed Model DTN 2010 Pressure Transmitters", June 2002
- 16690-QTR Rev. 00, "Qualification Test Report for Environmental and Seismic Qualification of Weed Model DTN 2010 Pressure Transmitters", December 2002

CSA Documents

- CAN3-N289.4-M86, "Testing Procedures for Seismic Qualification of CANDU Nuclear Power Plants"

3. DEFINITIONS

Accident Conditions are those enveloped by the maximum expected transients of pressure, temperature and radiation after any event postulated for the station.

Aging is the degradation of the properties of a material that occurs as a result of being exposed to elevated temperatures or to a source of radiation for a period of time.

Design Basis Earthquake is an engineering representation of the design basis seismic ground motion expressed in the form of response spectra or time-histories and is employed for the seismic qualification of structures and equipment.

Margin is the difference between the postulated service conditions and the test conditions actually used for qualification testing. It allows for manufacturing variations existing between the test sample and the in-service unit.

Mission Time is the time interval for which the equipment must operate satisfactorily once an accident has occurred.

Normal Conditions are those conditions under which the equipment will operate during normal service, including hot summer days or ventilation system failures.

Operating Basis Earthquake (OBE) is an earthquake that could reasonably be expected to occur at the plant site during the operating life of the plant considering the regional and local geology and seismology and specific characteristics of local subsurface material. It is that earthquake that produces the vibratory ground motion for which those features of the nuclear power plant, necessary for continued operation without undue risk to the health and safety of the public, are designed to remain functional.

Required Response Spectrum (RRS) is the response spectrum specified by the Purchaser as part of their specification. An RRS is also known as a Specified Response Spectrum.

Safe Shutdown Earthquake (SSE) is an earthquake that is based upon an evaluation of the maximum earthquake potential considering the regional and local geology and seismology and specific characteristics of local subsurface material. It is that earthquake that produces the maximum vibratory ground motion for which certain structures, systems, and components are designed to remain functional. These structures, systems, and components are those necessary to ensure:

(1) The integrity of the reactor coolant pressure boundary
(2) The capability to shut down the reactor and maintain it in a safe shutdown condition,
(3) The capability to prevent or mitigate the consequences of accidents that could result in potential off-site exposure.

Service Conditions are the environmental loading power and signal conditions expected as a result of normal operating requirements, expected extremes (abnormal) in operating requirements, and postulated conditions appropriate for the design basis events of the station.

Test Response Spectrum (TRS) is the response of the actual shaker table motion as obtained from the test with the equipment mounted on the shake table.

4. IDENTIFICATION AND DESCRIPTION OF TEST SPECIMENS

The equipment tested were Weed Instrument Model DTN2010 Pressure Transmitters. Table 2 below lists the individual specimen configurations and the related testing completed on each. Table 3 identifies the test specimen's applicable options and mounting configurations.

Table 2: Test Specimen Identification

ITEM #	Serial No.	Calibration Range	Output	High Temp. Test	Radiation Aging	Thermal Aging (40 Years)	Seismic	LOCA/MSLB
1	304	0 – 50 in WC	4 - 20 mA	YES	10 Mrad	YES	YES	MSLB
2	305	0 – 50 in WC	4 - 20 mA	YES	31 Mrad	YES	YES	LOCA
3[4]	313	0 – 50 in WC	4 - 20 mA	YES	31 Mrad	YES	YES	LOCA
	306[1]	0 – 50 in WC	4 - 20 mA	[1]	NO	NO	NO	NO
4 C	314	0 – 50 in WC	4 - 20 mA	N/A	N/A	N/A	N/A	N/A
5	307	0 – 100 in WC	4 - 20 mA	YES	31 Mrad	YES	YES	LOCA
6[2]	315	0 – 100 in WC	4 - 20 mA	YES	31 Mrad	YES	YES	LOCA
7	308	0 – 250 in WC	4 - 20 mA	YES	10 Mrad	YES	YES	MSLB
	309[3]	0 – 250 in WC	4 - 20 mA	YES	10 Mrad	YES	N/A	N/A
8 C	310	0 – 250 in WC	4 - 20 mA	N/A	N/A	N/A	N/A	N/A
9	317	0 – 200 psig	4 - 20 mA	YES	10 Mrad	YES	YES	MSLB
10	318	0 – 200 psig	10-50 mA	YES	31 Mrad	YES	YES	LOCA
	316[3]	0 – 200 psig	4 - 20 mA	YES	31 Mrad	YES	N/A	N/A
11 C	319	0 – 200 psig	4 - 20 mA	N/A	N/A	N/A	N/A	N/A
12[5]	320	2500 - 0 psig	4 - 20 mA	YES	10 Mrad	YES	YES	MSLB
13[4]	322	2500 - 0 psig	4 - 20 mA	YES	31 Mrad	YES	YES	LOCA
14	323	2500 - 0 psig	4 - 20 mA	YES	10 Mrad	YES	YES	LOCA
15 C	324	2500 - 0 psig	4 - 20 mA	N/A	N/A	N/A	N/A	N/A

Note: Item codes with C suffix used as control (reference) transmitters during testing.

[1] This transmitter had an anomaly during the High Temp. test and was removed from the qualification program. See Notice of Anomaly RD0288-1.

[2] This transmitter is actually a 0-250 in WC transmitter turned down to a 0-100 in WC.

[3] These two transmitters were used as spares through thermal and radiation aging. Their applicable data has been utilized in the overall shift calculations presented in the summary.

[4] Data from Specimens #3 and #13 were excluded due to board contamination since it could not be determined when the contamination started to affect readings.

[5] Data from Specimen #12 was excluded due to two bad resistors since it could not be determined when the failed resistors started to affect readings.

TABLE 3: Test Specimen Configuration and Mounting			
#	**Serial No.**	**OPTION**	**MOUNTING**
1	304	Quick Disconnect Connector	Wall
2	305	N/A	Wall
3	313	Connection Head / Metal O-rings	Pipe
5	307	N/A	Wall
6	315	Turned Down Output / Metal O-rings	Wall
7	308	Dampened Output	Wall
9	317	N/A	Wall
10	318	N/A	Vertical Pipe
12	320	Connection Head / Reverse Output	Horizontal Pipe
13	322	Dampened Output / Reverse Output	Wall
14	323	Reverse Output	Wall

5. PERFORMANCE REQUIREMENTS & ACCEPTANCE CRITERIA

The following test specimen performance requirements and acceptance criteria were specified by Weed for use during qualification testing at RCMT.

5.1. Baseline Function Tests (RCM)

The output shift determined by the functional check shall not be more than ±0.25% of the calibrated span.

5.2. Seismic Testing

The specimens shall not experience significant physical damage and shall remain functional during seismic testing.

5.3. Post-Seismic Function Tests

The output shift determined by the functional check shall not be more than ±0.8% of the calibrated span.

5.4. Harsh Environment Simulation

The specimens shall not experience significant physical damage and shall remain functional from 0% to 100% of the URL throughout the harsh environment simulation.

5.5. Post Harsh Environment Function Tests

The output shift determined by the functional check shall not be more than ±2% URL for the LOCA specimens and ±2% URL for the MSLB specimens.

5.6. Negative Pressure Test

The specimens shall not experience significant physical damage and shall remain functional from 0% to 100% of the URL throughout the negative pressure test.

5.7. Post Negative Pressure Function Tests

The output shift determined by the functional check shall not be more than ±0.8% of the calibrated span.

5.8. Physical Integrity

The test specimen transmitters shall not show any significant physical damage as a result of qualification testing.

6. TEST EQUIPMENT AND SET UP

A list of all equipment used by RCM and Weed Instrument Company to conduct the qualification test program is included in Appendix F of the complete test report.

6.1. Test Specimen Function Testing

For all function testing, including that carried out during harsh environment and seismic testing, the test specimen transmitters were mounted to a test fixture and connected to the following test equipment which is summarized in this Qualification Test Report complete with calibration records:

- Precision Pressure Controller/Calibrator
- 2500 psig "Extra Dry" Air Bottles and Regulators
- 4500 psig Nitrogen Bottle and Regulator
- Pressure Gauges
- Step-Down Air Regulators
- Computer Data Acquisition System

Each test specimen was secured (bolted) to a mounting bracket supplied by Weed. The brackets and transmitters were attached to a test fixture throughout all stages of testing. Each set of transmitters with identical calibration ranges were pressurized from the same header, including the control transmitters, to ensure no differences in input pressure. The low sensing lines from each transmitter were vented to atmosphere.

The functional checks were performed by a calibrated precision pressure controller/calibrator or regulator and applicable gauges. The calibrator or regulator controlled the required step pressures while the output of the specimen transmitters were monitored by a computer data acquisition system. The input pressure was measured by the reference transmitter for each pressure range (the accuracy of the input pressure measurement was dependant on the reference specimen accuracy). For each supplemental test following baseline, the input pressure was applied as close as possible to that measured during the baseline tests.

6.2. Negative Pressure/Harsh Environment Testing

The specified harsh conditions were imposed on the test specimen transmitters by means of the RCM Environmental Chamber, Boiler, and Superheater as required. The chamber ambient environmental conditions were varied according to the transient shown in Figures 4, 5, and 6. Conditions within the chamber were controlled and monitored

Conditions within the chamber were monitored by a computer data acquisition system with manually read, calibrated backup instruments. Computer data collection was from two type 'T' thermocouple probes and a pressure transmitter. A pressure gauge and third thermocouple probe were provided as backup to the data acquisition system. The accuracy of measurement of the test parameters by the data acquisition system was verified as approximately 2°C for temperature and 2 psig for pressure prior to testing.

The computer recorded the chamber conditions a minimum of every second for the first hour of the harsh conditions transient, every 5 seconds from 1 to 24 hours, and every minute thereafter.

6.3. Seismic Testing

The dynamic motion of the shake table was monitored by a high-speed PC-based data acquisition system and accelerometers. RCM seismic facility software was used to calculate test response spectrum (TRS) to be compared to the required response spectra (RRS) as shown in Figures 1 and 2.

During all tests, the shake table cylinder was controlled by a servo-valve and controller which receives a low voltage DC signal generated by the I/O board through software running on the PC. Output of the accelerometers were recorded through the I/O board into the computer's Random Access Memory and stored on the computer's hard disc drive.

6.3.1. Shake Table Monitoring During Exploratory Test

During exploratory testing, 3 accelerometers (one in each of the three orthogonal axes of symmetry) were affixed to a block mounted on the top of the test specimen transmitter. Following the tests, the response of these accelerometers relative to that of the table accelerometer were calculated in order to determine resonant behaviour and any cross-coupling effects.

7. QUALIFICATION TEST PROGRAM AND DISCUSSION OF RESULTS

7.1. Test Sequence

The test sequence for the qualification program is outlined in Table 4 below.

TABLE 4: TEST SEQUENCE

#	SEQUENCE DESCRIPTION	FACILITY	SECTION
1*	Initial Inspection and Specimen Preparation	WEED	-
2*	Baseline Function Tests	WEED	7.2
3*	High Temperature Operability Test	WEED	7.3
4*	Post High Temperature Operability Function Tests	WEED	7.4
5*	Radiation Aging	WEED	7.5
6*	Post Radiation Aging Function Tests	WEED	7.6
7*	Thermal Aging / Pressure Cycling	WEED	7.7
8*	Post Thermal Aging / Pressure Cycling Function Tests	WEED	7.8
9	Initial Inspection (RCM)	RCM	7.9
10	Baseline Function Tests (RCM)	RCM	7.10
11	Seismic Testing (Resonance Search, Broadband Random)	RCM	7.11
12	Post-Seismic Function Tests	RCM	7.12
13	Harsh Environment Simulation (MSLB / LOCA)	RCM	7.13
14	Post Harsh Environment Function Tests	RCM	7.14
15	Negative Pressure Test	RCM	7.15
16	Post Negative Pressure Function Tests	RCM	7.16
17	Final Inspection	RCM	7.17
18*	Post-Qualification/Static Pressure Test	WEED	7.18

* These steps are not within the scope of the RCM qualification test program and were not included in the qualification test procedure, however, data for these steps have been provided to RCM for inclusion in this Qualification Test Report.

Note: Resonance Search testing was conducted prior to Baseline Function Tests (at RCM).

7.2. Baseline Function Tests (Weed)

Prior to any testing, the performance of each specimen was verified through an 11-point calibration per ISA S37.8 which consisted of measuring and recording the transmitter output at 20% intervals from 0 to 100% of upper range limit (URL) for 2 cycles. A summary of the test data is presented in Appendix K of the complete report.

Prior to the start of testing, the electronics housing cover was hand tightened plus $^1/_8$ to ¼ of a turn. The span and zero covers screws were torqued to 24 in-lbs.

7.3. High Temperature Operability Test

The test specimens were placed inside the test chamber at a temperature of 120 °C +5°C (248°F +9°F) for 24 hours. The test specimens were energized and pressurized to 50% URL during the test. Following the test, an 11-point calibration check was performed on each specimen. The output of Transmitter Serial No. 306 was locked at ~5 V during the test and was unstable upon completion of the test. See Notice of Anomaly (NOA) RD0288-1. NOA RD0288-1 was dispositioned by Weed.

Anomaly No. RD0288-1
The cause of this anomaly was considered to be a manufacturing defect. The procedure for the fabrication of the capsule has been revised to ensure adequate manufacturing and inspection steps are implemented to prevent such defects.

During the High Temperature Operability Test, erratic transmitter output was observed. Upon investigation, the input pressure became suspect due to the fact that the output changes were identical on all transmitters. It was decided to repeat the test while monitoring the supply line to the transmitters. The test specimens were placed inside the test chamber at a temperature of 120 °C +5°C (248°F +9°F) for another 24 hours. The monitoring of the supply line showed that the line pressure exiting the regulators was unstable and in rhythm with the transmitter output. Therefore, it was concluded that the erratic output of the transmitters were responses to the input pressure.

7.4. Post High Temperature Operability Function Tests

Following the High Temperature Operability Test, an 11-point calibration check was performed on each specimen. The data was analyzed for percent changes in output. This test was equivalent to 1.9 years of thermal aging for the test specimens; therefore, an equivalent test time was deducted from the accelerated thermal aging test.

7.5. Radiation Aging

The test specimens were subjected to the applicable Total Integrated Dose (TID) of gamma radiation (according to Table 2). This TID included the 40-year service life plus the accident exposure (it also includes the gamma equivalent of the post-accident beta dose). A cobalt 60 source and an exposure rate of 1.0 Mrads/hour maximum was utilized. To include margin, the specimens requiring 31 Mrad TID were exposed to 34.1 Mrad TID and the specimens requiring 10 Mrad were exposed to 11 Mrad TID.

Each specimen was energized, supplied with a constant pressure of 20% to 80% of URL, and monitored throughout the test. The radiation test was conducted by Southwest Research Institute.

7.6. Post Radiation Aging Function Tests

Following radiation aging, a calibration check was performed on each specimen. The data was analyzed for percent changes in output. The specimens did not experience any physical damage and remained functional during the test. Several test specimens exhibited shifts which exceeded the acceptance criteria specified in the Test Plan. NOA RD0288-2 was generated. NOA RD0288-2 was dispositioned by Weed and the anomaly was attributed to the presence of contamination or a poor solder joint on the board.

Anomaly No.RD0288-2 (Specimen #'s 3,6,12,13)
For the two specimens on which Q3 was replaced, the anomaly was initially attributed to a component failure. However, upon subsequent testing and evaluation of the transmitters, it is believed that correction of the problem by the replacement of the component was due to presence of contamination or poor solder joint on the board. To implement a corrective action for this failure, the soldering,

cleaning and handling procedure for the electronic assemblies for DTN2010 has been revised to incorporate the additional steps for these procedures.

For the test specimens which exhibited shifts of 2%-3%, the shift is noted. However, it is not of concern. The fact that during the test the specimens are exposed to the TID in a short period of time compared to actual plant conditions, is a consideration that must be taken into account by the end user for the specific application and upon review of the full data for each test specimen.

7.7. Thermal Aging / Pressure Cycling

To simulate a 40 year service life, the specimens were placed in a thermal aging chamber and subjected to a constant temperature of 110°C +5°C (230°F +9°F) for a period of 20 days and 120 °C +5°C (248°F +9°F) for 11 days.

The accelerated schedule was based on the Arrhenius model of accelerated aging using an activation energy of 0.8 eV and an operating temperature of 35 °C (95 °F). The calculation details and the evaluation of activation energies are presented in the Test Plan in Appendix L of the complete report. The Activation Energy Evaluation report is based on the model N97 pressure transmitter. The materials/components used in DTN 2010 are similar to those of N97, therefore the same activation energy was utilized for this test.

The specimens were energized and pressurized at 50% URL during the thermal aging test. The specimen outputs were monitored throughout the test and data recorded approximately every 30 to 45 seconds using a PC controlled Hewlett Packard data acquisition and voltmeter system.

At 10-year, and 20-year intervals (240 and 479 hours test time, respectively) the aging test was halted, the specimens allowed to cool to ambient and a functional calibration check was performed. The aging clock resumed once the specimens were returned to the chamber and the aging temperature reached.

During thermal aging, cycle aging of transmitters was accomplished by raising the pressure in the pressure sensing lines from 0% to at least 100% URL and back to 0% 20,000 times. The time for each cycle was ~30 seconds (15 seconds at 0% and 15 seconds at 100%). At the 628th cycle, the supply pressure for the high pressure (2500 psi) test specimens dropped to 1200 psi. A test anomaly was generated. The supply pressure was restored and the test continued to the required levels. See NOA RD0288-3.

Anomaly No. RD0288-3 (Specimen #'s 12,13,14,15)
This was a test equipment malfunction. The interruption to the test did not have an impact on the qualification. The test time and the number of cycles were adjusted to meet the Test Plan requirements.

7.8. Post Thermal Aging / Pressure Cycling Function Tests

Following thermal aging, a calibration check was performed on each specimen. The data was analyzed for percent changes in output. There were no failures noted due to thermal aging.

After the post-test performance verification, each specimen was re-calibrated to provide nominal outputs, 4 to 20mA or 10 to 50mA per Table 2. This established the baseline for the next set of tests to be conducted at RCM Technologies. During the calibration adjustment, one transmitter exhibited unstable output. NOA RD0288-4 was generated. NOA RD0288-4 was dispositioned by Weed and the anomaly was attributed to contamination on the PC boards.

Anomaly No. RD0288-4 (Specimen #13)
The anomaly was initially attributed to the potentiometer malfunction. However, upon subsequent failure of the test specimen (S/N 322), the cause of failure was determined to be presence of contamination on the boards. See NOA RCM (1669-03).

Thermal aging is not typically used to identify drift, because aging is performed above the plant operating temperature. However, based on the simulated 40 year life, the effective change using a root sum square of the average zero and span errors was 0.69% of URL for 40 years.

Prior to shipment of the transmitters to RCM, it was decided to test three of the transmitters in pipe-mounted configuration. The brackets for Specimens 3, 5 and 7 were modified for the pipe-mounted configuration. The DP transmitter was mounted on a 2" pipe using a 3/8 SS U-bolt and a 3/8-16UNC-2A, 3.5" long, Grade 5 bolt with 3/8 hex nut and a SS split lock washer. The PA/PG transmitter was mounted in two different configurations horizontal and vertical. The horizontal configuration used two 3/8-16UNC-2A, 3.5" long, Grade 5 bolts with 3/8 hex nut and SS split lock washers. The vertical configuration mounting was similar to the DP mounting hardware. The U-bolt on each test specimen was torqued 20-22 ft-lbs. and the 3/8 bolt was torqued 35-37 ft-lbs.

7.9. Initial Inspection (RCM)

Prior to initiation of the RCM test program, the test specimens underwent inspection comprised of the following:

a) Compliance with existing specifications

b) Dimensional verification as per the manufacturer's assembly drawing

c) Visual inspection of the physical condition

Photographs were taken and all pertinent information recorded on the appropriate data forms.

All specimens were found undamaged and conformed with their associated drawings with the following exceptions. The mounting bracket for Specimen 3 included two additional side bracing plates and one additional bolt hole through the bottom of the bracket. In addition, the mounting brackets included with Specimens 5 & 7 were supplied with this additional bolt hole. These discrepancies were not expected to impact qualification.

7.10. Baseline Function Tests (RCM)

Baseline function tests were conducted to measure and record critical parameters at the beginning of the test program. This information was used to compare the results from subsequent testing to evaluate degradation of these parameters that may have occurred due to the imposition of stress during the test program.

During Baseline testing, each specimen was verified through a Functional Check consisting of measuring and recording the transmitter output at 0, 60 and 100% of upper range limit (URL) and comparing the results to those of the same transmitter tested before leaving Weed Instrument Co. . The pressure sensing lines were pressurized with air. All results were recorded on the appropriate data form and compared to the acceptance criteria of Section 5.

Except for the initial Baseline and the Seismic tests, test specimen performance was evaluated with respect to the output of the 4 reference units (4C, 8C, 11C & 15C). This being the case, it was necessary to perform a baseline of test specimen output vs. reference unit output. The results of these tests would be used to evaluate any degradation of performance as a result of the test program. Since no reference unit was supplied for Specimens 5 & 6 (0-100" H_2O) it was necessary to compare their output to Specimen 8C. Since specimen 8C was calibrated for 0-250" H_2O, its output required scaling in order to make the comparison valid. All output values for 8C (excluding zero) were converted using the following formula: $y = 2.5x - 1.5$.

A baseline acceptance criteria of ±0.25% error was specified by Weed. This accuracy, however, referred to actual transmitter accuracy when compared to a recognized pressure standard, not a reference transmitter. As a result, a number of test units (Specimens 1, 2, 3, 5, 6, 7, 9, 13 & 14) did not meet the required acceptance criteria. NOA 1669-01 was issued to Weed to describe the anomaly. NOA 1669-01 was dispositioned by Weed and the anomaly was attributed to position effect and transportation vibration/shock during shipment to RCM.

Anomaly No. RCM (1669-01, Specimen #'s 1,2,3,5,6,7,9,13)
The shift in output was noted after the transmitters were shipped from Weed to RCM Technology. Factors such as position effect and transportation vibration/shock which may have influenced the output of the transmitters, will not be present after plant installation and the calibration errors would be readjusted after installation in the plant location; therefore the anomaly has no impact on qualification.

7.11. Seismic Testing

The test specimens identified in Table 2 as requiring seismic testing were subjected to resonance search and broadband random motion seismic conditions per Operating Basis Earthquake (OBE) and Safe Shutdown Earthquake (SSE) Required Response Spectra levels presented in Figures 1 and 2 respectively.

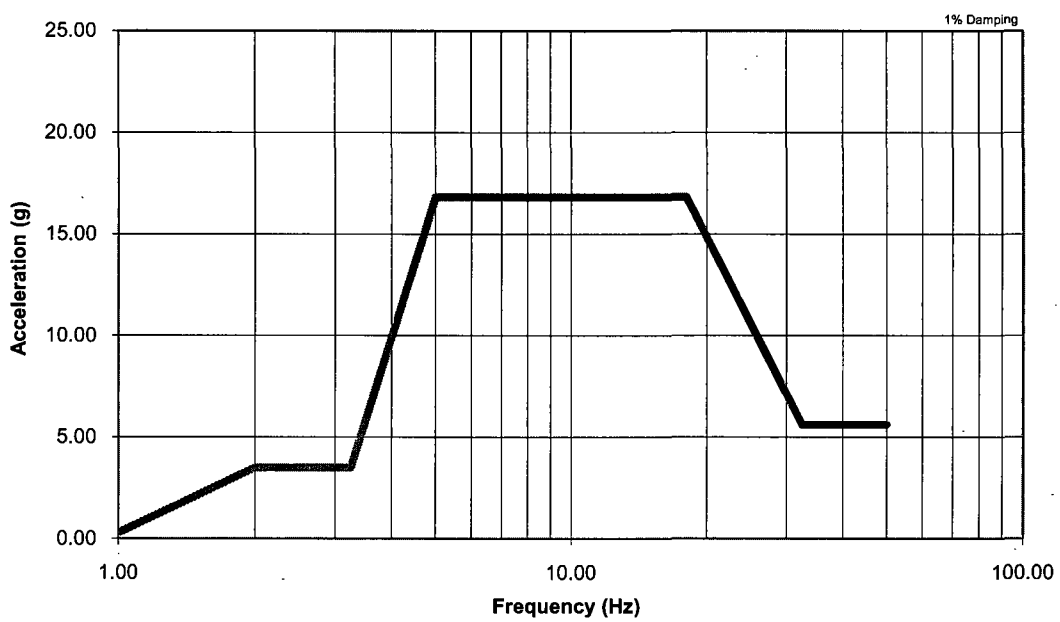


Figure 1: Required Response Spectrum (OBE)

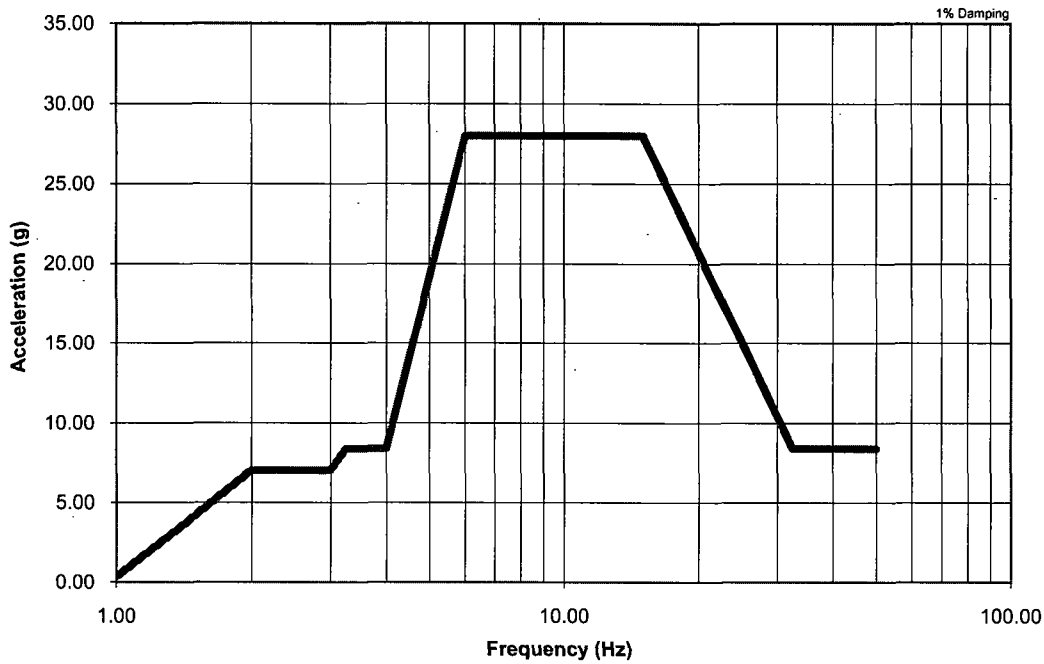


Figure 2: Required Response Spectrum (SSE)

7.11.1. Resonance Search

The resonance search test was used to establish the presence of any resonant frequencies of the test specimens. As there were a number of unique transmitter configurations, only one transmitter from each group was tested for resonance. The following table lists the units tested and the specimens that are covered from each test and their associated lowest resonant frequency:

TABLE 5: RESONANCE SEARCH TEST SPECIMENS

TEST SPECIMEN	UNITS OF SIMILAR CONSTRUCTION	LOWEST RESONANT FREQUENCY
1	N/A	46 Hz
3	N/A	49 Hz
7	2, 5, & 6	48 Hz
9	13, 14	69 Hz
10	N/A	>100 Hz
12	N/A	36 Hz

Exploratory results on the specimens tested are applicable to all test specimens of similar construction and configuration.

The resonance search was a bi-axial sinusoidal sweep from 1-100Hz at a sweep rate of 2.0 octaves/minute and at an input level of 0.2 g. The test consisted of one upward sweep and one downward sweep and was repeated for both the XY and ZY orientations.

The RCM bi-axial shake table was used to conduct the exploratory testing on the test specimens. The selected test specimens were rigidly mounted to the shake table. The bolt torque used to secure the specimen brackets to the test fixture were recorded in the seismic test log. The identical materials and torque values were used subsequently for Broadband Random Testing. DP test specimens were mounted with 3/8" UNC 18-8 SS bolts 2" long with 3/8" SS hex nuts and SS split lock washers. PA/PG test specimens were mounted with 5/16" UNC 18-8 SS bolts 1" long with 5/16" SS hex nuts and SS split lock washers.

During exploratory testing, three accelerometers (one in each of the three orthogonal axes of symmetry) were affixed to a block mounted on the top of the specimen. Following the test, the response of these accelerometers relative to that of the table accelerometer was calculated in order to determine resonant behavior and cross-coupling effects, if any.

7.11.2. Broadband Random Testing

Each test specimen was subjected to a series of broadband random tests between frequencies of 1 to 50 Hz. The simulation consisted of 5 consecutive runs of OBE and a subsequent single run of SSE levels. The Test Response Spectrum (TRS) for each of the tests enveloped the Required Response Spectra (RRS) as per Figures 1 and 2.

Broadband random testing was performed with the transmitters divided into two groups. Group 1 consisted of the LOCA specimens while Group 2 was composed of the MSLB specimens (as identified in Table 2)

The table acceleration time history as measured by the accelerometer during each test was analyzed using a damping ratio of 1% and plotted as a Test Response Spectrum (TRS) at a minimum of 1/6 octave intervals over the range of 1 to 50 Hz.

Broadband random vibration qualification tests were performed with the test specimens mounted on a uni-axial shake table. The specimens were tested with the input motion in each of the 3 major axis of symmetry. The RRS levels presented as Figures 1 and 2 were amplified by a factor of 1.4 to account for multi-directional affects as recommended by Reference 2.4.1.

During broadband random testing, the control transmitters were placed outside of the test area. The pressure sensing lines were filled with water (both DP and Pressure units). The pressure lines to the test specimens and their respective control transmitters were taken off the same header to ensure no variations in the input pressure. The input pressure was kept at 50% of URL throughout the test. The input and output of each test specimen was monitored during the broadband random simulation and the results were compared to the acceptance criteria of Section 5. Each specimen was mounted to the table to simulate field mounting.

For each seismic trial, the transmitter response relative to its pre-test output was calculated and plotted.

It was noted that all units functioned during seismic testing.

7.12. Post-Seismic Function Tests

Upon completion of seismic testing, function testing was repeated as outlined in Section 7.10.

The acceptance criteria of Section 5 were applicable.

All units except Specimen 3 and Specimen 13 were within the required accuracy of ± 0.8%. Specimen 3 was 1.075% (zero) and 0.989% (span) and Specimen 13 was 1.750% (zero) and 2.500% (span). NOA 1669-02 was issued to Weed to describe the anomaly. NOA 1669-02 was dispositioned by Weed and the anomaly was attributed to contamination of the PC board.

Anomaly No. RCM (1669-02, Specimen #'s 3,13)
It should be noted that the two transmitters that had the shift, ultimately failed at subsequent tests. The cause of failure which was determined to be contamination of the PC board has been discussed under Anomalies RCM (1669-03) and RCM (1669-05).

7.13. Harsh Environment Testing

The test specimens were subjected to the accident conditions presented in Figures 4, 5, and 6. The specimens were tested in two groups, LOCA and MSLB, as identified in Table 2. The chamber pressure was kept as low as possible during the negative requirement portion of the test.
The integrity of the electronic housing covers and the zero and span cover was verified prior to the start of the accident tests and they were re-torqued as necessary.

During the transient peak period of the test profiles, chamber temperature and pressure were controlled by the application and venting of saturated (LOCA) or superheated (MSLB) steam from the RCM boiler/superheater. During the cool down and tail periods temperature and pressure (and the assurance of 100% humidity) were controlled by heating the water condensed in the chamber sump with a 5 kW element controlled to the required temperature of the test chamber. This method for the maintenance of a moisture-saturated environment in the test chamber satisfies the requirements of IEEE-323 (Reference 2.2.1).

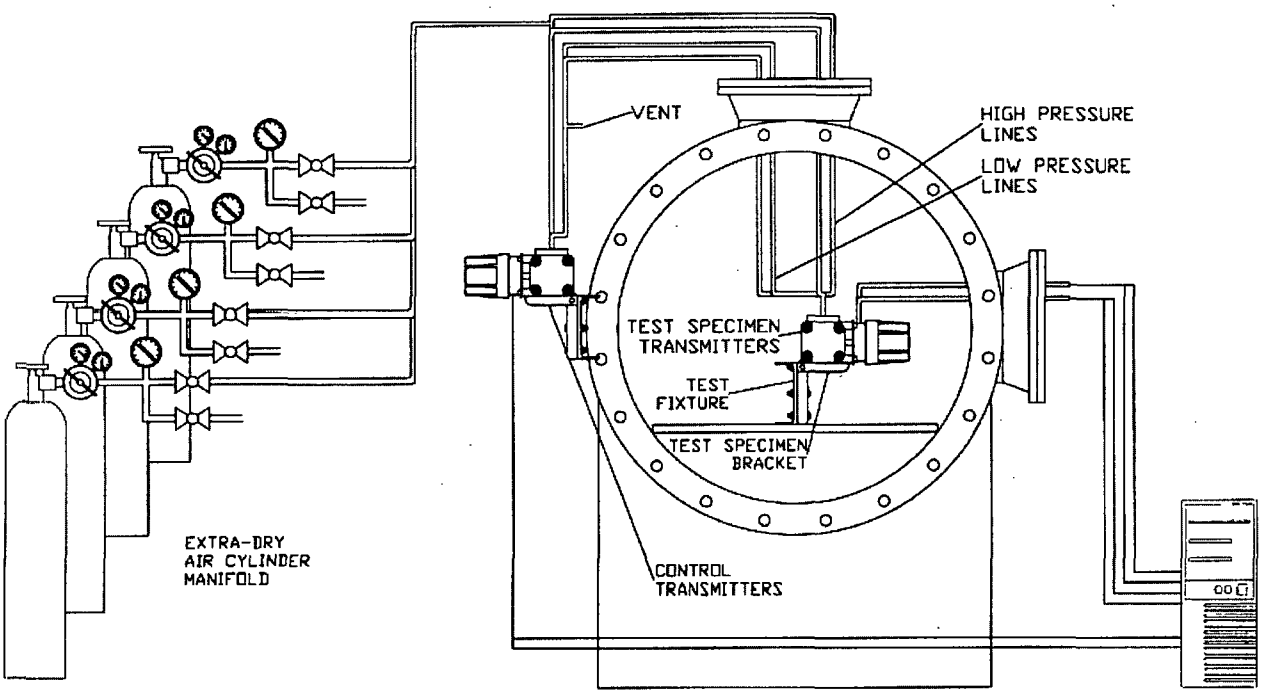
The specimen transmitters were energized, supplied with a constant pressure, and monitored throughout the LOCA and MSLB tests. The data was recorded at a high scan rate during the transient phase and then the rate reduced for the remainder of the test. The input pressure to the control transmitters and the test transmitters were kept at 50% of the URL throughout testing except as required during the operability testing. The pressure sensing lines were pressurized with air.

7.13.1. LOCA Testing

The test specimens were installed in the chamber. The lead wires exiting the specimens were protected from the accident environment by means of a sealed conduit. The high pressure line for each transmitter was routed through the chamber to its respective header while the low side of the DP units were referenced to atmospheric pressure

Temperature and pressure conditions throughout the test were recorded and plotted.

During the LOCA simulation, function checks (consisting of changing each header pressure from 50% - 100% - 0% - 50% and monitoring the output of the test units) were performed at various time intervals. In between function checks, the performance of each transmitter was monitored. Relative transmitter response (test unit vs. control unit) was calculated for the entire simulation and plotted. Due to the delayed response of some units, a spike appears in some plots where a function check was performed.



NOTE: THIS FIGURE DEPICTS A DP TRANSMITTER UNIT WITH NO CONNECTION HEAD. OTHER TRANSMITTER TEST ASSEMBLIES MAY VARY.

Figure 3: Harsh Environment Test set-up
(LOCA, MSLB, Neg Pressure)

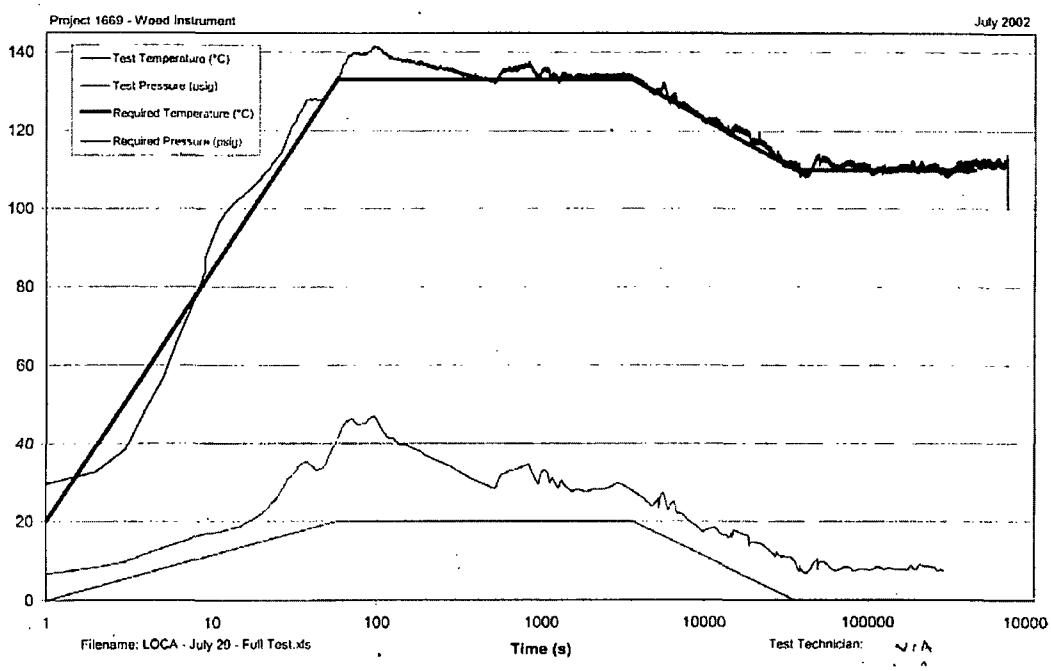


Figure 4: LOCA Harsh Environment Simulation

At a test time of 47h 28min, it was noted during a function check that Specimen 13 was not responding. Following the function check, the input was set to 50%URL and the output from the transmitter was erratic. Specimen 13 did not recover for the remainder of the test and did not function properly following the LOCA simulation. NOA 1669-03 was issued to Weed to describe the anomaly. The customer advised that testing should continue. NOA 1669-03 was dispositioned by Weed and the anomaly was attributed to contamination of the PC board.

Anomaly No. RCM (1669-03, Specimen #13)
Serial No. 322 (Test Specimen No. 13) failed during LOCA. Upon evaluation, it was discovered that PC board contamination was the cause of failure. The electronic assemblies were cleaned and the unit became operational. To implement a corrective action for this failure, the cleaning and handling procedure for the electronic assemblies for DTN2010 has been revised to incorporate additional steps for cleaning, handling and inspection.

Note: The data from this transmitter was not included in the LOCA error calculations presented in the Summary section of the report.

All other units responded satisfactorily during the LOCA simulation.

The LOCA test was set to be ended at a test time of ~120h. Although the test instrumentation was shut down at this time, the environmental chamber conditions remained at ~110°C and 7 psig until a test time of 189h 50min. RCM issued NOA 1669-04 to Weed to describe this test equipment anomaly. Although the test transmitters were exposed to an additional period (~70 hours) at elevated temperature/pressure, the results of post-LOCA functional checks were acceptable (See Section 7.14). Although two units were not within the acceptance criteria (See NOA 1669-05), the failure of these units was identified prior to the extended test (See NOA 1669-03) and therefore does not affect qualification.

Anomaly No. RCM (1669-04)
This was a test equipment anomaly. This anomaly caused the test specimens to be subjected to the elevated temperature 69 hours longer than the specified test duration. Due to the fact that this was the last test in the sequence of the program, it is noted for consideration during evaluation of the final test data. The impact of extended exposure to this temperature is unknown.

7.13.2. MSLB Testing

The test specimens were installed in the chamber. The lead wires exiting the specimens were protected from the accident environment by means of a sealed conduit. The high pressure line for each transmitter was routed through the chamber to its respective header while the low side of the DP units were referenced to atmospheric pressure.

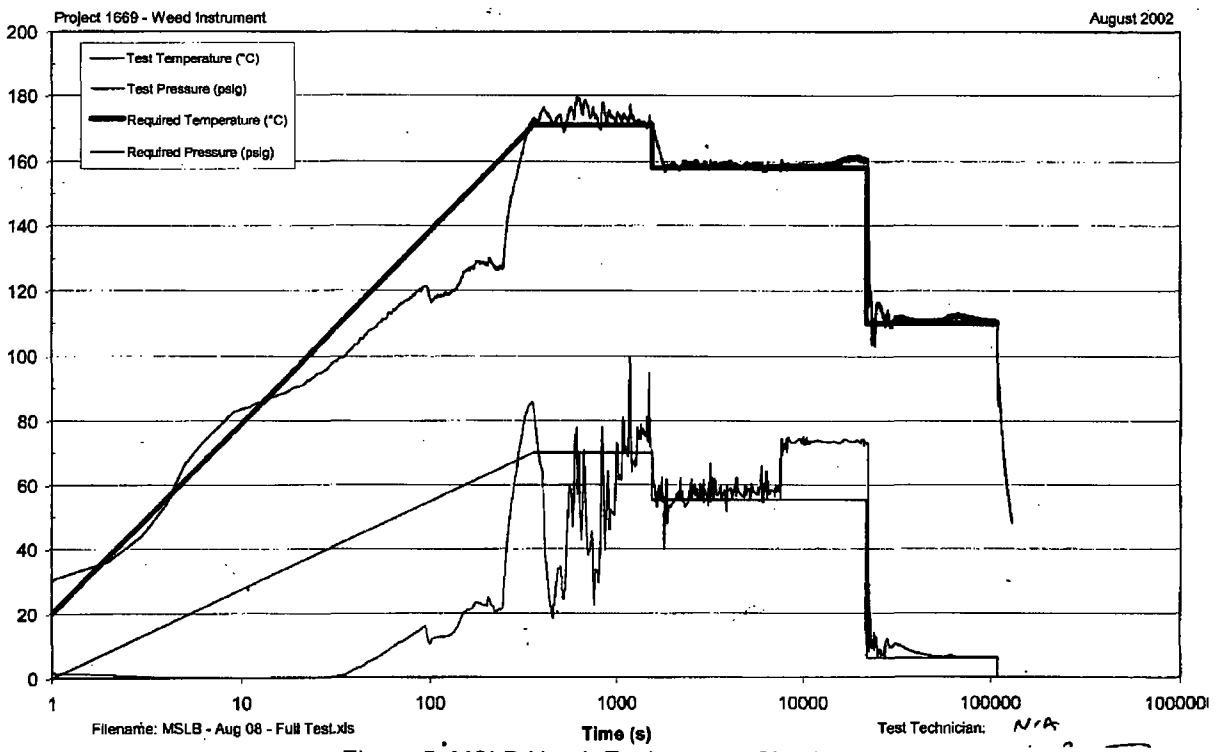


Figure 5: MSLB Harsh Environment Simulation

Temperature and pressure conditions throughout the test were recorded and plotted.

During the MSLB simulation, function checks (consisting of changing each header pressure from 50% - 100% - 0% - 50% and monitoring the output of the test units) were performed at various time intervals. In between function checks, the performance of each transmitter was monitored. Relative transmitter response (test unit vs. control unit) was calculated for the entire simulation and plotted. Due to the delayed response of some units, a spike may appear in the plot where a function check was performed.

At a test time of 11min, it was noted during a function check that Specimen 12 was not responding. Following the function check, the input was set to 50%URL and the output from the transmitter was erratic. Specimen 12 did not recover for the remainder of the test and did not function properly following the MSLB simulation. At a test time of 6h 3min, it was noted during a function check that Specimen 10 was not responding. By 29h 17min test time, Specimen 10 had recovered and continued to function for the remainder of the MSLB simulation. NOA 1669-06 was issued to Weed to describe the anomaly NOA 1669-06 was dispositioned by Weed and the anomaly was attributed to contamination of the PC board (Specimen 10) and random component failure (Specimen 12).

Anomaly No. RCM (1669-06, Specimen #'s 10,12)
Test specimen 10 had a significant shift and Test Specimen 12 did not respond during and after MSLB. Upon evaluation the following was observed:

Test Specimen 10 (Serial No. 318) – Verification of outputs at specific test nodes on the electronic assembly indicated that all values were within the expected range. In order to evaluate the capsule, the capsule was isolated from the electronics. The capsule output was also normal. The removal and re-soldering of the capsule connector board eliminated the shift in the output. It was determined that a short between the pins on the capsule connector board had caused the failure. To implement a corrective action for this failure, the soldering, cleaning and handling procedure for the electronic assemblies for DTN2010 has been revised to incorporate the necessary steps for these procedures.

Test Specimen 12 (Serial No. 320) – The initial verification of the test nodes on the electronic assembly revealed that the values were outside of the expected range. Further troubleshooting of the boards revealed that two Amplifier board resistors (R5-30K and R43-499K) were open. The resistors were removed from the board and replaced with new resistors. The transmitter responded normally to the changes in input pressure. However, the accuracy/shift cannot be obtained unless the boards are trimmed. There are about one hundred of similar type resistors on the electronic assembly of each test specimen, which have completed the qualification successfully. Therefore, this random component (resistor) failure has no impact on qualification. As an additional corrective action, the component preparation and soldering procedure have been reevaluated to ensure proper manufacturing practices during assembly.

Note: The data from the two test specimens 10 and 12 was not included in the MSLB error calculations presented in the Summary section of the report.

The MSLB simulation was to be at 171°C @ 70 psig for 20 min followed by 158°C @ 55 psig to a test time of 6h. Due to the limitations of RCM's boiler & Superheater, it was decided that it would be impossible to complete the 6 hour transient at 55 psig. NOA 1669-07 was issued to describe the anomaly.

Anomaly No. RCM (1669-07)
The test chamber limitation required an increase in chamber pressure for 4 hours of the test, to accomplish the temperature transient portion of the profile. This anomaly does not impact the qualification. The Test profile was derived from combination of several specifications and represented a generic profile for temperature and pressure conditions. It would be the responsibility of the end user to consider the specific application vs. the actual test profiles.

Approval was given by Weed to increase the pressure to the saturation pressure @ 158°C for the remainder of the 6 hour transient (2h test time). This anomaly does not impact qualification.

The remaining 4 hours of the initial MSLB transient were performed at 158°C and 74 psig. The transmitter performance was not affected by the increase in pressure. Although Specimen 10 failed to function following the 6h mark, it can be seen that it's zero point had been shifting at a constant rate since the initial transient and did not change with the increase in pressure.

7.14. Post Harsh Environment Function Tests

Upon completion of harsh environment testing, function testing was repeated as outlined in Section 7.10.

The acceptance criteria of Section 5 were applicable.

All LOCA units except Specimen 3, Specimen 6, and Specimen 13 were within the required accuracy of ± 2.0%. Specimen 3 was 9.750% (zero), Specimen 6 was 2.025% (zero) and Specimen 13 did not respond to the function test. NOA 1669-05 was issued to Weed to describe the anomaly. NOA 1669-05 was dispositioned by Weed and the anomaly was attributed to contamination of the PC boards.

Anomaly No. RCM (1669-05, Specimen #'s 3,6,13)
The evaluation of Test Specimen 13 showed that the cause of failure was board contamination as discussed under Anomaly No. RCM (1669-03).

Test Specimen 3 (Serial no. 313) had an output shift during LOCA and Post LOCA. Upon evaluation, all test points on the electronic boards were within normal range. The capsule was isolated and measurements were taken on the capsule by itself; initially, the shift seemed to be in the capsule, however, upon further evaluation and testing, it was determined that presence of contamination on the PC boards was responsible for the continuos output shift. The electronic boards were disassembled and cleaned and reassembled to the transmitter. Further testing of the transmitter showed that the output became stable and there was no longer a shift.

Note: The data from the two test specimens 3 and 13 was not included in the LOCA error calculations presented in the Summary section of the report.

The output shift of test specimen 6, although exceeded the acceptance criteria set forth in the Test Plan, is not considered a failure. This shift in output should be taken into consideration by the end user for each specific application and upon review of the full data for each test specimen.

All MSLB units except Specimen 10 and Specimen 12 were within the required accuracy of ± 2.0%. Specimen 10 was 4.850% (zero) and 24.812% (span) and Specimen 12 did not respond to the function test. NOA 1669-08 was issued to Weed to describe the anomaly. NOA 1669-08 was dispositioned by Weed and the anomaly was attributed to contamination of the PC board (Specimen 10) and random component failure (Specimen 12).

Anomaly No. RCM (1669-08, Specimen #'s 10,12)
The failure analysis of test specimens 10 & 12 has been addressed under Anomaly No. RCM (1669-06).

Anomaly No. RCM (1669-06, Specimen #'s 10,12)
Test specimen 10 had a significant shift and Test Specimen 12 did not respond during and after MSLB. Upon evaluation the following was observed:

Test Specimen 10 (Serial No. 318) – Verification of outputs at specific test nodes on the electronic assembly indicated that all values were within the expected range. In order to evaluate the capsule, the capsule was isolated from the electronics. The capsule output was also normal. The removal and re-soldering of the capsule connector board eliminated the shift in the output. It was determined that a short between the pins on the capsule connector board had caused the failure. To implement a corrective action for this failure, the soldering, cleaning and handling procedure for the electronic assemblies for DTN2010 has been revised to incorporate the necessary steps for these procedures.

Test Specimen 12 (Serial No. 320) – The initial verification of the test nodes on the electronic assembly revealed that the values were outside of the expected range. Further troubleshooting of the boards revealed that two Amplifier board resistors (R5-30K and R43-499K) were open. The resistors were removed from the board and replaced with new resistors. The transmitter responded normally to

the changes in input pressure. However, the accuracy/shift cannot be obtained unless the boards are trimmed. There are about one hundred of similar type resistors on the electronic assembly of each test specimen, which have completed the qualification successfully. Therefore, this random component (resistor) failure has no impact on qualification. As an additional corrective action, the component preparation and soldering procedure have been reevaluated to ensure proper manufacturing practices during assembly.

Note: The data from the two test specimens 10 and 12 was not included in the MSLB error calculations presented in the Summary section of the report.

Due to the fact that two of the MSLB units did not meet the acceptance criteria for Post-MSLB function tests, Specimen 10 and Specimen 12 were removed from the test program at the request of Weed Instrument. As a result, Specimen 9 and Specimen 14 from the LOCA group were selected to be included in the Negative Pressure Test.

7.15. Negative Pressure Test

The abrupt drop in pressure from 15 psig to -7 psig during the MSLB Accident Profile was not attempted during the Harsh Environment Simulation. The conditions presented for MSLB are based on the volume of the reactor building structure and, therefore, could not be simulated in the smaller scale of the environmental chamber.

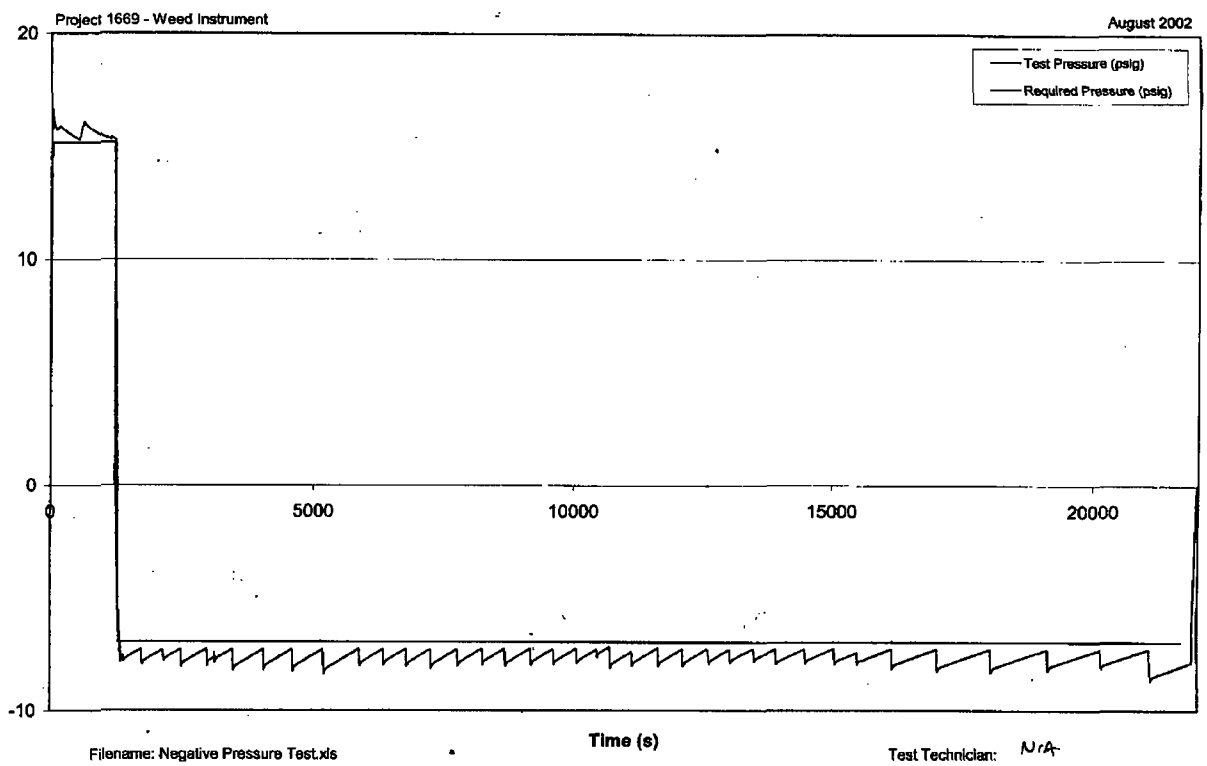


Figure 6: Harsh Environment Simulation, Negative Pressure

In order to meet the requirement for MSLB pressure, a negative pressure test (i.e. no steam or high temperature) was conducted on the test specimens following MSLB testing. As mentioned in Section 7.14, only Specimens 1, 7, 9 & 14 were included in the Negative Pressure test.

The specimens were installed in the environmental chamber in an identical fashion to the MSLB test. The pressure conditions of Figure 6 were simulated in the chamber on a best effort basis for the 6 hour duration of the test.

At various times during the Negative Pressure Test profile, an operability test was completed for each of the test specimens.
All test specimens functioned properly during the Negative Pressure Test.

7.16. Post Negative Pressure Function Tests

Upon completion of negative pressure testing, function testing was repeated as outlined in Section 7.10.

The acceptance criteria of Section 5 were applicable.

All test specimens were within the required accuracy of ± 2.0%.

7.17. Final Inspection

Upon completion of the qualification test program, an examination of the test specimens was conducted to determine the level of degradation sustained. Photographs were taken of the specimens to document their condition. All observations were recorded on the appropriate data form and included in the complete Qualification Test Report.

Aside from general discoloration and corrosion, the test specimens did not sustain any external damage as a result of the test program. A number of units were damaged slightly during disassembly of the harsh environment setups. Some of the lead wires were damaged while being removed from the copper tubing and two units experienced damaged seals (from the hermetic connector to the transmitter housing) during disassembly of the tube couplings.

7.18. Post-Qualification/Static Pressure Test

Upon arrival at Weed Instrument Company, the test specimens were subjected to a post-test calibration check. Test specimen 317 had a locked output and did not respond to pressure change. NOA RD0288-5 was generated. NOA RD0288-5 was dispositioned by Weed and the anomaly was attributed to transportation shock and vibration.

Anomaly No. RD0288-5 (Specimen #9)
This failure occurred during shipment from RCM to Weed. Factors such as transportation shock and transport vibration may have caused this failures This anomaly occurred after the completion of all tests by RCM. Therefore, there is no impact on qualification.

The DP transmitters were subjected also to a hydro test at 3600 psi and 4500 psi. Two transmitters leaked at 3600 psi and two leaked at 4500 psi. NOA RD0288-6 was dispositioned by Weed and the anomaly was attributed to o-ring compression set of the EPM o-rings after radiation. Weed has since restricted the use of EPM o-rings to < 10Mrad applications. Metal o-rings will be used between 10 and 31 Mrad and pressures up to 2400 psi.

Anomaly No. RD0288-6 (Specimen #'s 2,5,3,6)
Based on manufacturer data, EPM O-rings take compression set of about 30-50% after exposure to gamma radiation levels greater than 10 Mrads. Therefore, these O-rings would not be suitable for their intended function to withstand the high pressure in this particular application. For such applications, the current design of the metal O-ring may be used, provided the maximum working pressure does not exceed 2400 psi for the DP units.

Weed Instrument Co. is redesigning the flange O-ring groove for the specific metal O-ring. Upon completion of the design and tested configuration, the maximum working pressure will be redefined.

8. CONCLUSION

The DTN2010 Pressure Transmitters was Environmentally and Seismically Qualified to the following specification:

3129-RD0288-001, Rev 0, "Nuclear Qualification Test Plan for Weed Model DTN/2010 Series Pressure and Differential Pressure Transmitters"

There were 14 anomalies that occurred during testing. The main cause of failure of the test specimens during the qualification program was identified as presence of contamination on the boards. The source of this contamination is associated with presence of flux on the boards. To prevent such failures, the procedures concerning component preparation, soldering, PCB cleaning and handling have been reevaluated and necessary steps are being implemented.

Appendix A: RCM Certification Page from Full Report

RCM Technologies The Source of Smart Solutions	RCM TECHNOLOGIES CANADA CORP.		Document Number: 16690-QTR
	Document: QUALIFICATION TEST REPORT	Revision: REV. 00	Issue Date: December 2002

RCMT CERTIFICATION

I, the undersigned, being a Licensed Professional Engineer competent in the applicable field of design and testing of nuclear power plant components using the specification identified below as the basis for the proposed testing have prepared this test report*, and certify that to the best of my knowledge and belief it satisfies the requirements stated in the following specification:

Weed Instrument Specification

3129-RD0288-001, Rev 0, "*Nuclear Qualification Test Plan for Weed Model DTN/2010 Series Pressure and Differential Pressure Transmitters*".

* Only Test Steps 9 through 17, identified in Table 4 on Page 10, of this report are certified by RCMT. The remainder of the report, including the customer dispositions to notices of anomaly contained in Appendix J, have been provided by Weed Instrument Company which has not been audited by the RCMT Quality Assurance Program. Since the conclusions of this report are based on test data from both RCMT and Weed Instrument, they cannot be certified in whole by RCMT.

LICENSED PROFESSIONAL ENGINEER
J. R. BURNETT
12 DEC 02
PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER
T. E. MITTON
Dec 13/02
PROVINCE OF ONTARIO

Certified by:		Reviewed by:	
Name (print):	Jason R. Burnett	Name (print):	Todd Mitton
Province:	ONTARIO	Province:	ONTARIO
Date:	12 DEC 02	Date:	Dec 13/02

Attachment 4

Ultra Electronics "Application for Withholding Proprietary Information from Public Disclosure - Document No.: Qualification Test Report No.: 16690-QTR Rev 0, Qualification Test Report For Environmental And Seismic Qualification Of Weed Instrument Model DTN2010 Pressure Transmitters"

BECHTEL POWER CORPORATION	Job Number: 25402

SUPPLIER DOCUMENT REVIEW STATUS

STATUS CODE:

1	☐	Work may proceed.	3	☐	Rejected. Revise and resubmit.
1C	☐	Work may proceed. Editorial comments need only be incorporated if revised for other purposes.	4	☒	Review not required. Work may proceed.
2	☐	Revise and resubmit. Work may proceed subject to incorporation of changes indicated.			**PO 234955**

Permission to proceed does not constitute acceptance or approval of design details, calculations, analysis, test methods, or materials developed or selected by the Supplier and does not relieve the Supplier from full compliance with contractual obligations.

Reviewed by	Arch	Civil	CS	Elect	Mech	MET	PD	Constr	Startup	STE
	NA	NA	[illegible]	NA	NA	NA	NA	NA	NA	NA

Status By:	DATE
M. S. Clark [signature]	8/30/11

Ultra ELECTRONICS

US Nuclear Regulatory Commission
Document Control Desk
Washington, D.C. 20555-0001

August 10, 2012

Ultra Electronics
NUCLEAR SENSORS &
PROCESS INSTRUMENTATION
707 Jeffrey Way
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RE: APPLICATION FOR WITHHOLDING PROPRIETARY INFORMATION FROM PUBLIC DISCLOSURE - Document No.: Qualification Test Report No.: 16690-QTR Rev 0, QUALIFICATION TEST REPORT FOR ENVIRONMENTAL AND SEISMIC QUALIFICATION OF WEED INSTRUMENT MODEL DTN2010 PRESSURE TRANSMITTERS

The proprietary information for which withholding is being requested in the above-referenced report is further identified in the attached Affidavit signed by the owner of the proprietary information, Weed Instrument, Co. Inc., dba Ultra Electronics – Nuclear Sensors & Process Instrumentation. The affidavit, which accompanies this letter, sets forth the basis on which the information may be withheld from public disclosure by the Commission and addresses with specificity the considerations listed in paragraph (b)(4) of 10CFR Section 2.390 of the Commission's regulations.

Accordingly, this letter authorizes the utilization of the accompanying affidavit by Bechtel Power Corporation and the Tennessee Valley Authority.

Correspondence with respect to the proprietary aspects of the application for withholding or the Ultra Electronics affidavit should reference this letter and should be addressed to Mark McCray, Vice President of Engineering at the address listed above.

Sincerely,

Daniel L. Upp
President, Ultra Electronics – NSPI

AFFIDAVIT

THE STATE OF TEXAS §
§
COUNTY OF WILLIAMSON §

BEFORE ME, the undersigned authority, on this day personally appeared **Rick Andersen**, known to me to be the person whose name is subscribed to the foregoing instrument and, being by me first duly sworn, upon oath declared that the statements and capacity acted in are true and correct.

Signer: Rick Andersen
Title: Principal Engineer Nuclear-qualified Pressure Transmitters

Subscribed and sworn to before me, this ***16th*** day of ***August, 2011 A.D.,*** to certify which witness my Hand and seal of office:

(SEAL)

My commission expires: **July 20th, 2015**

DENISE M. STEFEK
Notary Public, State of Texas
My Commission Expires
JULY 20, 2015

Denise M. Stefek
Notary Public, State of Texas

1) I, Rick Andersen, am the Principal Design Engineer for Weed Instrument, Co. Inc., dba Ultra Electronics – Nuclear Sensors & Process Instrumentation, hereafter referred to as "Ultra Electronics," for the Nuclear Qualified Pressure Transmitters, and as such, I have been specifically delegated the function of reviewing the proprietary information sought to be withheld from public disclosure in connection with nuclear power plant licensing and rule making proceedings, and am authorized to apply for its withholding on behalf of Ultra Electronics.

2) I am making this Affidavit in conformance with the provisions of 10 CFR Section 2.390 of the Commission's regulations and in conjunction with Ultra Electronics' Application for Withholding Proprietary Information from Public Disclosure accompanying this Affidavit.

3) I have personal knowledge of the criteria and procedures utilized by Ultra Electronics in designating information as a trade secret, privileged or as proprietary commercial or financial information.

4) Pursuant to the provisions of paragraph (b)(4) of Section 2.390 of the Commission's regulations, the following is furnished for consideration by the Commission in determining whether the information sought to be withheld from public disclosure should be withheld.

   a. The information sought to be withheld from public disclosure is owned and has been held in confidence by Ultra Electronics.

   b. The information is of a type customarily held in confidence by Ultra Electronics and not customarily disclosed to the public. Ultra Electronics has a rational basis for determining the types of information customarily held in confidence by it and, in that connection, utilizes a system to determine when and whether to hold certain types of information in confidence. The application of that system and the substance of that system constitutes Ultra Electronics' policy and provides the rational basis as required.

      The following criteria are evaluated to determine if information is to be held in confidence so as to prevent a loss of an existing or potential competitive advantage:

      i. The information reveals the distinguishing aspects of a process (or component, structure, tool, method, etc.) where prevention of its use by any of Ultra Electronics' competitors without license from Ultra Electronics constitutes a competitive economic advantage over other companies.

      ii. It consists of supporting data, including test data, relative to a process (or component, structure, tool, method, etc.), the application of which data secures a competitive economic advantage, e.g. by optimization or improved marketability.

      iii. Its use by a competitor would reduce their expenditure of resources or improve their competitive position in the design, manufacture, shipment, installation, assurance or quality, or licensing a similar product.

iv. It reveals cost or price information, production capacities, budget levels, or commercial strategies of Ultra Electronics, its customers, or suppliers.

v. It reveals aspects of past, present, or future Ultra Electronics or customer funded development plans and programs of potential commercial value to Ultra Electronics.

vi. It contains patentable ideas, for which patent protection may be desired.

There are sound policy reasons behind Ultra Electronics' system which include the following:

(1) The use of such information by Ultra Electronics gives Ultra Electronics a competitive advantage over its competitors. It is, therefore, withheld from disclosure to protect the Ultra Electronics competitive position.

(2) It is information that is marketable in many ways. The extent to which such information is available to competitors diminishes Ultra Electronics' ability to sell products and services involving the use of the information.

(3) Use by our competitor would put Ultra Electronics at a competitive disadvantage by reducing their expenditure of resources at our expense.

(4) Each component of proprietary information pertinent to a particular competitive advantage is potentially as valuable as the total competitive advantage. Any one component could deprive Ultra Electronics of a competitive advantage.

(5) Unrestricted disclosure would jeopardize the position of prominence of Ultra Electronics in the world market, and thereby give a market advantage to the competition in this or other countries.

(6) The Ultra Electronics capacity to invest corporate assets in research and development depends upon the success in obtaining and maintaining a competitive advantage.

c. The information is being transmitted to the Commission in confidence and, under the provisions of 10 CFR Section 2.390; it is to be received in confidence by the Commission.

d. The information sought to be protected is not available in public sources or available information has not been previously employed in the same original manner or method to the best of our knowledge and belief.

e. The proprietary information sought to be withheld in this submittal is contained in the document titled Qualification Test Report No.: 16690-QTR Rev 0, QUALIFICATION TEST REPORT FOR ENVIRONMENTAL AND SEISMIC

QUALIFICATION OF WEED INSTRUMENT MODEL DTN2010 PRESSURE TRANSMITTERS and attachments.

This document, dated December 2002, contains a summary of test results followed by Appendices A through L. The information in the Appendices is considered proprietary as it:

i. describes in detail the methodology used by Ultra Electronics to test the DTN2010 Pressure Transmitter to standards,

ii. details the performance of the DTN2010 Pressure Transmitter as a result of the testing,

iii. provides significant design and performance details of the DTN2010 Pressure Transmitter not available in public literature,

iv. is indicative of the methodology Ultra Electronics employs to qualify instrumentation to international performance standards for safety-related equipment at nuclear power plants globally.

This information has significant commercial value as follows:

(1) Its use by a competitor would give them significant information about the general practice of creating procedures, steps, and methodology to qualify a product to nuclear standards, thus reducing their cost to research and establish such procedures, steps, and methodology as well as reducing the amount of time spent doing the same.

(2) Its use by a competitor would give them insight into the costs Ultra Electronics has in creating such a report.

(3) Product performance details in this specific report could be exploited by a competitor to create their own competitive advantage for a competing product.

Public disclosure of this proprietary information is likely to cause substantial harm to the competitive position of Ultra Electronics because it would enhance the ability of competitors to provide similar products with similar qualifications at a lower cost to the commercial nuclear power industry on a global basis. The development of the product itself as well as the methodology to qualify this or any other product to the requirements of safety-related equipment described in the supplied information is the result of many years of experience and extraordinary effort and cost borne by Ultra Electronics.

In order for competitors of Ultra Electronics to duplicate this information, similar technical programs would have to be performed and a significant manpower effort, having the requisite talent and experience, would have to be expended.

Further the deponent sayeth not.

PROPRIETARY INFORMATION NOTICE

Transmitted herewith are proprietary and non-proprietary versions of documents furnished to the NRC in connection with requests for equipment supplied by Ultra Electronics under Purchase Order 00038593.

In order to conform to the requirements of 10 CFR 2.390 of the Commission's regulations concerning the protection of proprietary information so submitted to the NRC, the information which is proprietary is contained in all volumes of information except for the Executive Summary. The justification for claiming the information is proprietary falls into the categories 4b (i) – (iv) of the Affidavit attached.

Tennessee Valley Authority

Letter for Transmittal to the NRC

The following paragraphs should be included in your letter to the NRC:

Enclosed are:

1. Qualification Test Report No.: 16690-QTR Rev 0, QUALIFICATION TEST REPORT FOR ENVIRONMENTAL AND SEISMIC QUALIFICATION OF WEED INSTRUMENT MODEL DTN2010 PRESSURE TRANSMITTERS (Proprietary),

2. Document No.: 3077-390572-001 Rev. 0, QUALIFICATION TEST REPORT FOR ENVIRONMENTAL AND SEISMIC QUALIFICATION OF WEED INSTRUMENT MODEL DTN2010 PRESSURE TRANSMITTERS (Non-proprietary)

Also enclosed is the Ultra Electronics application for withholding proprietary information from public disclosure and an accompanying Affidavit.

As Item 1 contains information proprietary to Weed Instrument Co. Inc, dba Ultra Electronics Nuclear Sensors and Process Instrumentation, it is supported by an Affidavit signed by Ultra Electronics, the owner of the information. The affidavit sets forth the basis on which the information may be withheld from public disclosure by the Commission and addresses with specificity the considerations listed in paragraph (b)(4) of Section 2.390 of the Commission's regulations.

Accordingly, it is respectfully requested that the information which is proprietary to Ultra Electronics be withheld from public disclosure in accordance with 10 CFR Section 2.390 of the Commission's regulations.

Correspondence with respect to the copyright or proprietary aspects of the items listed above or the supporting affidavit should be addressed to Mark McCray, Vice President of Engineering, 707 Jeffrey Way, PO Box 300, Round Rock, TX 78680-0300.