TEST REPORT

Accepted for Use

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EVALUATION CENTER
16015 Shady Falls Road
Elmendorf, TX 78112
(voice) 210-635-8100
(fax) 210-635-8101
www.intertek.com

RENDERED TO

AREVA NP Inc.
4100 International Plaza
Fort Worth, TX 76109

AREVA	AREVA NP Inc.
	58-9224205-000

PRODUCTS EVALUATED: Unifrax Fiberfrax® Durablanket® S, Dow Corning® Sylgard® 170 Silicone Elastomer , Quantum Silicones QSil 5558MC Silicone Elastomer, Dow Corning® 732 Multi-Purpose Sealant and Dow Corning® 790 Silicone Building Sealant

EVALUATION PROPERTY: Fire and Pressure Resistance (Fire-Pressure Test 3)

Report of Testing various fire stop systems when exposed to the fire and positive pressure conditions of ASTM E814-94b Standard Test Method for Fire Tests of Penetration Firestop Systems, and in accordance with AREVA NP Inc. Document No. 51-9213021-000, *Detailed Test Plan for Conducting MOX Fire-Pressure Test 3.*

1 Table of Contents

2 Introduction

Intertek Testing Services NA (Intertek) has conducted testing for AREVA NP Inc., on the fire and pressure resistance capabilities of Unifrax Fiberfrax® Durablanket® S (Durablanket), Dow Corning® Sylgard® 170 Silicone Elastomer (DC-170), Quantum Silicones QSil 5558MC Silicone Elastomer (QSil 5558MC), Dow Corning® 732 Multi-Purpose Sealant (DC-732) and Dow Corning® 790 Silicone Building Sealant (DC-790) through a 12" thick concrete deck for compliance with the applicable requirements of and in accordance with AREVA NP Inc. Document No. 51-9213021-000, *Detailed Test Plan for Conducting MOX Fire-Pressure Test 3*. This test took place on November 15 through November 19, 2013.

This project was undertaken to evaluate the ability of select penetration seal designs to withstand various pressure levels after being subjected to a fire exposure (fire test).

NOTE: The test assembly used in this fire-pressure test was the same test assembly that was constructed and tested in Pressure Test 7 without any changes. Refer to AREVA Doc. 58-9223086-000 or Intertek Test Report No. 101276459SAT-001C for details on Pressure Test 7.

3 Test Samples

3.1. SAMPLE SELECTION

The sealant materials were not independently selected for testing; they were supplied by AREVA NP Inc., and were received in several shipments from June 13 to September 10, 2013. The samples were received with Certificates of Conformance and are considered traceable. Basic information on sealant material(s) is presented in the table below.

Sealant Material	Lot /Batch#	Expiration Date
DC-170	063B02	6/30/2014
QSil 5558MC	130606	6/14/2014
Durablanket S	32039	N/A
DC-732	0007251823	5/29/2015
DC-790	0007390959	4/24/2014

Information regarding receiving dates and origin of all the materials in the assembly can be found in Appendix F: Quality Documents of Pressure Test 7 (Intertek Test Report 101276459SAT-001C, AREVA Doc. 58-9223086-000). All samples were received in good condition at the Evaluation Center.

3.2. SAMPLE AND ASSEMBLY DESCRIPTION

The assembly used for Fire-Pressure Test 3 was first tested as Pressure Test 7, then tested again as Seismic Pressure Test 5 before finally being repurposed for Fire-Pressure Test 3.

A detailed description and drawings of the concrete deck and penetrations can be found in AREVA NP Inc. Document No. 51-9213021-000, *Detailed Test Plan for Conducting MOX Fire-Pressure Test 3,* which is contained in Appendix E. The installation and documentation of penetration seal assemblies contained within the test slab was performed by AREVA under AREVA's Quality Assurance Program (Reference 12.3 in the test plan found in Appendix E).

There were four openings sealed and tested in MOX Fire-Pressure Test 3.

- Penetration P1: This penetration was a 36" x 1" precast opening. One side of the opening had a 3/4" bevel, the other side of the opening was not beveled. Both sides of the opening were sealed using 3/4" depth Dow Corning Sylgard® 170 Silicone Elastomer (DC-170) backed by 1" depth of Unifrax Fiberfrax® Durablanket® S.
- Penetration P2: This penetration was a 36" x 1" precast opening. One side of the opening had a 3/4" bevel, the other side of the opening was not beveled. Both sides of the opening were sealed using 3/4" depth Quantum Silicones QSil 5558MC Silicone Elastomer (QSil 5558MC) backed by 1" depth of Unifrax Fiberfrax® Durablanket® S.
- Penetration P3: This penetration was a 36" x 1" precast opening. One side of the opening had a 3/4" bevel, the other side of the opening was not beveled. Both sides of the opening were sealed using 3/4" depth Dow Corning 732 Multi-Purpose Sealant backed by 1" depth of Unifrax Fiberfrax® Durablanket® S.
- Penetration P4: This penetration was a 36" x 1" precast opening. One side of the opening had a 3/4" bevel, the other side of the opening was not beveled. Both sides of the opening were sealed using 3/4" depth Dow Corning 790 Silicone Building Sealant backed by 1" depth of Unifrax Fiberfrax® Durablanket® S.

4 Testing and Evaluation Methods

Fire-pressure tests are unique in that a fire-pressure test consists of two separate tests; a modified fire test, followed by a pressure test.

The Test Plan in Appendix E defines the test methods, acceptance criteria and test report documentation requirements for conducting MOX Fire-Pressure Test 3. Additionally, this detailed test plan defines the roles and responsibilities of MOX Services, AREVA, the selected testing laboratory, and any other subcontracted entity engaged in support of fire-pressure testing efforts.

The detailed test plan also describes the procurement plan for materials associated with Fire-Pressure Test 3 and identifies the entities responsible for procuring the various components of the test assemblies based on the quality level assigned to each component.

The Test Plan also establishes minimum quality requirements for the penetration seal materials used in the test assemblies and links quality requirements in the AREVA QA program to customer/project quality requirements.

4.1. INSTRUMENTATION FOR FIRE TESTING

Nine (9) 24 GA, Type K, fiberglass jacketed thermocouples were installed as depicted on the drawings contained in Appendix B. The output of the thermocouples was monitored by a 300-channel Yokogawa, Inc., Darwin Data Acquisition Unit. The computer was programmed to save data every 30 seconds. Following the test, those files were imported into MS Excel for tabular and graphical display (presented in Appendix C1).

4.2. TEST STANDARD FOR FIRE TESTING

ASTM E814-94b, Standard Test Method for Fire Tests of Through-Penetration Fire Stops

The test was conducted in accordance with an older version of the standard, per the client's request. The acceptance criteria identified in ASTM E814-94b, Standard Test Method for Fire Tests of Through-Penetration Fire Stops are identified below.

A fire stop (penetration seal) shall be considered as meeting the requirements for an F-rating when it remains in the opening during the fire test and hose stream test within the following limitations:

a) The fire stops (penetration seals) shall have withstood the fire test for the rating period without permitting the passage of flame through openings, or the occurrence of flaming on any element of the unexposed side of the fire stops (penetration seals)

b) During the hose stream test, the fire stops (penetration seals) shall not develop any opening that would permit a projection of water from the stream beyond the unexposed side.

4.2.1 Deviation from Standard Method

Engineering thermocouples were installed on each fire stop system generally in accordance with the test standard, but not in all cases. Therefore, thermocouple data is presented for information purposes and was not used to determine compliance for T-ratings.

The test plan did not require a hose stream test, so none was conducted. As such, F-ratings were not applicable for this test.

4.3. TEST APPARATUS FOR PRESSURE TESTING

In the absence of any consensus codes or standards related to the pressure testing of penetration seal assemblies, the MOX Penetration Seal Program has developed a standardized method for conducting pressure testing of MOX penetration seal designs. In support of this effort, Intertek assisted in the design and construction of a pressure test apparatus to be use in the conduct of MOX penetration seal pressure tests.

The pressure chamber apparatus consists of two hemispherical 72" diameter steel pressure vessels, calibrated equipment and a data acquisition system. The apparatus accurately maintains the desired air pressure, using one of two sensitive, manually adjustable pressure

regulators; a high (0-15 psi) and a low (0-2 psi) range. The sealed collection chamber feeds any leakage air back to the test device, where it is channeled through one of two calibrated flow meters, once again, a high (0-200 L/min) and a low (0-20 L/min) range. A calibrated electronic pressure transducer (0-5 psi) measures the differential pressure between the two chambers and the data acquisition software determines the net pressure drop across the test seal and the leakage through the seal. The chambers are interchangeable and the direction can be reversed very quickly so both can serve as the pressure or the collection chamber.

The primary components described above include the following devices:

Pressure Chamber	2-piece hemispherical 72” diameter steel vessel 3 connection ports per piece 16 flange attachment points per piece Flange attachment via 3/8” diameter holes @ 22-1/2° spacing

Pressure Cart	Stainless steel rolling cart with control equipment and associated Data Acquisition System

Regulator (low)	Control Air, Inc., Amherst, NH Type 700 0-2 psi
Regulator (high)	Control Air, Inc., Amherst, NH Type 700 0-15 psi

Mass Flow Meter

Omega Engineering, Inc., Stamford, CT
Model No. FMA-872A-V-NIST
Serial No. 4270050001001
0-20 lpm

Mass Flow Meter

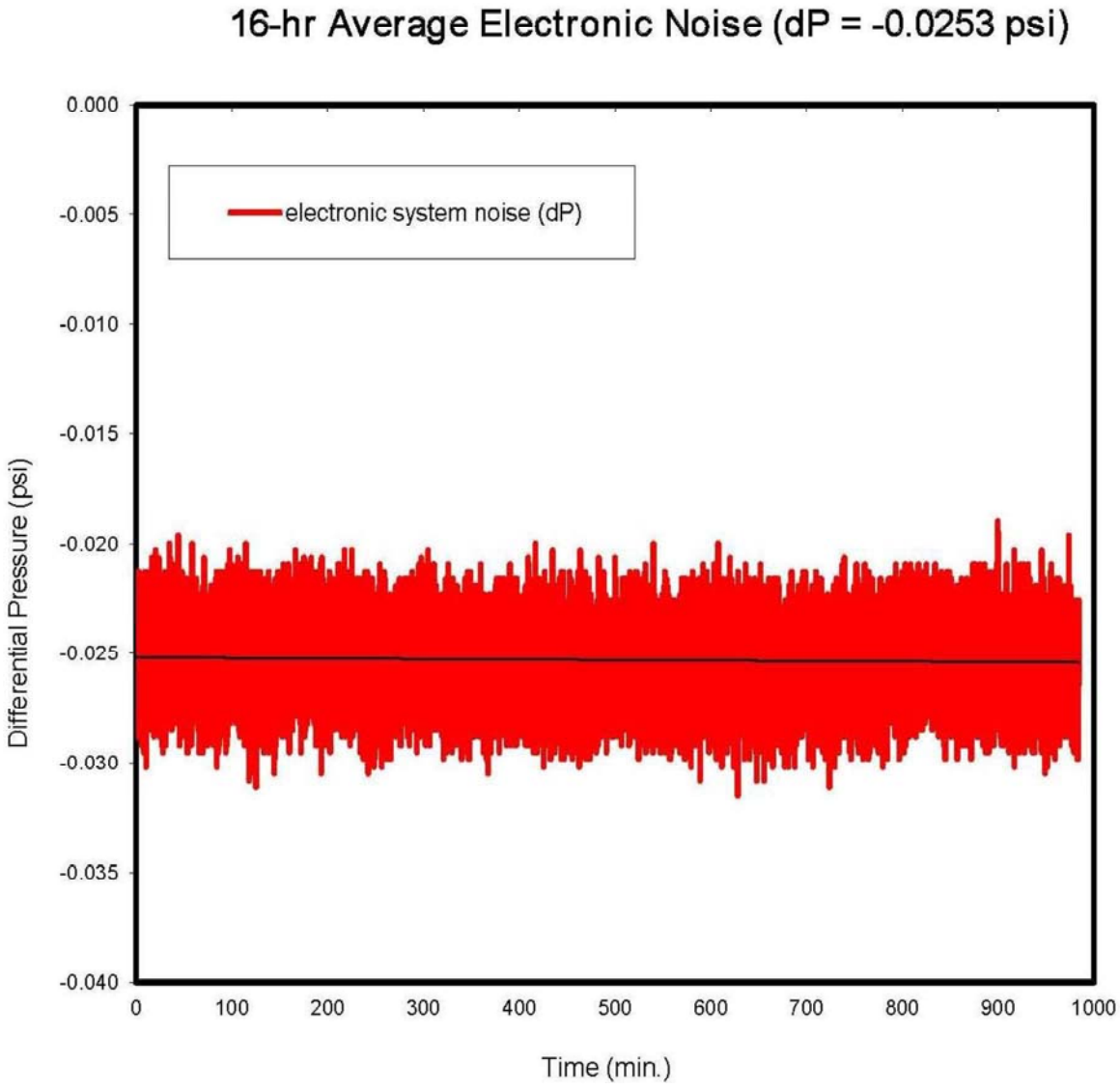
Omega Engineering, Inc., Stamford, CT
Model No. FMA-875A-V-NIST
Serial No. 4270050003001
0-200 lpm

Pressure Transducer	Omegadyne Inc., Sunbury, OH Model No. PX409-005 DWUV Serial No. 406707 Pressure Range: 0-5 psi Input 0-100mVdc

Power Supply	Omega Engineering, Inc., Stamford, CT Model No. PSS-10 +10V @ 400 mA Input 115 VAC 50/60 Hz
Multifunction DAQ	National Instruments, Model No. NI USB-6210 16 Input, 16-bit, 250 kS/s, Multifunction I/O

Dedicated CPU HP Compaq Pro-6300 Microtower
Serial No. MXL3090LN6
OS Windows 7 Pro

During initial system start-up testing and verification, it was discovered that the data acquisition system (DAQ) was so sensitive that "signal noise" resulted in data fluctuations for reported differential pressure even when the system was at equilibrium (i.e., both high side and low side pressure chambers were at atmospheric conditions). After collecting data for 16 hours overnight, the average fluctuation was -0.025 psi.



For this test, the Test Plan required pressure was applied and maintained using the DAQ reported differential pressure without consideration for any "signal noise". Since the "signal noise" always reported some level of negative pressure at the beginning of the test, this method assured that the tests were conducted with additional margin, as the actual differential pressure that the test specimen was subjected to was equal to the DAQ reported differential pressure plus the additional pressure needed to overcome the negative "signal noise" reported at the beginning of the test when both pressure chambers were at atmospheric conditions.

4.4. TEST STANDARD FOR PRESSURE TESTING

AREVA NP Inc. Document No. 51-9213021-000, *Detailed Test Plan for Conducting MOX Fire-Pressure Test 3*.

The requirements for fire rated penetration seals are discussed in DCS01-BRA-DS-TRD-B-01365-0, *Technical Requirements Document for MFFF Penetration Seals* [Test Plan Reference 12.5]. These requirements include the need for fire barrier penetration seals to be F-rated, commensurate with the hourly rating of the fire barrier in which they are installed. Additionally, these requirements also discuss the need for fire barrier penetration seals to withstand different forms of pressure concurrent with a fire (i.e., fire induced pressures and pressures from clean agent system discharge).

The MOX qualification strategy for concurrent fire and pressure conditions was to fire test penetration seals following consensus codes and standards committed to by the MOX project (ASTM E 814-94b [Test Plan Reference 12.9]), while invoking the “standard pressure condition” from standard test method ASTM E 814-94b for maintaining furnace pressure (i.e., furnace pressure at 0.01 in. wg greater than the pressure on the unexposed side of the test assembly).

Separate penetration seal assemblies will be pressure tested using detailed test plans for conducting pressure tests.

Finally, some additional test assemblies, such as the assembly to be tested under this Test Plan, underwent a limited duration fire test (30 minute duration) with the fire tested specimens then subjected to subsequent pressure tests.

The results of fire testing, pressure testing and combination limited duration fire tests followed by pressure testing of the same assembly served as the overall qualification for penetration seals required for concurrent fire and pressure conditions.

Based on the above, the specific acceptance criteria to be used for combination fire-pressure testing were as follows:

1. During the limited duration fire endurance portion of the test, the fire stops (penetration seals) shall have withstood the fire test for the limited 30 minute duration without permitting the passage of flame through openings, or the occurrence of flaming on any element of the unexposed side of the fire stops (penetration seals).

2. After the limited duration fire test, any residual flaming on the exposed side of the test assembly shall be extinguished with water. Following flame extinguishment, the fire stops (penetration seals) shall remain in place such that the unexposed side of the penetration remains completely sealed.

3. During the pressure test, the fire stops (penetration seals) are allowed to leak. However, the fire stops (penetration seals) shall remain in place (i.e., shall not become dislodged from the opening or otherwise catastrophically fail).

The anticipated fire-induced differential pressures, as they apply to MFFF penetration seal designs, are discussed in DCS01-BRA-DS-TRD-B-01365-0 [Test Plan Reference 12.5] and in calculation DCS01-ASI-DS-CAL-R-10552 [Test Plan Reference 12.6]. Most areas of the facility are bounded by a fire induced differential pressure of +/- 7.0 inches w.g. Plant areas with higher fire induced differential pressures are identified in calculation DCS01-ASI-DS-CAL-R-10552 [Test Plan Reference 12.6]. The maximum fire-induced differential pressure in any plant area is -14.7 inches w.g.

The pressure levels specified in the table below are to be used in the pressure test portion of this fire-pressure test. The 10 inch w.g. pressure is intended to bound the +/- 7.0 inches w.g. with margin. The 20 inches w.g. pressure is intended to bound the maximum fire-induced compartment pressure of -14.7 inches w.g. with margin.

A hold time of 5 minutes has been established for each pressure level to ensure that sufficient time at pressure is maintained to; 1) confirm that no leakage occurs at that pressure, or 2) stabilize make up air to maintain the pressure and identify the apparent location of the leak.

Differential Pressure Test Levels

Test Stage	Differential Pressure (inch w.g.)	Required Hold Time (minutes)	Acceptance Criteria	Basis for the Selected Differential Pressure
1	10.0	5	Seal Remains In Place	Testing at this differential pressure bounds the +/- 7.0 inches w.g. pressure used as the screening pressure cutoff for fire induced pressures [Test Plan Reference 12.6].
2	20.0	5	Seal Remains In Place	Testing at this differential pressure bounds the –maximum compartment fire-induced pressure of -14.7 inches w.g. pressure per the fire-induced pressure calculation [Test Plan Reference 12.6].

The test assembly was attached to the pressure test apparatus and subjected to the pressures identified in the above table as described below.

For Test Stages 1 and 2 the side of the test deck applied to the pressure was the same side that was exposed to fire. The pressure was applied as described below.

The test assembly was attached to the pressure test apparatus and subjected to air pressure at the select pressure levels identified in table, beginning with the Stage 1 pressure of 10.0 inches w.g. Once this pressure was obtained, the pressure was maintained for the hold time specified. Any leakage observed during the hold time was noted.

Once the designated hold time had been achieved, the pressure was increased to the next pressure level identified in the table (Stage 2, 20.0 inches w.g.) and held for the designated hold time. Any leakage observed during this hold time was noted.

If at any pressure level (or test stage) the penetration seal became dislodged from the opening or otherwise catastrophically failed, the pressure test was terminated and the time to failure and pressure at which the failure occurred was recorded.

5 Testing and Evaluation Results

5.1. RESULTS AND OBSERVATIONS

5.1.1. Fire Test

The test assembly was placed on the laboratory's small-scale (7'x7') horizontal furnace on November 15, 2013. Scott Groesbeck from AREVA was present to witness the test. The ambient temperature at the start of the test was 66°F, with a relative humidity of 68%.

The furnace was fired at 10:38 a.m. and the standard time/temperature curve in ASTM E814-94b was followed for a period of 30 minutes. After the first 5 minutes, the pressure differential between the inside of the furnace (measured at a point 12" below the concrete slab) and the laboratory ambient air was maintained at a nominal 0.00 inches of water column, which resulted in a positive pressure of 0.01" WC at the bottom of the test slab. Throughout the test, no visible changes occurred on either side of the assembly. There was no hose stream test required for this fire-pressure test. However, water was applied with a standard garden hose to extinguish residual flaming as allowed by the test plan. The assembly was allowed to cool for several days prior to conducting the subsequent pressure test.

Following the fire test, it was observed that for the bottom side of Penetrations 1 and 2 (the elastomer seals) the seals were charred and slightly swollen from their original position. The top side of these penetrations appeared unchanged.

For Penetration 3 (DC-732), there was some evidence of charring on the bottom side. The top side of this seal remained unchanged.

For Penetration 4 (DC-790), the bottom side appeared mostly unaffected. The top side of this seal remained unchanged.

Listings of the furnace control temperatures and specimen unexposed surface temperatures may be found in Appendix C1. Photographic documentation of the test has been included in Appendix D1.

5.1.2. Pressure Test

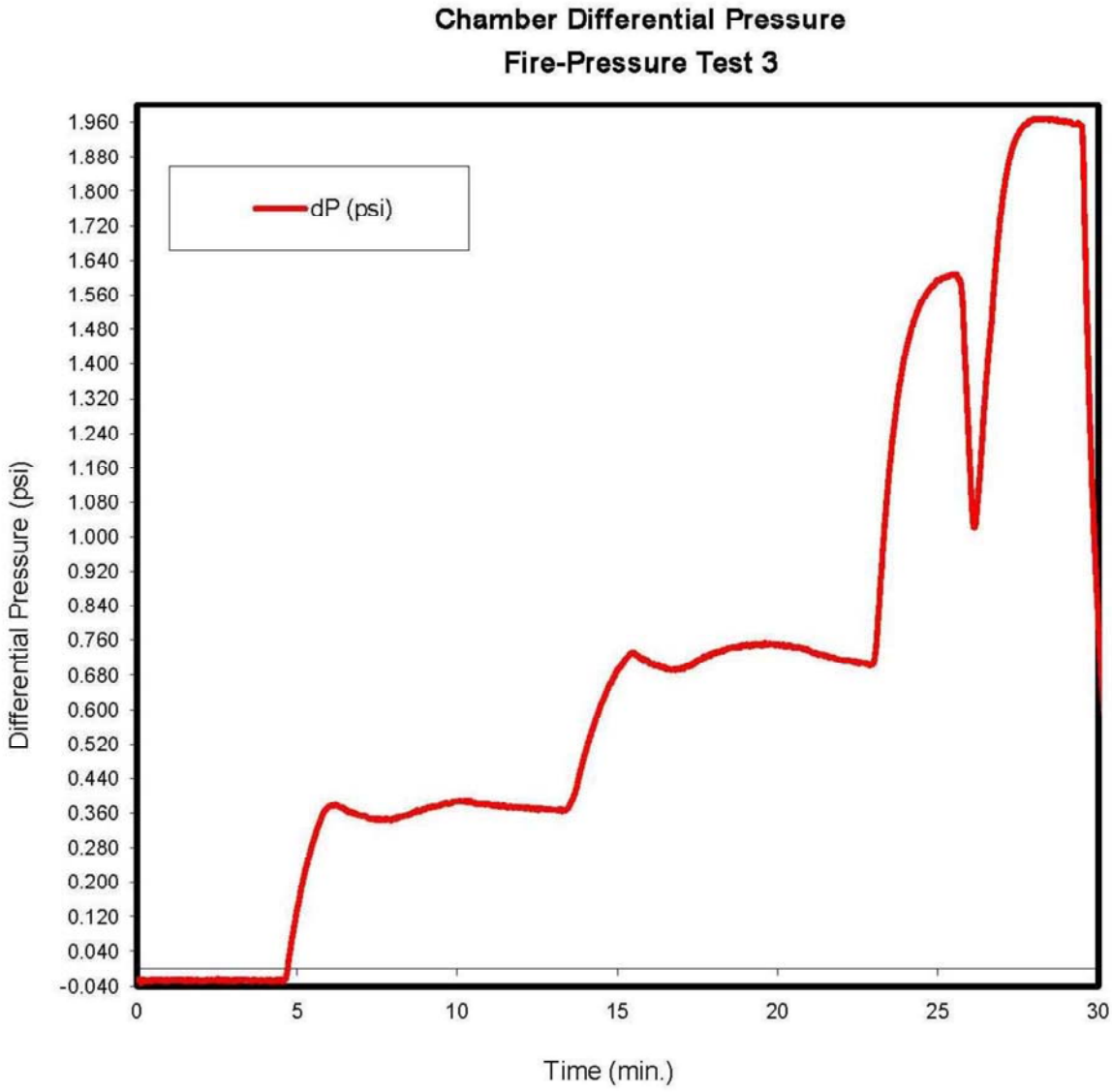
The test plan stated that the pressure bonnet was to be applied to the unexposed side of the test slab. However, following the fire test, it was determined that the concrete on the exposed side of the test assembly was smooth enough to accept the pressure bonnet. With concurrence from the AREVA Test Engineer, the decision was made to attach the pressure bonnet to the bottom side (exposed side) of the test assembly. The deck was fixed to the pressure chamber using (16) 5/16" x 2-1/2" long sleeve anchors (Red Head) through 16 pre-drilled holes. Silicone II caulk (GE) was used to create a pressure tight seal between the pressure chamber and the test deck.

The test was initiated at 11:01 a.m. on November 19, 2013. Scott Groesbeck representing AREVA NP Inc. was present to witness the test. The ambient temperature at the start of the test was 68°F, with a relative humidity of 46%.

The test procedure followed that presented in Section 9.0 of the Test Plan. During both stages

of the pressure test, a soapy-water solution was applied to the non-pressurized side of the seal assembly. Some leakage was detected for each of the four seal assemblies being tested. However, all of the seal assemblies remained in place throughout the pressure tests. The graph and table on the following page(s) provide a summary of results and observations for the two pressure stages.

Listings of the pressure data may be found in Appendix C2. Photographic documentation of the test has been included in Appendix D2.



After Stage 2 (approximately 20 minutes), the differential pressure was increased to approximately 2 psi to determine if any additional leaks would appear. At 25 minutes the 0-2 psi regulator was maxed and the input air was then routed through the 0-15 psi regulator. No additional leaks appeared at the higher pressure.

Test Results and Observations

Test Stage	Differential Pressure inch w.g. (psi)	Required Hold Time (minutes)	Acceptance Criteria	PASS/ FAIL
1	10 (0.361)	5	Seal Remains In Place	PASS
2	20 (0.723)	5	Seal Remains In Place	PASS

5.1.3. POST TEST EXAMINATION

Following completion of the pressure test, visual post-test examinations were performed. These examinations included, but were not limited to, the following:

- Integrity of seal and conditions on the exposed side of the penetration
  - No visual changes were observed.
- Integrity of seal and conditions on the unexposed side of the penetration
  - No visual changes were observed.
- Location of any penetration seal degradation
  - No visual changes were observed. Even though all seals exhibited some leakage, there was no visible seal degradation at the leakage points.
- Condition of seal to barrier interface
  - No visual changes were observed.
- Condition of seal to penetrating item interfaces
  - This inspection point is not applicable, since there we no penetrating items in this test.

6 Conclusion

Intertek Testing Services NA (Intertek) has conducted testing for AREVA NP Inc., on the fire and pressure resistance capabilities of Unifrax Fiberfrax® Durablanket® S (Durablanket), Dow Corning® Sylgard® 170 Silicone Elastomer (DC-170), Quantum Silicones QSil 5558MC Silicone Elastomer (QSil 5558MC), Dow Corning® 732 Multi-Purpose Sealant (DC-732) and Dow Corning® 790 Silicone Building Sealant (DC-790) through a 12" thick concrete deck for compliance with the applicable requirements of and in accordance with AREVA NP Inc. Document No. 51-9213021-000, *Detailed Test Plan for Conducting MOX Fire-Pressure Test 3*. This evaluation took place on November 15 through November 19, 2013.

This project was undertaken to evaluate the ability of select penetration seal designs to withstand various pressure levels after being subjected to a fire exposure (fire test).

The tested configurations did not burn through when exposed to the fire and positive pressure conditions as outlined in ASTM E814-94b, Standard Test Method for Fire Tests of Through-Penetration Fire Stops.. In addition, the seals met the acceptance criteria (remained in place) through all pressure stages as defined in the Test Plan. These results apply only to the configurations and materials tested.

The conclusions of this test report may not be used as part of the requirements for Intertek product certification. Authority to Mark must be issued for a product to become certified.

INTERTEK TESTING SERVICES NA

Reported by: [redacted]
Mike Dey
Staff Engineer

Reviewed by: [redacted]
Project Engineer, Fire Resistance

Reviewed by: [redacted]
Michael A. Brown
Quality Supervisor

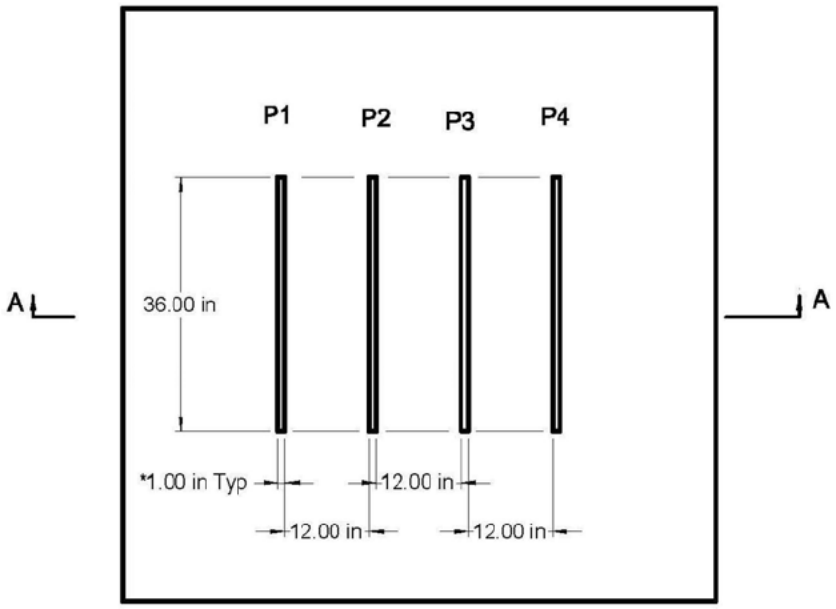
APPENDIX A
Assembly Drawings

AREVA

Document No.: 51-9213021-000

Detailed Test Plan for Conducting MOX Fire-Pressure Test 3

Fire-Pressure Test 3

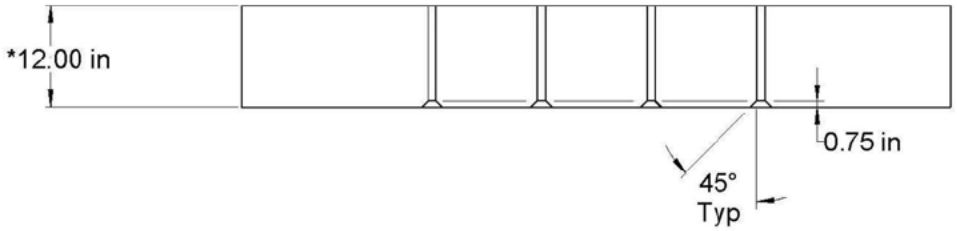


Section View is on
Page A-3.

NOTES:

1. TOLERANCE ON ALL SLAB DIMENSIONS IS +/- 1/4"
2. * INDICATES DIMENSIONS TO BE VERIFIED BY AREVA QC.

Intertek



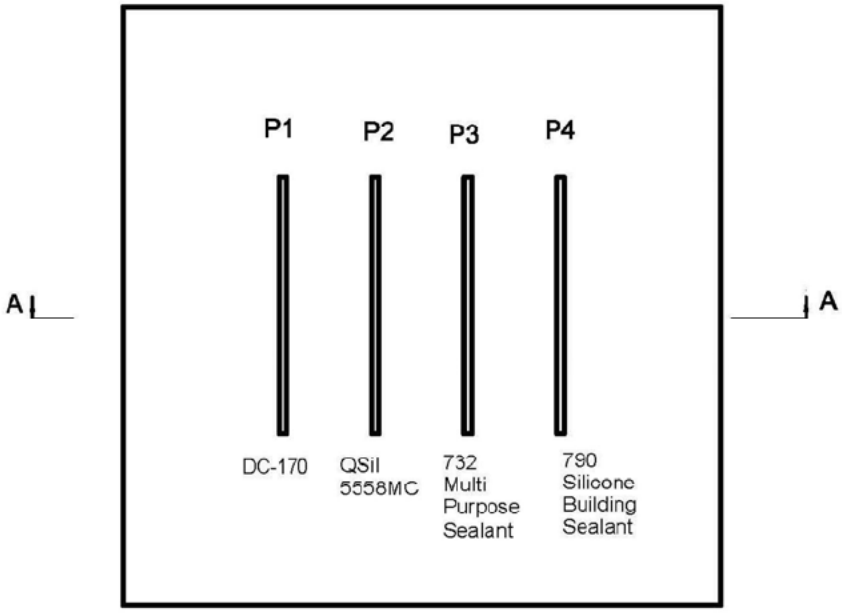
Section A-A

NOTES:

1. TOLERANCE ON ALL SLAB DIMENSIONS IS +/- 1/4"
2. * INDICATES DIMENSIONS TO BE VERIFIED BY AREVA QC
3. ALL GAPS BEVELED ¾" X 45° ON BOTTOM SIDE OF SLAB.

Fire-Pressure Test 3

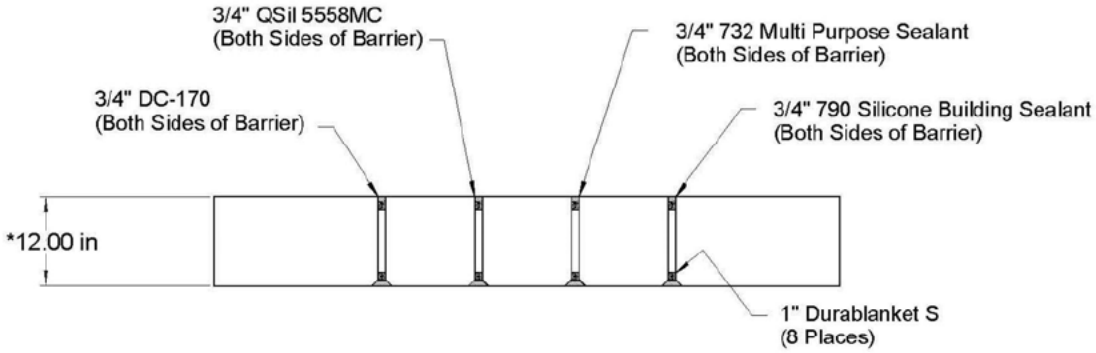
Penetration Seal Material



Section View is on Page A-5.

NOTES:

1. TOLERANCE ON ALL SLAB DIMENSIONS IS +/ 1/4"
2. * INDICATES DIMENSIONS TO BE VERIFIED BY AREVA QC.



Section A-A

NOTES:

1. TOLERANCE ON ALL SLAB DIMENSIONS IS +/- 1/4"
2. * INDICATES DIMENSIONS TO BE VERIFIED BY AREVA QC.

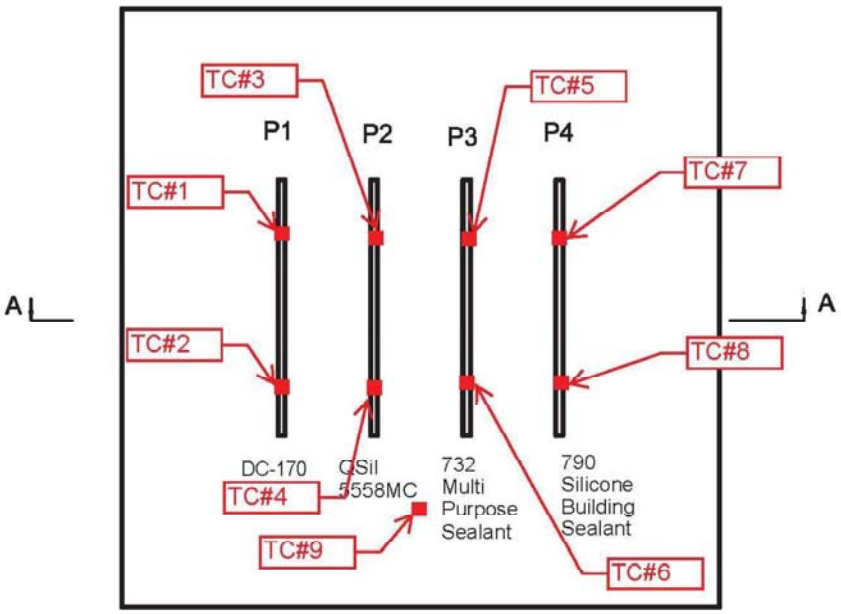
APPENDIX B
Thermocouple Layout

Thermocouple Layout, Fire-Pressure Test 3

Pen. No.	TC No.	TC Location	Mark No.
SLAB	TC#9	Surface - Test Slab	
Pen 1	TC#1	Surface - DC-170	
Pen 1	TC#2	Surface - DC-170	
Pen 2	TC#3	Surface - QSil 5558MC	
Pen 2	TC#4	Surface - QSil 5558MC	
Pen 3	TC#5	Surface - DC-732	
Pen 3	TC#6	Surface - DC-732	
Pen 3	TC#7	Surface - DC-790	
Pen 3	TC#8	Surface - DC-790	

Fire-Pressure Test 3

Penetration Seal Material

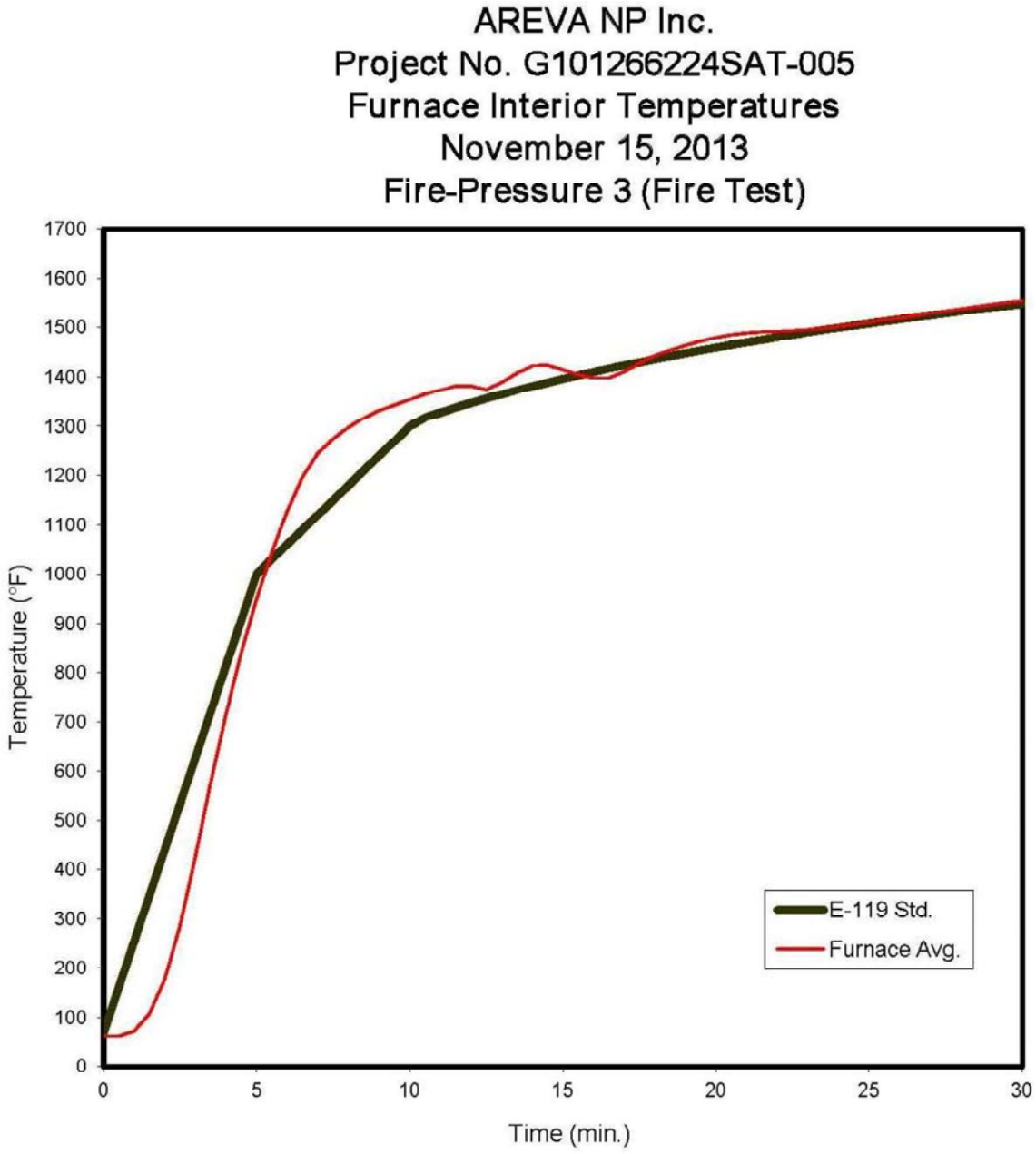


Section View is on
Page A-5.

NOTES:

1. TOLERANCE ON ALL SLAB DIMENSIONS IS +/- 1/4"
2. * INDICATES DIMENSIONS TO BE VERIFIED BY AREVA QC.

APPENDIX C1
Temperature Data


AREVA NP Inc.
Project No. G101266224SAT-005
Furnace Interior Temperatures
November 15, 2013
Fire-Pressure 3 (Fire Test)
Temperature (°F)
1700
1600
1500
1400
1300
1200
1100
1000
900
800
700
600
500
400
300
200
100
0
0
5
10
15
20
25
30
Time (min.)
E-119 Std.
Furnace Avg.

AREVA NP, Inc. Project No. G101266224SAT-005 November 15, 2013

Time (min)	E119 Std Average (°F)	Furnace Average (°F)	Furnace Probe #1 (°F)	Furnace Probe #2 (°F)	Furnace Probe #3 (°F)	Furnace Probe #4 (°F)	Furnace Pressure in. WC	Volt #16 (°F)	TC #1 (°F)
0	68	62	62	62	62	62	0.000	2.657	64
0.5	161	63	63	62	62	63	-0.063	3.287	64
1	254	72	71	68	72	78	-0.027	2.932	64
1.5	348	108	98	91	107	134	-0.009	2.751	64
2	441	177	154	138	172	244	-0.011	2.775	64
2.5	534	286	247	213	258	427	-0.039	3.049	64
3	627	427	378	315	357	658	-0.060	3.26	64
3.5	720	576	534	442	469	859	-0.060	3.264	64
4	814	716	692	583	583	1004	-0.069	3.354	64
4.5	907	842	837	725	696	1110	-0.041	3.067	64
5	1000	949	962	848	798	1189	-0.096	3.617	64
5.5	1030	1045	1082	951	891	1255	-0.161	4.275	64
6	1060	1128	1179	1042	976	1313	-0.160	4.263	64
6.5	1090	1197	1254	1121	1051	1362	-0.061	3.273	64
7	1120	1245	1306	1179	1108	1387	-0.017	2.831	64
7.5	1150	1275	1337	1217	1146	1399	0.003	2.636	64
8	1180	1298	1360	1246	1175	1411	0.010	2.566	64
8.5	1210	1317	1378	1269	1199	1420	0.023	2.428	64
9	1240	1332	1393	1288	1218	1427	0.042	2.241	64
9.5	1270	1343	1405	1302	1233	1431	0.041	2.253	64
10	1300	1353	1415	1315	1246	1437	0.046	2.198	64
10.5	1317	1365	1427	1327	1259	1445	0.053	2.134	64
11	1328	1374	1436	1338	1270	1450	0.064	2.017	64
11.5	1337	1381	1445	1348	1281	1451	0.126	1.401	64
12	1347	1382	1448	1356	1291	1431	0.092	1.743	64
12.5	1356	1375	1444	1357	1297	1400	0.015	2.511	64
13	1364	1389	1455	1367	1308	1424	0.009	2.572	64
13.5	1373	1408	1472	1381	1321	1457	0.032	2.34	64
14	1381	1423	1488	1394	1331	1479	0.093	1.736	64
14.5	1388	1424	1493	1403	1340	1460	0.120	1.466	64
15	1396	1415	1486	1403	1344	1426	0.031	2.35	65
15.5	1403	1405	1474	1398	1345	1401	0.001	2.654	64
16	1410	1398	1467	1394	1346	1386	0.029	2.37	64
16.5	1417	1398	1467	1393	1350	1383	-0.031	2.967	65
17	1424	1410	1477	1399	1357	1408	0.028	2.385	65
17.5	1430	1428	1492	1409	1365	1444	0.024	2.422	65
18	1436	1443	1506	1422	1373	1470	-0.005	2.707	65
18.5	1442	1454	1517	1432	1382	1486	0.005	2.607	65
19	1448	1464	1526	1442	1390	1497	0.011	2.549	65
19.5	1454	1472	1535	1452	1400	1502	0.028	2.381	65
20	1459	1479	1542	1460	1409	1506	0.027	2.387	65
20.5	1465	1485	1548	1468	1418	1505	0.030	2.366	65
21	1470	1488	1551	1474	1424	1504	0.005	2.609	65
21.5	1475	1491	1554	1478	1430	1500	0.004	2.617	65
22	1480	1492	1556	1480	1434	1497	-0.006	2.726	65
22.5	1485	1494	1558	1483	1439	1495	0.016	2.505	65
23	1490	1496	1561	1487	1442	1493	-0.004	2.706	65

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Time (min)	E119 Std Average (°F)	Furnace Average (°F)	Furnace Probe #1 (°F)	Furnace Probe #2 (°F)	Furnace Probe #3 (°F)	Furnace Probe #4 (°F)	Furnace Pressure in. WC	Volt #16 (°F)	TC #1 (°F)
23.5	1495	1499	1564	1491	1446	1493	0.011	2.548	65
24	1499	1503	1568	1496	1454	1493	-0.002	2.679	65
24.5	1504	1507	1572	1501	1461	1493	-0.006	2.723	65
25	1508	1511	1575	1506	1469	1494	0.047	2.195	65
25.5	1513	1516	1580	1512	1475	1497	0.016	2.502	65
26	1517	1520	1584	1516	1481	1498	0.009	2.572	65
26.5	1521	1524	1588	1522	1489	1498	0.019	2.468	65
27	1525	1529	1592	1527	1498	1498	0.019	2.47	65
27.5	1529	1534	1596	1533	1505	1500	0.064	2.024	65
28	1533	1538	1600	1538	1510	1505	0.041	2.251	66
28.5	1537	1543	1604	1543	1515	1508	0.025	2.414	65
29	1541	1547	1608	1547	1520	1512	0.028	2.379	65
29.5	1545	1551	1613	1552	1524	1515	0.017	2.488	66
30	1549	1555	1616	1557	1530	1516	0.012	2.54	66

Time (min)	TC #2 (°F)	TC #3 (°F)	TC #4 (°F)	TC #5 (°F)	TC #6 (°F)	TC #7 (°F)	TC #8 (°F)	TC #9 (°F)
0	64	64	64	64	65	64	63	63
0.5	64	64	64	65	65	64	64	63
1	64	64	64	65	65	64	64	63
1.5	64	64	64	65	65	64	64	63
2	64	64	64	65	65	64	64	63
2.5	64	64	64	65	65	64	64	63
3	64	64	65	65	65	64	64	63
3.5	64	64	65	65	65	64	64	63
4	64	64	65	65	65	64	64	63
4.5	64	64	65	65	65	64	64	63
5	64	64	65	65	65	64	64	64
5.5	64	64	65	65	65	64	64	64
6	64	64	65	65	65	64	64	64
6.5	64	64	65	65	65	64	64	64
7	64	64	65	65	65	64	64	64
7.5	64	64	65	65	65	64	64	64
8	64	64	65	65	65	64	64	63
8.5	64	64	65	65	65	64	64	64
9	64	64	65	65	65	64	64	64
9.5	64	64	65	65	65	64	64	64
10	64	64	65	65	65	64	64	64
10.5	65	64	65	65	65	64	64	64
11	64	65	65	65	65	64	64	64
11.5	64	64	65	65	65	64	64	64
12	65	65	65	65	65	64	64	64
12.5	65	65	65	65	65	64	64	64
13	65	65	65	65	65	64	64	64
13.5	65	65	65	65	65	64	64	64
14	65	65	65	65	65	64	64	64
14.5	65	65	65	65	65	64	64	64
15	65	65	65	65	66	65	64	64
15.5	65	65	65	65	65	64	64	64
16	65	64	65	65	65	64	64	64
16.5	65	65	66	65	66	65	64	64
17	65	65	66	65	66	65	64	64
17.5	65	65	66	65	66	65	64	64
18	65	65	66	65	66	65	64	64
18.5	65	65	66	65	66	65	64	64
19	65	65	66	66	66	65	65	64
19.5	65	65	66	66	66	65	64	64
20	65	65	66	66	66	65	64	64
20.5	65	65	66	66	66	65	65	64
21	65	65	66	66	66	65	65	64
21.5	65	65	66	66	66	65	65	64
22	65	65	66	66	66	65	65	65
22.5	65	65	66	66	66	65	65	65
23	65	65	66	66	66	65	65	65

Time (min)	TC #2 (°F)	TC #3 (°F)	TC #4 (°F)	TC #5 (°F)	TC #6 (°F)	TC #7 (°F)	TC #8 (°F)	TC #9 (°F)
23.5	65	65	66	66	66	65	65	64
24	65	65	66	66	66	65	65	65
24.5	65	65	66	66	66	65	65	65
25	65	65	66	66	66	65	65	65
25.5	65	65	66	66	66	65	65	65
26	65	65	66	66	66	65	65	65
26.5	65	65	66	66	66	65	65	65
27	65	66	66	66	66	65	65	65
27.5	65	65	66	66	66	65	65	65
28	66	66	67	66	67	65	65	65
28.5	66	66	66	66	66	65	65	65
29	65	66	66	66	67	65	65	65
29.5	66	66	67	66	67	66	65	65
30	66	66	67	66	67	66	65	65

APPENDIX C2
Pressure Data

AREVA NP, Inc. Project No. G101266224SAT-005 November 19, 2013

Time (min)	Ch 1 dP (psi)	Ch 2 High Flow (LPM)	Ch 3 Low Flow (LPM)	Total Flow (LPM)
0	-0.0249	0	0.0002	0.0002
0.0333	-0.0249	0	0	0
0.0667	-0.0275	0	0	0
0.1	-0.0252	0	0.0002	0.0002
0.1333	-0.0331	0.016	0.0015	0.0175
0.1667	-0.0255	0.0028	0.0015	0.0043
0.2	-0.0242	0	0	0
0.2333	-0.0252	0	0	0
0.2667	-0.0288	0.016	0.0002	0.0162
0.3	-0.0269	0.016	0	0.016
0.3333	-0.0252	0	0.0015	0.0015
0.3667	-0.0272	0	0	0
0.4	-0.0282	0.0028	0.0002	0.003
0.4333	-0.0252	0.0028	0.0002	0.003
0.4667	-0.0279	0	0.0002	0.0002
0.5	-0.0282	0.0028	0.0002	0.003
0.5333	-0.0249	0	0	0
0.5667	-0.0246	0	0	0
0.6	-0.0265	0.0028	0.0015	0.0043
0.6333	-0.0246	0.0028	0	0.0028
0.6667	-0.0265	0.016	0	0.016
0.7	-0.0262	0	0.0002	0.0002
0.7333	-0.0262	0.0028	0.0002	0.003
0.7667	-0.0242	0	0.0002	0.0002
0.8	-0.0269	0.0028	0	0.0028
0.8333	-0.0288	0.0028	0.0015	0.0043
0.8667	-0.0295	0	0	0
0.9	-0.0265	0.016	0	0.016
0.9333	-0.0242	0.0028	0.0002	0.003
0.9667	-0.0259	0	0.0002	0.0002
1	-0.0279	0.0028	0.0002	0.003
1.0333	-0.0252	0	0	0
1.0667	-0.0262	0.0028	0.0002	0.003
1.1	-0.0236	0.0028	0.0002	0.003
1.1333	-0.0265	0	0.0002	0.0002
1.1667	-0.0259	0	0.0002	0.0002
1.2	-0.0246	0	0.0015	0.0015
1.2333	-0.0269	0	0.0002	0.0002
1.2667	-0.0239	0.0028	0	0.0028
1.3	-0.0262	0.016	0.0002	0.0162
1.3333	-0.0269	0.0028	0.0002	0.003
1.3667	-0.0246	0	0.0002	0.0002
1.4	-0.0272	0	0	0
1.4333	-0.0252	0.0028	0	0.0028

AREVA NP, Inc. Project No. G101266224SAT-005 November 19, 2013

Time (min)	Ch 1 dP (psi)	Ch 2 High Flow (LPM)	Ch 3 Low Flow (LPM)	Total Flow (LPM)
1.4667	-0.0295	0.0028	0.0002	0.003
1.5	-0.0275	0	0.0015	0.0015
1.5333	-0.0295	0.0028	0.0002	0.003
1.5667	-0.0242	0.0028	0.0002	0.003
1.6	-0.0255	0.016	0	0.016
1.6333	-0.0298	0	0	0
1.6667	-0.0239	0	0.0002	0.0002
1.7	-0.0252	0.0028	0	0.0028
1.7333	-0.0272	0	0.0002	0.0002
1.7667	-0.0272	0	0.0002	0.0002
1.8	-0.0272	0.0028	0.0002	0.003
1.8333	-0.0265	0.0028	0.0002	0.003
1.8667	-0.0249	0.0028	0.0002	0.003
1.9	-0.0279	0.0028	0	0.0028
1.9333	-0.0279	0.0028	0.0002	0.003
1.9667	-0.0295	0.016	0.0002	0.0162
2	-0.0272	0.0028	0	0.0028
2.0333	-0.0262	0.0028	0.0015	0.0043
2.0667	-0.0288	0.0028	0	0.0028
2.1	-0.0259	0.016	0.0015	0.0175
2.1333	-0.0275	0	0	0
2.1667	-0.0272	0.016	0.0002	0.0162
2.2	-0.0249	0	0.0002	0.0002
2.2333	-0.0275	0.0028	0.0002	0.003
2.2667	-0.0259	0.0028	0.0002	0.003
2.3	-0.0275	0.0028	0.0002	0.003
2.3333	-0.0252	0	0.0015	0.0015
2.3667	-0.0275	0	0	0
2.4	-0.0269	0	0	0
2.4333	-0.0272	0	0.0015	0.0015
2.4667	-0.0255	0	0.0015	0.0015
2.5	-0.0236	0	0.0002	0.0002
2.5333	-0.0232	0	0	0
2.5667	-0.0279	0.0028	0	0.0028
2.6	-0.0265	0.0028	0	0.0028
2.6333	-0.0249	0.0028	0	0.0028
2.6667	-0.0255	0	0	0
2.7	-0.0288	0.0028	0	0.0028
2.7333	-0.0269	0.0028	0.0002	0.003
2.7667	-0.0249	0	0.0015	0.0015
2.8	-0.0275	0	0	0
2.8333	-0.0249	0.0028	0	0.0028
2.8667	-0.0282	0.0028	0.0002	0.003
2.9	-0.0275	0.016	0.0002	0.0162

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Time (min)	Ch 1 dP (psi)	Ch 2 High Flow (LPM)	Ch 3 Low Flow (LPM)	Total Flow (LPM)
2.9333	-0.0288	0	0.0002	0.0002
2.9667	-0.0288	0.0028	0.0002	0.003
3	-0.0279	0	0.0002	0.0002
3.0333	-0.0255	0.0028	0.0002	0.003
3.0667	-0.0246	0.0028	0.0002	0.003
3.1	-0.0285	0.0028	0	0.0028
3.1333	-0.0269	0.0028	0	0.0028
3.1667	-0.0255	0.0028	0.0002	0.003
3.2	-0.0262	0.0028	0.0002	0.003
3.2333	-0.0259	0	0.0015	0.0015
3.2667	-0.0242	0.0028	0.0002	0.003
3.3	-0.0249	0.0028	0	0.0028
3.3333	-0.0262	0	0	0
3.3667	-0.0249	0	0.0002	0.0002
3.4	-0.0246	0.016	0	0.016
3.4333	-0.0252	0	0.0002	0.0002
3.4667	-0.0255	0.0028	0	0.0028
3.5	-0.0282	0	0.0002	0.0002
3.5333	-0.0262	0	0.0002	0.0002
3.5667	-0.0265	0.0028	0.0002	0.003
3.6	-0.0288	0	0	0
3.6333	-0.0252	0	0	0
3.6667	-0.0252	0.016	0.0002	0.0162
3.7	-0.0262	0.0028	0.0002	0.003
3.7333	-0.0259	0.0028	0.0002	0.003
3.7667	-0.0269	0.0028	0	0.0028
3.8	-0.0275	0.0028	0.0002	0.003
3.8333	-0.0279	0.0028	0.0002	0.003
3.8667	-0.0249	0	0	0
3.9	-0.0279	0	0.0002	0.0002
3.9333	-0.0272	0	0.0002	0.0002
3.9667	-0.0265	0	0	0
4	-0.0275	0.0028	0.0002	0.003
4.0333	-0.0249	0.0028	0.0002	0.003
4.0667	-0.0259	0	0.0002	0.0002
4.1	-0.0279	0.0028	0	0.0028
4.1333	-0.0255	0	0.0015	0.0015
4.1667	-0.0252	0.016	0.0002	0.0162
4.2	-0.0279	0.0028	0	0.0028
4.2333	-0.0269	0	0.0002	0.0002
4.2667	-0.0279	0	0.0015	0.0015
4.3	-0.0265	0	0.0002	0.0002
4.3333	-0.0292	0.0291	0.0002	0.0293
4.3667	-0.0255	0.016	0	0.016

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Time (min)	Ch 1 dP (psi)	Ch 2 High Flow (LPM)	Ch 3 Low Flow (LPM)	Total Flow (LPM)
4.4	-0.0282	0	0	0
4.4333	-0.0246	0.0028	0	0.0028
4.4667	-0.0242	0	0	0
4.5	-0.0255	0	0.0002	0.0002
4.5333	-0.0255	0.0028	0	0.0028
4.5667	-0.0298	0.0028	0.0002	0.003
4.6	-0.0262	0	0	0
4.6333	-0.0255	0.0028	0.0002	0.003
4.6667	-0.0176	0	0.0002	0.0002
4.7	-0.0009	0	0	0
4.7333	0.0192	0.016	0	0.016
4.7667	0.0367	0.016	0.0002	0.0162
4.8	0.0488	0.0028	0.0002	0.003
4.8333	0.0663	0.016	0.0002	0.0162
4.8667	0.0801	0	0.0015	0.0015
4.9	0.0933	0.0028	0	0.0028
4.9333	0.1081	0	0	0
4.9667	0.1229	0	0.0002	0.0002
5	0.138	0	0	0
5.0333	0.1469	0	0.0002	0.0002
5.0667	0.1591	0.0028	0	0.0028
5.1	0.1732	0	0.0002	0.0002
5.1333	0.1884	0.0028	0.0002	0.003
5.1667	0.1989	0.0028	0	0.0028
5.2	0.2088	0	0	0
5.2333	0.22	0.0028	0.0002	0.003
5.2667	0.2315	0.016	0.0002	0.0162
5.3	0.2384	0.0028	0	0.0028
5.3333	0.2503	0.0028	0.0002	0.003
5.3667	0.2568	0	0	0
5.4	0.2687	0	0	0
5.4333	0.2769	0.0028	0	0.0028
5.4667	0.2871	0.0028	0.0002	0.003
5.5	0.294	0.0028	0.0002	0.003
5.5333	0.3006	0.0028	0	0.0028
5.5667	0.3089	0	0.0002	0.0002
5.6	0.3194	0.016	0	0.016
5.6333	0.3266	0.016	0	0.016
5.6667	0.3302	0	0.0015	0.0015
5.7	0.3385	0.0028	0.0002	0.003
5.7333	0.3428	0	0.0015	0.0015
5.7667	0.3516	0	0	0
5.8	0.3569	0.0028	0	0.0028
5.8333	0.3632	0	0	0

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Time (min)	Ch 1 dP (psi)	Ch 2 High Flow (LPM)	Ch 3 Low Flow (LPM)	Total Flow (LPM)
5.8667	0.3665	0	0.0002	0.0002
5.9	0.3674	0.0028	0.0002	0.003
5.9333	0.3717	0.0028	0.0002	0.003
5.9667	0.3734	0.0028	0.0002	0.003
6	0.3763	0.0028	0	0.0028
6.0333	0.3773	0.0028	0	0.0028
6.0667	0.3763	0.0028	0.0002	0.003
6.1	0.3773	0.0028	0.0002	0.003
6.1333	0.378	0.0028	0	0.0028
6.1667	0.3773	0	0	0
6.2	0.3806	0	0.0002	0.0002
6.2333	0.3776	0	0.0002	0.0002
6.2667	0.377	0.0028	0	0.0028
6.3	0.3743	0	0.0002	0.0002
6.3333	0.3743	0	0.0002	0.0002
6.3667	0.3724	0.0028	0	0.0028
6.4	0.373	0	0	0
6.4333	0.373	0	0.0002	0.0002
6.4667	0.3701	0.016	0.0002	0.0162
6.5	0.3658	0	0	0
6.5333	0.3684	0	0	0
6.5667	0.3638	0.0028	0.0002	0.003
6.6	0.3612	0	0.0002	0.0002
6.6333	0.3622	0.0028	0	0.0028
6.6667	0.3625	0.0028	0.0002	0.003
6.7	0.3638	0.0028	0.0002	0.003
6.7333	0.3605	0.0028	0.0015	0.0043
6.7667	0.3582	0.0028	0	0.0028
6.8	0.3602	0.0028	0.0002	0.003
6.8333	0.3572	0	0	0
6.8667	0.3569	0.0028	0.0002	0.003
6.9	0.3566	0	0	0
6.9333	0.3549	0.0028	0	0.0028
6.9667	0.3556	0	0.0015	0.0015
7	0.3533	0.0028	0	0.0028
7.0333	0.3539	0.0028	0	0.0028
7.0667	0.3539	0.0028	0	0.0028
7.1	0.3539	0	0	0
7.1333	0.3516	0.0028	0	0.0028
7.1667	0.352	0.0028	0.0002	0.003
7.2	0.3487	0.0028	0	0.0028
7.2333	0.3477	0.016	0.0002	0.0162
7.2667	0.3467	0.0028	0	0.0028
7.3	0.3477	0.0028	0.0002	0.003

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Time (min)	Ch 1 dP (psi)	Ch 2 High Flow (LPM)	Ch 3 Low Flow (LPM)	Total Flow (LPM)
7.3333	0.346	0.0028	0.0002	0.003
7.3667	0.347	0.016	0	0.016
7.4	0.3487	0.0028	0.0015	0.0043
7.4333	0.3437	0.0028	0.0015	0.0043
7.4667	0.348	0.0028	0.0002	0.003
7.5	0.349	0	0.0002	0.0002
7.5333	0.3441	0	0.0002	0.0002
7.5667	0.3447	0.0028	0.0015	0.0043
7.6	0.347	0.0028	0	0.0028
7.6333	0.3457	0	0	0
7.6667	0.3447	0.0028	0.0002	0.003
7.7	0.3444	0	0.0015	0.0015
7.7333	0.347	0	0.0002	0.0002
7.7667	0.3447	0	0	0
7.8	0.3487	0	0	0
7.8333	0.3457	0.016	0.0002	0.0162
7.8667	0.3464	0	0.0015	0.0015
7.9	0.3457	0.016	0.0002	0.0162
7.9333	0.3424	0	0.0002	0.0002
7.9667	0.3467	0.0028	0.0015	0.0043
8	0.348	0.0028	0.0002	0.003
8.0333	0.3464	0.0028	0	0.0028
8.0667	0.3454	0.0291	0.0015	0.0306
8.1	0.351	0.016	0.0002	0.0162
8.1333	0.3477	0	0.0002	0.0002
8.1667	0.3516	0.0028	0.0002	0.003
8.2	0.352	0	0	0
8.2333	0.3513	0.0028	0.0002	0.003
8.2667	0.353	0.0291	0	0.0291
8.3	0.3516	0.0028	0.0002	0.003
8.3333	0.3539	0.0028	0.0002	0.003
8.3667	0.3539	0.0028	0.0015	0.0043
8.4	0.3543	0.016	0	0.016
8.4333	0.3566	0.0028	0.0002	0.003
8.4667	0.3556	0	0.0002	0.0002
8.5	0.3562	0.0028	0.0015	0.0043
8.5333	0.3562	0.0028	0.0015	0.0043
8.5667	0.3589	0	0.0002	0.0002
8.6	0.3605	0.0028	0.0002	0.003
8.6333	0.3609	0.016	0.0015	0.0175
8.6667	0.3641	0	0	0
8.7	0.3612	0.0028	0.0015	0.0043
8.7333	0.3668	0.0028	0	0.0028
8.7667	0.3651	0	0	0

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Time (min)	Ch 1 dP (psi)	Ch 2 High Flow (LPM)	Ch 3 Low Flow (LPM)	Total Flow (LPM)
8.8	0.3651	0.0028	0.0015	0.0043
8.8333	0.3632	0.0028	0.0002	0.003
8.8667	0.3655	0	0.0002	0.0002
8.9	0.3688	0.0028	0.0002	0.003
8.9333	0.3674	0	0.0002	0.0002
8.9667	0.3694	0.0028	0.0015	0.0043
9	0.3684	0	0	0
9.0333	0.3711	0	0.0002	0.0002
9.0667	0.3717	0	0.0002	0.0002
9.1	0.374	0.016	0	0.016
9.1333	0.3711	0.0028	0.0002	0.003
9.1667	0.3743	0	0	0
9.2	0.376	0	0	0
9.2333	0.3734	0.0028	0.0015	0.0043
9.2667	0.3767	0.0028	0	0.0028
9.3	0.3747	0.0028	0.0002	0.003
9.3333	0.3743	0.0028	0.0002	0.003
9.3667	0.377	0.0028	0.0002	0.003
9.4	0.3767	0	0	0
9.4333	0.376	0	0.0002	0.0002
9.4667	0.3799	0.0028	0	0.0028
9.5	0.3786	0.0028	0	0.0028
9.5333	0.3816	0	0.0002	0.0002
9.5667	0.3809	0.0028	0.0002	0.003
9.6	0.3839	0	0.0002	0.0002
9.6333	0.3836	0	0	0
9.6667	0.3836	0.0028	0.0002	0.003
9.7	0.3826	0.0028	0	0.0028
9.7333	0.3803	0.0028	0.0015	0.0043
9.7667	0.3832	0.0028	0	0.0028
9.8	0.3819	0.016	0.0015	0.0175
9.8333	0.3839	0	0.0002	0.0002
9.8667	0.3869	0.0028	0	0.0028
9.9	0.3865	0.0028	0.0015	0.0043
9.9333	0.3872	0.0028	0	0.0028
9.9667	0.3875	0.0028	0.0002	0.003
10	0.3875	0.0028	0	0.0028
10.0333	0.3865	0	0	0
10.0667	0.3895	0.0028	0	0.0028
10.1	0.3875	0.0028	0	0.0028
10.1333	0.3859	0.0028	0.0028	0.0056
10.1667	0.3878	0.016	0.0002	0.0162
10.2	0.3875	0.016	0	0.016
10.2333	0.3895	0	0	0

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Time (min)	Ch 1 dP (psi)	Ch 2 High Flow (LPM)	Ch 3 Low Flow (LPM)	Total Flow (LPM)
10.2667	0.3859	0	0	0
10.3	0.3892	0	0	0
10.3333	0.3846	0.0028	0.0015	0.0043
10.3667	0.3865	0.0028	0	0.0028
10.4	0.3892	0.0028	0	0.0028
10.4333	0.3849	0.0028	0.0002	0.003
10.4667	0.3849	0.0028	0	0.0028
10.5	0.3832	0.0028	0.0002	0.003
10.5333	0.3839	0.0028	0	0.0028
10.5667	0.3842	0.0028	0.0002	0.003
10.6	0.3803	0	0.0002	0.0002
10.6333	0.3826	0.0028	0.0015	0.0043
10.6667	0.3836	0.0028	0.0015	0.0043
10.7	0.3816	0.0028	0	0.0028
10.7333	0.3813	0.0028	0.0002	0.003
10.7667	0.3822	0	0.0002	0.0002
10.8	0.3839	0.0028	0.0002	0.003
10.8333	0.3819	0	0.0002	0.0002
10.8667	0.3796	0	0.0002	0.0002
10.9	0.3819	0.0028	0.0002	0.003
10.9333	0.3803	0	0	0
10.9667	0.3819	0.0028	0	0.0028
11	0.3793	0	0	0
11.0333	0.3803	0.016	0	0.016
11.0667	0.378	0.0028	0	0.0028
11.1	0.3773	0.0028	0.0002	0.003
11.1333	0.378	0.016	0	0.016
11.1667	0.3796	0.0028	0.0002	0.003
11.2	0.3767	0	0.0002	0.0002
11.2333	0.378	0.0028	0.0002	0.003
11.2667	0.3803	0	0.0002	0.0002
11.3	0.375	0	0	0
11.3333	0.374	0.0028	0	0.0028
11.3667	0.376	0	0.0002	0.0002
11.4	0.377	0	0.0002	0.0002
11.4333	0.378	0.0028	0	0.0028
11.4667	0.3743	0.0028	0.0002	0.003
11.5	0.377	0.016	0	0.016
11.5333	0.3753	0.0028	0.0002	0.003
11.5667	0.372	0.0028	0	0.0028
11.6	0.3747	0.0028	0	0.0028
11.6333	0.375	0.016	0	0.016
11.6667	0.3747	0	0.0002	0.0002
11.7	0.374	0.0028	0.0015	0.0043

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Time (min)	Ch 1 dP (psi)	Ch 2 High Flow (LPM)	Ch 3 Low Flow (LPM)	Total Flow (LPM)
11.7333	0.373	0.0028	0.0015	0.0043
11.7667	0.373	0	0	0
11.8	0.374	0.016	0.0002	0.0162
11.8333	0.3747	0	0	0
11.8667	0.3727	0.016	0.0002	0.0162
11.9	0.3714	0.0028	0.0002	0.003
11.9333	0.374	0.0028	0.0002	0.003
11.9667	0.3724	0	0.0002	0.0002
12	0.373	0.0028	0.0002	0.003
12.0333	0.3737	0	0	0
12.0667	0.3717	0	0	0
12.1	0.3711	0.0028	0.0015	0.0043
12.1333	0.3697	0.0028	0	0.0028
12.1667	0.3747	0.0028	0.0002	0.003
12.2	0.3734	0.016	0	0.016
12.2333	0.3717	0.016	0	0.016
12.2667	0.3727	0.0028	0	0.0028
12.3	0.3684	0.0291	0.0002	0.0293
12.3333	0.3711	0	0.0002	0.0002
12.3667	0.3691	0.0028	0.0002	0.003
12.4	0.3714	0.0028	0.0002	0.003
12.4333	0.3678	0.016	0	0.016
12.4667	0.3704	0	0	0
12.5	0.373	0.0028	0.0002	0.003
12.5333	0.3665	0.0028	0.0015	0.0043
12.5667	0.3684	0	0	0
12.6	0.3714	0.0028	0	0.0028
12.6333	0.3697	0.016	0	0.016
12.6667	0.3704	0.0028	0	0.0028
12.7	0.3697	0.0028	0.0002	0.003
12.7333	0.3701	0.0028	0.0002	0.003
12.7667	0.3681	0	0.0002	0.0002
12.8	0.3691	0	0.0002	0.0002
12.8333	0.3697	0	0.0002	0.0002
12.8667	0.3694	0.0028	0.0028	0.0056
12.9	0.3681	0.0028	0.0002	0.003
12.9333	0.3688	0	0.0002	0.0002
12.9667	0.3678	0	0.0015	0.0015
13	0.3668	0.0028	0.0015	0.0043
13.0333	0.3684	0	0.0002	0.0002
13.0667	0.3671	0.0028	0.0002	0.003
13.1	0.3681	0.0028	0.0002	0.003
13.1333	0.3651	0.016	0	0.016
13.1667	0.3681	0.016	0	0.016

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Time (min)	Ch 1 dP (psi)	Ch 2 High Flow (LPM)	Ch 3 Low Flow (LPM)	Total Flow (LPM)
13.2	0.3701	0.016	0.0002	0.0162
13.2333	0.3681	0	0.0002	0.0002
13.2667	0.3645	0.0028	0.0002	0.003
13.3	0.3655	0.0028	0.0002	0.003
13.3333	0.3671	0.0028	0	0.0028
13.3667	0.3658	0.016	0	0.016
13.4	0.3684	0.016	0.0002	0.0162
13.4333	0.3707	0.016	0	0.016
13.4667	0.372	0.0028	0	0.0028
13.5	0.379	0	0.0015	0.0015
13.5333	0.3829	0	0.0002	0.0002
13.5667	0.3869	0	0.0015	0.0015
13.6	0.3921	0	0.0002	0.0002
13.6333	0.3997	0.0028	0.0002	0.003
13.6667	0.405	0.016	0.0002	0.0162
13.7	0.4142	0	0.0015	0.0015
13.7333	0.4221	0	0.0015	0.0015
13.7667	0.4369	0	0.0002	0.0002
13.8	0.4422	0.0028	0.0002	0.003
13.8333	0.457	0.0028	0.0002	0.003
13.8667	0.4658	0.0028	0.0002	0.003
13.9	0.4737	0.0028	0.0015	0.0043
13.9333	0.4853	0.0028	0.0002	0.003
13.9667	0.4935	0	0.0002	0.0002
14	0.5017	0.0028	0.0015	0.0043
14.0333	0.509	0	0.0002	0.0002
14.0667	0.5231	0.016	0.0002	0.0162
14.1	0.5264	0.0028	0.0002	0.003
14.1333	0.5356	0.016	0	0.016
14.1667	0.5422	0.0028	0.0015	0.0043
14.2	0.5504	0.016	0	0.016
14.2333	0.5557	0.0028	0.0002	0.003
14.2667	0.5639	0.016	0.0002	0.0162
14.3	0.5712	0.0028	0.0002	0.003
14.3333	0.5807	0	0.0015	0.0015
14.3667	0.5873	0.0028	0.0002	0.003
14.4	0.5942	0	0	0
14.4333	0.6008	0.0028	0.0002	0.003
14.4667	0.6087	0.0028	0	0.0028
14.5	0.6159	0.0028	0.0002	0.003
14.5333	0.6209	0.0028	0.0015	0.0043
14.5667	0.6251	0.016	0.0015	0.0175
14.6	0.6324	0.0028	0	0.0028
14.6333	0.6363	0	0.0002	0.0002

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Time (min)	Ch 1 dP (psi)	Ch 2 High Flow (LPM)	Ch 3 Low Flow (LPM)	Total Flow (LPM)
14.6667	0.6446	0.016	0	0.016
14.7	0.6498	0	0.0015	0.0015
14.7333	0.6544	0	0.0002	0.0002
14.7667	0.6614	0.0028	0.0002	0.003
14.8	0.6614	0.0028	0.0002	0.003
14.8333	0.6679	0	0.0002	0.0002
14.8667	0.6742	0.0028	0.0002	0.003
14.9	0.6765	0.0028	0.0002	0.003
14.9333	0.6818	0.016	0.0002	0.0162
14.9667	0.6906	0.0028	0	0.0028
15	0.6906	0	0.0015	0.0015
15.0333	0.6956	0.0291	0.0015	0.0306
15.0667	0.6982	0.016	0.0002	0.0162
15.1	0.6999	0	0	0
15.1333	0.7061	0.0028	0.0002	0.003
15.1667	0.7078	0	0.0002	0.0002
15.2	0.7097	0	0	0
15.2333	0.716	0.0028	0	0.0028
15.2667	0.7176	0.0028	0	0.0028
15.3	0.7213	0.0028	0	0.0028
15.3333	0.7216	0.016	0.0002	0.0162
15.3667	0.7262	0.016	0	0.016
15.4	0.7301	0.0028	0	0.0028
15.4333	0.7308	0.0028	0.0002	0.003
15.4667	0.7308	0	0.0002	0.0002
15.5	0.7318	0.0028	0.0002	0.003
15.5333	0.7278	0.016	0	0.016
15.5667	0.7275	0.0028	0	0.0028
15.6	0.7239	0.0028	0.0015	0.0043
15.6333	0.7245	0.0028	0	0.0028
15.6667	0.7226	0	0	0
15.7	0.7183	0.016	0.0002	0.0162
15.7333	0.7176	0.0028	0.0002	0.003
15.7667	0.7186	0.016	0.0002	0.0162
15.8	0.7127	0	0	0
15.8333	0.7166	0	0.0002	0.0002
15.8667	0.712	0	0	0
15.9	0.7127	0.0028	0	0.0028
15.9333	0.714	0.0028	0.0002	0.003
15.9667	0.7111	0	0.0002	0.0002
16	0.7068	0.0028	0.0002	0.003
16.0333	0.7064	0	0	0
16.0667	0.7055	0.0028	0	0.0028
16.1	0.7068	0	0.0002	0.0002

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Time (min)	Ch 1 dP (psi)	Ch 2 High Flow (LPM)	Ch 3 Low Flow (LPM)	Total Flow (LPM)
16.1333	0.7025	0.0028	0.0015	0.0043
16.1667	0.7032	0	0	0
16.2	0.7025	0.0028	0	0.0028
16.2333	0.7028	0.016	0	0.016
16.2667	0.7035	0.0028	0	0.0028
16.3	0.6999	0.016	0	0.016
16.3333	0.6985	0.0028	0.0002	0.003
16.3667	0.6979	0	0	0
16.4	0.6999	0.016	0.0002	0.0162
16.4333	0.6985	0.0028	0.0002	0.003
16.4667	0.6979	0.016	0.0002	0.0162
16.5	0.6936	0.0028	0.0002	0.003
16.5333	0.6939	0.016	0.0002	0.0162
16.5667	0.6933	0.0028	0.0002	0.003
16.6	0.6936	0.0028	0.0002	0.003
16.6333	0.693	0	0.0002	0.0002
16.6667	0.692	0.0028	0.0002	0.003
16.7	0.6923	0.0028	0.0002	0.003
16.7333	0.6923	0.016	0.0002	0.0162
16.7667	0.6939	0.016	0.0002	0.0162
16.8	0.6916	0.0028	0	0.0028
16.8333	0.6939	0.0028	0.0002	0.003
16.8667	0.6923	0.0028	0.0002	0.003
16.9	0.6949	0	0.0002	0.0002
16.9333	0.6926	0	0.0015	0.0015
16.9667	0.6949	0.0028	0.0002	0.003
17	0.6966	0.0028	0.0002	0.003
17.0333	0.6966	0	0.0002	0.0002
17.0667	0.6936	0.016	0.0002	0.0162
17.1	0.6985	0	0.0002	0.0002
17.1333	0.7002	0	0.0002	0.0002
17.1667	0.7005	0.016	0	0.016
17.2	0.6992	0.0028	0.0002	0.003
17.2333	0.7002	0.0028	0.0002	0.003
17.2667	0.7028	0	0.0002	0.0002
17.3	0.7051	0.016	0	0.016
17.3333	0.7025	0	0.0002	0.0002
17.3667	0.7078	0.0028	0	0.0028
17.4	0.7064	0	0.0002	0.0002
17.4333	0.7091	0.0028	0.0002	0.003
17.4667	0.713	0.016	0	0.016
17.5	0.7107	0	0	0
17.5333	0.7157	0	0	0
17.5667	0.714	0.0028	0.0002	0.003

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Time (min)	Ch 1 dP (psi)	Ch 2 High Flow (LPM)	Ch 3 Low Flow (LPM)	Total Flow (LPM)
17.6	0.7157	0.0028	0.0002	0.003
17.6333	0.717	0.0291	0.0002	0.0293
17.6667	0.7216	0.0028	0.0002	0.003
17.7	0.7213	0	0.0002	0.0002
17.7333	0.7199	0	0.0028	0.0028
17.7667	0.7229	0.0028	0.0015	0.0043
17.8	0.7255	0.0028	0	0.0028
17.8333	0.7259	0	0	0
17.8667	0.7259	0.016	0	0.016
17.9	0.7229	0.016	0	0.016
17.9333	0.7301	0.0028	0	0.0028
17.9667	0.7275	0.0028	0.0002	0.003
18	0.7311	0	0.0002	0.0002
18.0333	0.7308	0	0.0002	0.0002
18.0667	0.7295	0.0028	0.0002	0.003
18.1	0.7344	0.0028	0.0002	0.003
18.1333	0.7311	0.016	0	0.016
18.1667	0.7334	0.0028	0.0015	0.0043
18.2	0.7344	0	0.0015	0.0015
18.2333	0.7331	0.0028	0.0002	0.003
18.2667	0.7377	0	0	0
18.3	0.7344	0.016	0.0002	0.0162
18.3333	0.7384	0.0028	0.0002	0.003
18.3667	0.7377	0	0.0015	0.0015
18.4	0.739	0.0028	0.0002	0.003
18.4333	0.742	0.0028	0.0002	0.003
18.4667	0.74	0.0028	0.0002	0.003
18.5	0.743	0.0028	0.0002	0.003
18.5333	0.7423	0.0028	0	0.0028
18.5667	0.742	0.0028	0.0015	0.0043
18.6	0.745	0	0.0015	0.0015
18.6333	0.744	0.0028	0.0002	0.003
18.6667	0.7427	0	0	0
18.7	0.7433	0.0028	0	0.0028
18.7333	0.7433	0.0028	0.0002	0.003
18.7667	0.7443	0.0028	0.0002	0.003
18.8	0.7469	0.0028	0	0.0028
18.8333	0.743	0	0.0002	0.0002
18.8667	0.7482	0	0	0
18.9	0.7463	0	0.0002	0.0002
18.9333	0.7486	0.016	0.0002	0.0162
18.9667	0.7486	0	0	0
19	0.7473	0.016	0	0.016
19.0333	0.7502	0.0028	0.0002	0.003

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Time (min)	Ch 1 dP (psi)	Ch 2 High Flow (LPM)	Ch 3 Low Flow (LPM)	Total Flow (LPM)
19.0667	0.7482	0.0028	0.0002	0.003
19.1	0.7463	0.0028	0.0002	0.003
19.1333	0.7453	0	0	0
19.1667	0.7489	0	0.0015	0.0015
19.2	0.7499	0	0	0
19.2333	0.7469	0.0028	0	0.0028
19.2667	0.7496	0.016	0.0002	0.0162
19.3	0.7519	0	0	0
19.3333	0.7482	0	0.0015	0.0015
19.3667	0.7512	0	0.0002	0.0002
19.4	0.7505	0	0	0
19.4333	0.7502	0	0.0002	0.0002
19.4667	0.7479	0	0.0015	0.0015
19.5	0.7463	0.016	0.0002	0.0162
19.5333	0.7502	0.0028	0	0.0028
19.5667	0.7486	0.0028	0.0015	0.0043
19.6	0.7545	0.0028	0	0.0028
19.6333	0.7486	0.016	0.0002	0.0162
19.6667	0.7512	0.0028	0.0015	0.0043
19.7	0.7499	0	0.0002	0.0002
19.7333	0.7519	0.016	0.0002	0.0162
19.7667	0.7512	0.016	0	0.016
19.8	0.7505	0.0028	0	0.0028
19.8333	0.7509	0.0028	0	0.0028
19.8667	0.7496	0.0028	0	0.0028
19.9	0.7515	0.0028	0.0015	0.0043
19.9333	0.7479	0	0.0002	0.0002
19.9667	0.7499	0.0028	0	0.0028
20	0.7512	0	0.0002	0.0002
20.0333	0.7486	0.0028	0.0002	0.003
20.0667	0.7473	0	0	0
20.1	0.7479	0.0028	0	0.0028
20.1333	0.7479	0.0028	0	0.0028
20.1667	0.7505	0.0028	0	0.0028
20.2	0.7456	0.0028	0	0.0028
20.2333	0.7466	0.0028	0.0002	0.003
20.2667	0.7456	0	0.0015	0.0015
20.3	0.7446	0.0028	0	0.0028
20.3333	0.7489	0.0028	0.0002	0.003
20.3667	0.7466	0	0.0002	0.0002
20.4	0.7473	0.0028	0.0002	0.003
20.4333	0.7456	0.0028	0.0002	0.003
20.4667	0.743	0.0028	0.0002	0.003
20.5	0.745	0.0028	0	0.0028

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Time (min)	Ch 1 dP (psi)	Ch 2 High Flow (LPM)	Ch 3 Low Flow (LPM)	Total Flow (LPM)
20.5333	0.744	0	0.0002	0.0002
20.5667	0.7427	0.016	0.0002	0.0162
20.6	0.7427	0	0.0002	0.0002
20.6333	0.7433	0	0.0002	0.0002
20.6667	0.7433	0.0028	0	0.0028
20.7	0.742	0	0	0
20.7333	0.7427	0	0.0015	0.0015
20.7667	0.742	0.0028	0.0002	0.003
20.8	0.739	0.0028	0.0002	0.003
20.8333	0.74	0.0028	0.0002	0.003
20.8667	0.7374	0.0028	0.0002	0.003
20.9	0.7403	0.0028	0.0015	0.0043
20.9333	0.7367	0.0028	0.0002	0.003
20.9667	0.7357	0.016	0	0.016
21	0.7348	0.016	0	0.016
21.0333	0.7334	0	0.0002	0.0002
21.0667	0.7318	0.0028	0.0015	0.0043
21.1	0.7298	0.016	0	0.016
21.1333	0.7318	0.016	0.0015	0.0175
21.1667	0.7318	0.016	0.0002	0.0162
21.2	0.7285	0.016	0.0015	0.0175
21.2333	0.7295	0	0	0
21.2667	0.7262	0.0028	0	0.0028
21.3	0.7278	0.0028	0	0.0028
21.3333	0.7278	0	0.0002	0.0002
21.3667	0.7265	0.0028	0.0015	0.0043
21.4	0.7262	0.0028	0.0002	0.003
21.4333	0.7278	0.0028	0	0.0028
21.4667	0.7236	0.0028	0	0.0028
21.5	0.7242	0.0028	0.0002	0.003
21.5333	0.7239	0.0028	0.0002	0.003
21.5667	0.7229	0.0028	0.0002	0.003
21.6	0.7203	0.0028	0.0015	0.0043
21.6333	0.7199	0	0	0
21.6667	0.7209	0.016	0	0.016
21.7	0.7196	0.016	0	0.016
21.7333	0.7203	0	0.0002	0.0002
21.7667	0.7196	0.0028	0	0.0028
21.8	0.7173	0.016	0.0002	0.0162
21.8333	0.7166	0.016	0	0.016
21.8667	0.7157	0.0028	0.0015	0.0043
21.9	0.715	0	0	0
21.9333	0.7157	0	0	0
21.9667	0.714	0.016	0.0002	0.0162

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Time (min)	Ch 1 dP (psi)	Ch 2 High Flow (LPM)	Ch 3 Low Flow (LPM)	Total Flow (LPM)
22	0.7147	0	0	0
22.0333	0.7143	0	0	0
22.0667	0.712	0.0028	0.0002	0.003
22.1	0.7124	0.0028	0.0015	0.0043
22.1333	0.713	0.016	0.0015	0.0175
22.1667	0.714	0	0	0
22.2	0.712	0.016	0.0015	0.0175
22.2333	0.714	0.0028	0	0.0028
22.2667	0.7114	0.0028	0.0002	0.003
22.3	0.7117	0.0028	0	0.0028
22.3333	0.712	0	0.0002	0.0002
22.3667	0.7107	0.0291	0	0.0291
22.4	0.7087	0.016	0.0002	0.0162
22.4333	0.712	0	0.0015	0.0015
22.4667	0.7097	0.0028	0.0002	0.003
22.5	0.7084	0	0	0
22.5333	0.7064	0.016	0.0002	0.0162
22.5667	0.7097	0	0.0002	0.0002
22.6	0.7084	0	0	0
22.6333	0.7068	0.0028	0.0015	0.0043
22.6667	0.7084	0	0	0
22.7	0.7081	0.0028	0	0.0028
22.7333	0.7051	0.016	0.0002	0.0162
22.7667	0.7078	0.016	0.0002	0.0162
22.8	0.7045	0.016	0	0.016
22.8333	0.7045	0.0028	0	0.0028
22.8667	0.7028	0.0028	0.0028	0.0056
22.9	0.7048	0.0028	0.0028	0.0056
22.9333	0.7061	0.0028	0.0015	0.0043
22.9667	0.7045	0	0.0002	0.0002
23	0.7101	0.0028	0.0002	0.003
23.0333	0.7252	0.0028	0.0002	0.003
23.0667	0.7479	0	0	0
23.1	0.7775	0.016	0	0.016
23.1333	0.8128	0	0	0
23.1667	0.8483	0	0	0
23.2	0.8891	0	0.0002	0.0002
23.2333	0.9227	0	0.0002	0.0002
23.2667	0.9622	0.016	0.0015	0.0175
23.3	0.9964	0	0.0002	0.0002
23.3333	1.028	0.0028	0	0.0028
23.3667	1.0609	0.0028	0.0002	0.003
23.4	1.0889	0	0.0002	0.0002
23.4333	1.1156	0.0028	0.0002	0.003

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Time (min)	Ch 1 dP (psi)	Ch 2 High Flow (LPM)	Ch 3 Low Flow (LPM)	Total Flow (LPM)
23.4667	1.1455	0.016	0	0.016
23.5	1.1712	0.0028	0	0.0028
23.5333	1.1942	0	0.0002	0.0002
23.5667	1.2189	0.0028	0.0002	0.003
23.6	1.2419	0.016	0	0.016
23.6333	1.2597	0	0.0002	0.0002
23.6667	1.2818	0.0028	0.0015	0.0043
23.7	1.3002	0.0028	0	0.0028
23.7333	1.3196	0.016	0.0002	0.0162
23.7667	1.3371	0.0028	0.0002	0.003
23.8	1.3525	0.0028	0.0002	0.003
23.8333	1.365	0.0028	0.0002	0.003
23.8667	1.3808	0	0.0002	0.0002
23.9	1.3983	0	0	0
23.9333	1.4101	0	0.0002	0.0002
23.9667	1.4217	0	0.0015	0.0015
24	1.4335	0.0028	0.0002	0.003
24.0333	1.4424	0.0028	0.0015	0.0043
24.0667	1.4523	0.0028	0.0002	0.003
24.1	1.4621	0.016	0	0.016
24.1333	1.471	0.0028	0.0002	0.003
24.1667	1.4829	0.0028	0.0002	0.003
24.2	1.4895	0.016	0.0002	0.0162
24.2333	1.4993	0.0028	0	0.0028
24.2667	1.5062	0.0028	0	0.0028
24.3	1.5115	0	0.0002	0.0002
24.3333	1.5181	0.0028	0	0.0028
24.3667	1.5247	0.0028	0	0.0028
24.4	1.5319	0.0028	0.0002	0.003
24.4333	1.5365	0.0028	0	0.0028
24.4667	1.5411	0	0.0002	0.0002
24.5	1.5464	0.0028	0.0002	0.003
24.5333	1.5523	0.016	0.0015	0.0175
24.5667	1.5553	0.0028	0	0.0028
24.6	1.5592	0.0028	0	0.0028
24.6333	1.5642	0.016	0.0002	0.0162
24.6667	1.5668	0.0028	0.0002	0.003
24.7	1.5694	0.016	0.0002	0.0162
24.7333	1.574	0	0.0002	0.0002
24.7667	1.576	0.0028	0.0002	0.003
24.8	1.5819	0	0.0002	0.0002
24.8333	1.5829	0.0028	0.0015	0.0043
24.8667	1.5813	0.016	0.0002	0.0162
24.9	1.5862	0.0028	0.0002	0.003

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Time (min)	Ch 1 dP (psi)	Ch 2 High Flow (LPM)	Ch 3 Low Flow (LPM)	Total Flow (LPM)
24.9333	1.5902	0.0028	0.0002	0.003
24.9667	1.5954	0.0028	0.0002	0.003
25	1.5958	0.0028	0.0015	0.0043
25.0333	1.5925	0.0028	0.0002	0.003
25.0667	1.5944	0.0028	0	0.0028
25.1	1.5991	0	0	0
25.1333	1.5984	0.016	0	0.016
25.1667	1.6	0.0028	0.0002	0.003
25.2	1.5991	0.0028	0.0015	0.0043
25.2333	1.6007	0	0.0002	0.0002
25.2667	1.6033	0.0028	0.0002	0.003
25.3	1.6033	0.016	0.0002	0.0162
25.3333	1.603	0.0028	0.0002	0.003
25.3667	1.6056	0	0.0015	0.0015
25.4	1.6053	0	0.0015	0.0015
25.4333	1.6076	0	0.0002	0.0002
25.4667	1.6063	0.0028	0.0015	0.0043
25.5	1.6066	0.0028	0.0002	0.003
25.5333	1.6079	0.016	0.0002	0.0162
25.5667	1.6083	0	0	0
25.6	1.602	0	0.0002	0.0002
25.6333	1.5961	0.016	0.0015	0.0175
25.6667	1.5974	0	0.0002	0.0002
25.7	1.5918	0	0.0002	0.0002
25.7333	1.5724	0	0.0002	0.0002
25.7667	1.5368	0.0028	0.0002	0.003
25.8	1.4832	0	0.0002	0.0002
25.8333	1.4279	0	0.0002	0.0002
25.8667	1.3756	0.0028	0.0002	0.003
25.9	1.3153	0	0.0015	0.0015
25.9333	1.2617	0	0.0015	0.0015
25.9667	1.2057	0	0.0015	0.0015
26	1.1514	0	0	0
26.0333	1.0984	0.016	0.0002	0.0162
26.0667	1.0481	0.016	0.0015	0.0175
26.1	1.0241	0.016	0	0.016
26.1333	1.0208	0	0.0002	0.0002
26.1667	1.0264	0.0028	0	0.0028
26.2	1.0497	0.016	0	0.016
26.2333	1.0849	0	0.0002	0.0002
26.2667	1.1113	0	0.0002	0.0002
26.3	1.1429	0.016	0.0002	0.0162
26.3333	1.1784	0.016	0	0.016
26.3667	1.2176	0.016	0.0015	0.0175

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Time (min)	Ch 1 dP (psi)	Ch 2 High Flow (LPM)	Ch 3 Low Flow (LPM)	Total Flow (LPM)
26.4	1.2587	0.0028	0.0002	0.003
26.4333	1.2943	0	0.0002	0.0002
26.4667	1.3252	0.0028	0.0002	0.003
26.5	1.3604	0.0028	0.0002	0.003
26.5333	1.3897	0.016	0	0.016
26.5667	1.422	0	0.0002	0.0002
26.6	1.4496	0	0	0
26.6333	1.4723	0	0	0
26.6667	1.4987	0	0.0002	0.0002
26.7	1.5322	0	0.0002	0.0002
26.7333	1.5678	0	0.0002	0.0002
26.7667	1.601	0	0	0
26.8	1.6303	0.0028	0	0.0028
26.8333	1.6583	0	0	0
26.8667	1.6896	0	0.0002	0.0002
26.9	1.709	0.016	0.0015	0.0175
26.9333	1.7373	0	0.0015	0.0015
26.9667	1.7557	0	0.0015	0.0015
27	1.7768	0	0	0
27.0333	1.7929	0.016	0.0002	0.0162
27.0667	1.8097	0	0.0015	0.0015
27.1	1.8258	0.0028	0	0.0028
27.1333	1.8423	0.0028	0.0002	0.003
27.1667	1.8512	0.0028	0	0.0028
27.2	1.8673	0	0.0002	0.0002
27.2333	1.8752	0	0	0
27.2667	1.8887	0.016	0	0.016
27.3	1.8963	0	0.0002	0.0002
27.3333	1.9025	0.0028	0.0002	0.003
27.3667	1.9121	0.016	0.0002	0.0162
27.4	1.917	0.0028	0	0.0028
27.4333	1.9242	0.016	0	0.016
27.4667	1.9295	0	0.0002	0.0002
27.5	1.9321	0.0028	0.0002	0.003
27.5333	1.9391	0.0028	0	0.0028
27.5667	1.943	0.0028	0.0015	0.0043
27.6	1.9466	0.016	0.0002	0.0162
27.6333	1.9479	0.016	0	0.016
27.6667	1.9502	0.0028	0.0002	0.003
27.7	1.9565	0.0028	0.0002	0.003
27.7333	1.9545	0.0028	0.0002	0.003
27.7667	1.9548	0.0028	0.0002	0.003
27.8	1.9575	0	0	0
27.8333	1.9624	0.0028	0.0002	0.003

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Time (min)	Ch 1 dP (psi)	Ch 2 High Flow (LPM)	Ch 3 Low Flow (LPM)	Total Flow (LPM)
27.8667	1.9641	0.0028	0.0002	0.003
27.9	1.9637	0.0028	0.0002	0.003
27.9333	1.9637	0.0028	0.0002	0.003
27.9667	1.9674	0.016	0.0028	0.0188
28	1.9654	0.016	0.0002	0.0162
28.0333	1.967	0	0.0002	0.0002
28.0667	1.9677	0.0028	0.0015	0.0043
28.1	1.9657	0.016	0	0.016
28.1333	1.9677	0.016	0	0.016
28.1667	1.9664	0	0.0002	0.0002
28.2	1.9677	0.016	0.0002	0.0162
28.2333	1.9687	0	0.0002	0.0002
28.2667	1.9664	0.0028	0	0.0028
28.3	1.9683	0.0028	0.0015	0.0043
28.3333	1.9677	0.016	0.0015	0.0175
28.3667	1.9674	0.0028	0.0002	0.003
28.4	1.9683	0.016	0	0.016
28.4333	1.9687	0.0028	0.0002	0.003
28.4667	1.9651	0.0028	0.0002	0.003
28.5	1.9664	0.0028	0.0002	0.003
28.5333	1.9667	0.016	0.0015	0.0175
28.5667	1.9674	0	0.0002	0.0002
28.6	1.9664	0.016	0.0015	0.0175
28.6333	1.9664	0.0028	0.0002	0.003
28.6667	1.9641	0.016	0.0015	0.0175
28.7	1.9677	0.0028	0.0015	0.0043
28.7333	1.9621	0.0028	0.0002	0.003
28.7667	1.9644	0.0028	0.0002	0.003
28.8	1.9641	0	0	0
28.8333	1.9641	0.0028	0	0.0028
28.8667	1.9621	0.016	0	0.016
28.9	1.9631	0	0	0
28.9333	1.9595	0.0028	0.0015	0.0043
28.9667	1.9631	0	0.0002	0.0002
29	1.9624	0.016	0.0002	0.0162
29.0333	1.9608	0.0028	0	0.0028
29.0667	1.9604	0	0	0
29.1	1.9618	0	0.0002	0.0002
29.1333	1.9598	0.016	0.0002	0.0162
29.1667	1.9585	0.0028	0	0.0028
29.2	1.9565	0.0028	0.0015	0.0043
29.2333	1.9539	0.0028	0.0002	0.003
29.2667	1.9558	0	0.0002	0.0002
29.3	1.9539	0.0028	0.0002	0.003

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Time (min)	Ch 1 dP (psi)	Ch 2 High Flow (LPM)	Ch 3 Low Flow (LPM)	Total Flow (LPM)
29.3333	1.9558	0	0.0002	0.0002
29.3667	1.9588	0.0028	0	0.0028
29.4	1.9552	0.0028	0.0002	0.003
29.4333	1.9545	0.0028	0.0002	0.003
29.4667	1.9509	0.0028	0.0002	0.003
29.5	1.9519	0.0028	0.0002	0.003
29.5333	1.865	0.0028	0	0.0028
29.5667	1.7482	0.016	0	0.016
29.6	1.6405	0.0028	0.0015	0.0043
29.6333	1.5388	0.0028	0.0002	0.003
29.6667	1.447	0	0	0
29.7	1.3585	0	0.0015	0.0015
29.7333	1.2785	0.0028	0.0002	0.003
29.7667	1.2011	0.0028	0	0.0028
29.8	1.1323	0	0.0002	0.0002
29.8333	1.0668	0	0.0002	0.0002
29.8667	1.0056	0.0291	0.0002	0.0293
29.9	0.9493	0.0028	0	0.0028
29.9333	0.8954	0	0.0002	0.0002
29.9667	0.8463	0.0028	0.0002	0.003
30	0.7993	0	0.0002	0.0002
30.0333	0.7522	0	0	0
30.0667	0.7147	0	0	0
30.1	0.6775	0.0028	0.0002	0.003
30.1333	0.6393	0.0028	0	0.0028
30.1667	0.607	0.0028	0.0002	0.003
30.2	0.5738	0	0.0002	0.0002
30.2333	0.5419	0.016	0.0002	0.0162
30.2667	0.5132	0.0028	0.0015	0.0043
30.3	0.4895	0.0028	0.0002	0.003
30.3333	0.4642	0.0028	0.0002	0.003
30.3667	0.4425	0.0028	0.0002	0.003
30.4	0.4185	0	0.0002	0.0002
30.4333	0.3974	0.0028	0.0002	0.003
30.4667	0.3776	0.0028	0.0015	0.0043
30.5	0.3566	0.016	0	0.016
30.5333	0.3395	0.016	0.0015	0.0175
30.5667	0.323	0.016	0.0015	0.0175
30.6	0.3026	0	0.0002	0.0002
30.6333	0.2875	0	0	0
30.6667	0.2713	0	0	0
30.7	0.2575	0.016	0.0002	0.0162
30.7333	0.245	0	0	0
30.7667	0.2292	0.0028	0.0002	0.003

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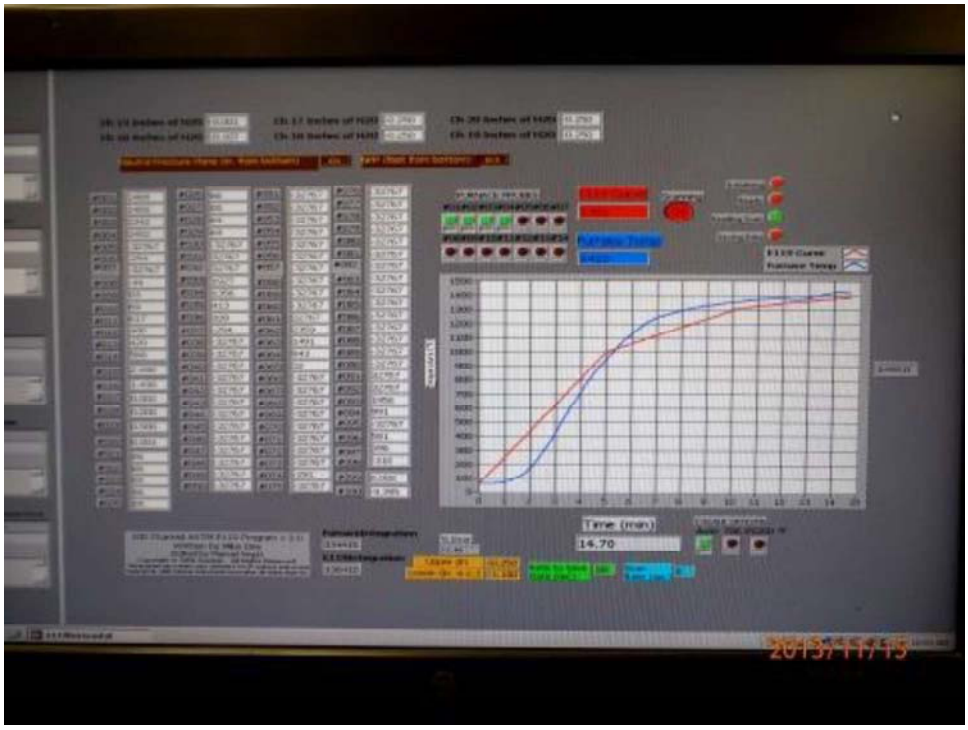
Time (min)	Ch 1 dP (psi)	Ch 2 High Flow (LPM)	Ch 3 Low Flow (LPM)	Total Flow (LPM)
30.8	0.2183	0	0.0002	0.0002
30.8333	0.2085	0	0	0
30.8667	0.1927	0.0028	0.0002	0.003
30.9	0.1825	0.016	0.0002	0.0162
30.9333	0.1739	0.0028	0.0002	0.003
30.9667	0.1647	0.0028	0	0.0028
31	0.1545	0.0028	0.0002	0.003
31.0333	0.1449	0.0028	0.0002	0.003
31.0667	0.1361	0.016	0.0002	0.0162
31.1	0.1259	0.0028	0	0.0028
31.1333	0.1189	0.016	0.0002	0.0162
31.1667	0.1127	0	0.0002	0.0002
31.2	0.1054	0.0028	0.0002	0.003
31.2333	0.0979	0	0.0002	0.0002
31.2667	0.0883	0.0028	0	0.0028
31.3	0.0857	0.0028	0.0002	0.003
31.3333	0.0778	0.0028	0.0002	0.003
31.3667	0.0729	0.0028	0.0002	0.003
31.4	0.0706	0.0028	0	0.0028
31.4333	0.065	0.0028	0.0002	0.003
31.4667	0.0587	0	0.0002	0.0002
31.5	0.0557	0.0028	0.0002	0.003
31.5333	0.0521	0.0028	0.0002	0.003
31.5667	0.0455	0	0.0015	0.0015
31.6	0.0426	0.0028	0	0.0028
31.6333	0.0396	0.0028	0.0002	0.003
31.6667	0.0321	0	0.0002	0.0002
31.7	0.0314	0.0028	0.0002	0.003
31.7333	0.0294	0	0.0002	0.0002
31.7667	0.0235	0.0291	0.0002	0.0293
31.8	0.0218	0	0.0002	0.0002
31.8333	0.0172	0.016	0.0002	0.0162
31.8667	0.0176	0.0028	0.0002	0.003
31.9	0.0136	0.0291	0.0015	0.0306
31.9333	0.0123	0	0	0
31.9667	0.0087	0.0028	0.0002	0.003
32	0.009	0.0291	0.0002	0.0293
32.0333	0.0074	0.0028	0.0002	0.003
32.0667	0.0041	0.0028	0	0.0028
32.1	0.0044	0.0028	0.0002	0.003
32.1333	0.0011	0.016	0.0015	0.0175
32.1667	0.0014	0.0028	0.0002	0.003
32.2	-0.0005	0	0.0015	0.0015
32.2333	-0.0015	0.0028	0	0.0028

AREVA NP, Inc. Project No. G101266224SAT-005 November 19, 2013

Time (min)	Ch 1 dP (psi)	Ch 2 High Flow (LPM)	Ch 3 Low Flow (LPM)	Total Flow (LPM)
32.2667	-0.0028	0.016	0	0.016
32.3	-0.0061	0.0028	0	0.0028
32.3333	-0.0088	0.0028	0	0.0028
32.3667	-0.0071	0.016	0.0002	0.0162
32.4	-0.0068	0.016	0.0002	0.0162
32.4333	-0.0071	0.016	0	0.016
32.4667	-0.0088	0.0028	0.0002	0.003
32.5	-0.013	0.0028	0.0002	0.003
32.5333	-0.0101	0.016	0.0002	0.0162
32.5667	-0.0137	0.0028	0.0002	0.003
32.6	-0.0114	0.0028	0.0002	0.003
32.6333	-0.013	0.016	0.0002	0.0162
32.6667	-0.015	0.0028	0.0002	0.003
32.7	-0.0137	0.016	0.0002	0.0162
32.7333	-0.0173	0.0028	0.0002	0.003
32.7667	-0.0147	0	0	0
32.8	-0.013	0.016	0.0002	0.0162
32.8333	-0.014	0.0028	0.0002	0.003
32.8667	-0.0147	0.016	0.0002	0.0162
32.9	-0.0186	0	0.0002	0.0002
32.9333	-0.0167	0	0.0002	0.0002
32.9667	-0.0183	0.0028	0.0002	0.003
33	-0.0176	0.016	0	0.016
33.0333	-0.0193	0.016	0.0002	0.0162
33.0667	-0.0176	0.0028	0.0002	0.003
33.1	-0.0216	0.0028	0.0002	0.003
33.1333	-0.0219	0	0	0

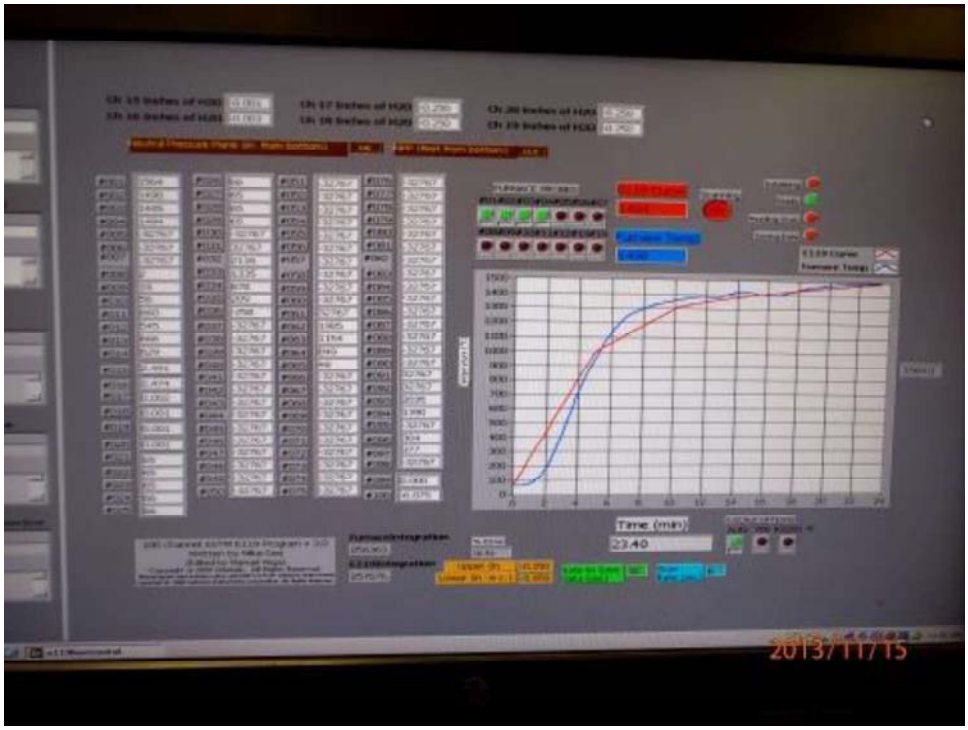
APPENDIX D1
Photographs: Fire Test


Time (min)
14.70


2013/11/15


DC-179
QSII
DC-737
2013/11/15


2013/11/15


Time (min)
23.40
2013/11/15

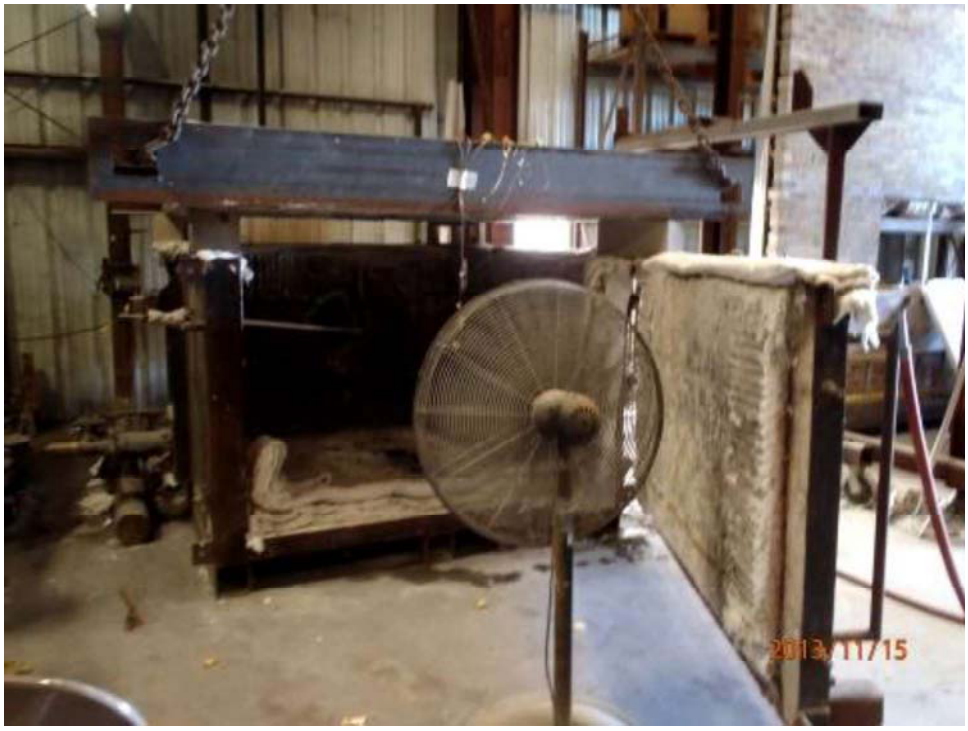

2013/11/15


2013/11/15


2013/11/15


2013/11/15


2013/11/15


2013/11/15


2013/11/15


2013/11/15


2013/11/15


2013/11/15


2013/11/15


2013/11/15

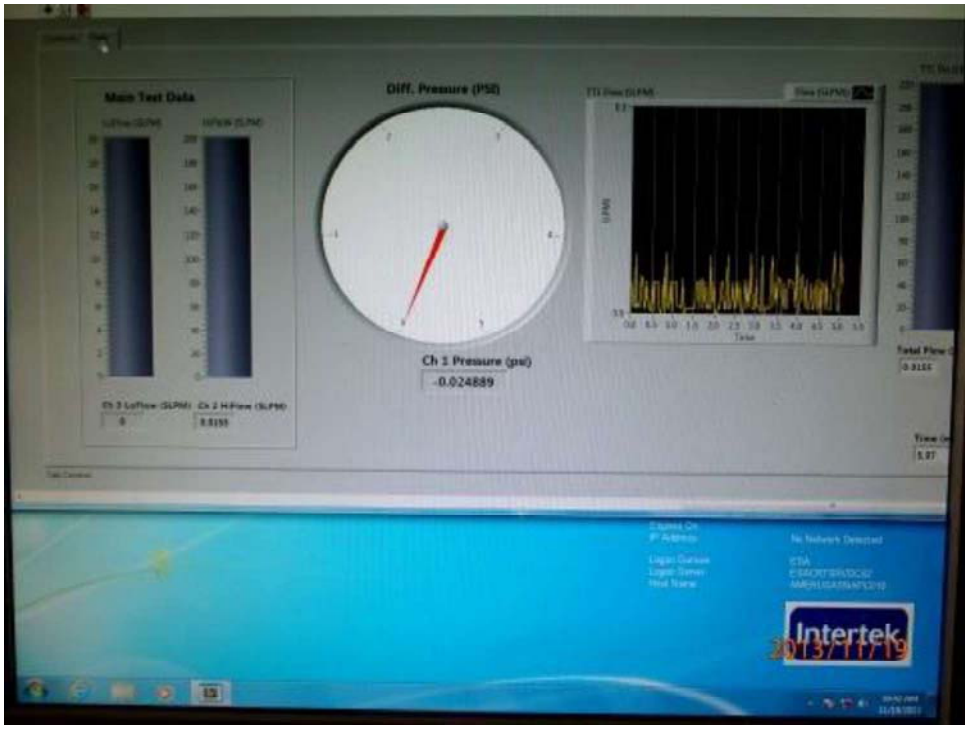

2013/11/15


2013/11/15

APPENDIX D2
Photographs: Pressure Test

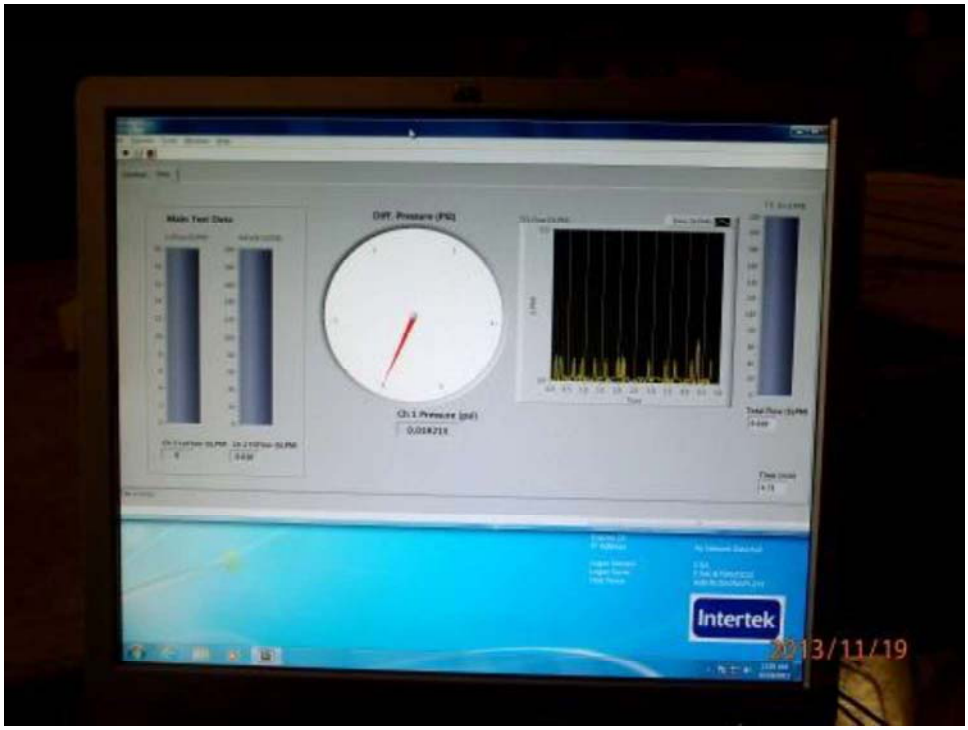

9213021
FIRE/PRESSURE TEST R3
(9213021)


9213021
FIRE/PRESSURE TEST R3
(9213021)


Main Test Data
Diff. Pressure (PSI)
Ch 1 Pressure (psi)
-0.024889
Intertek
2013/11/19


66F 47
2013/11/19

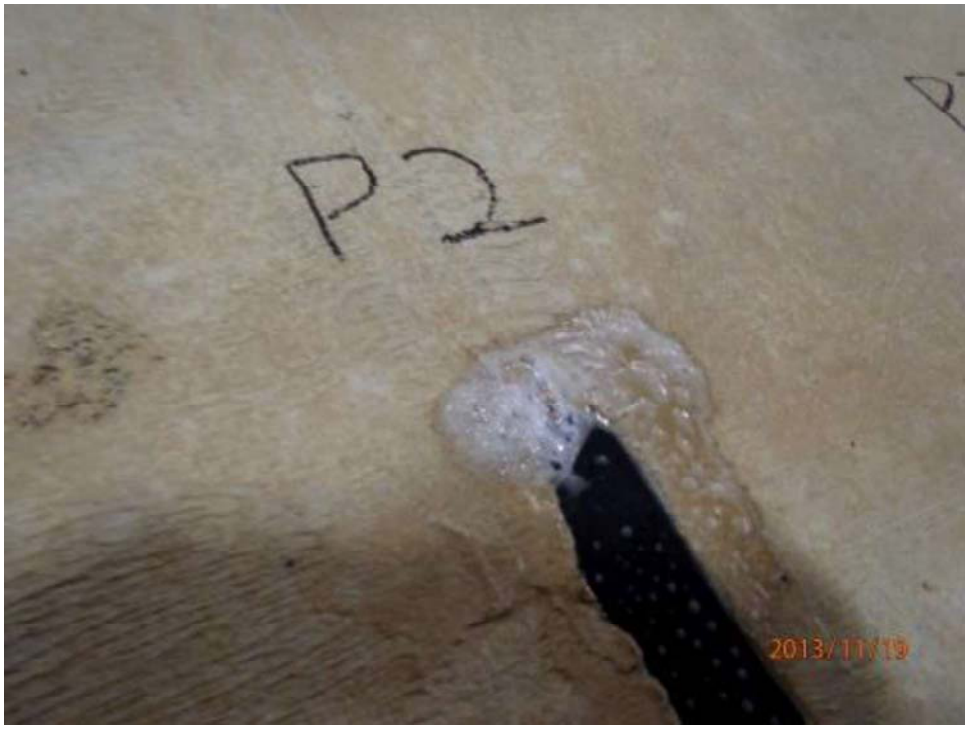

9213021
FIRE/PRESSURE TEST
(9213021)
2013/11/19

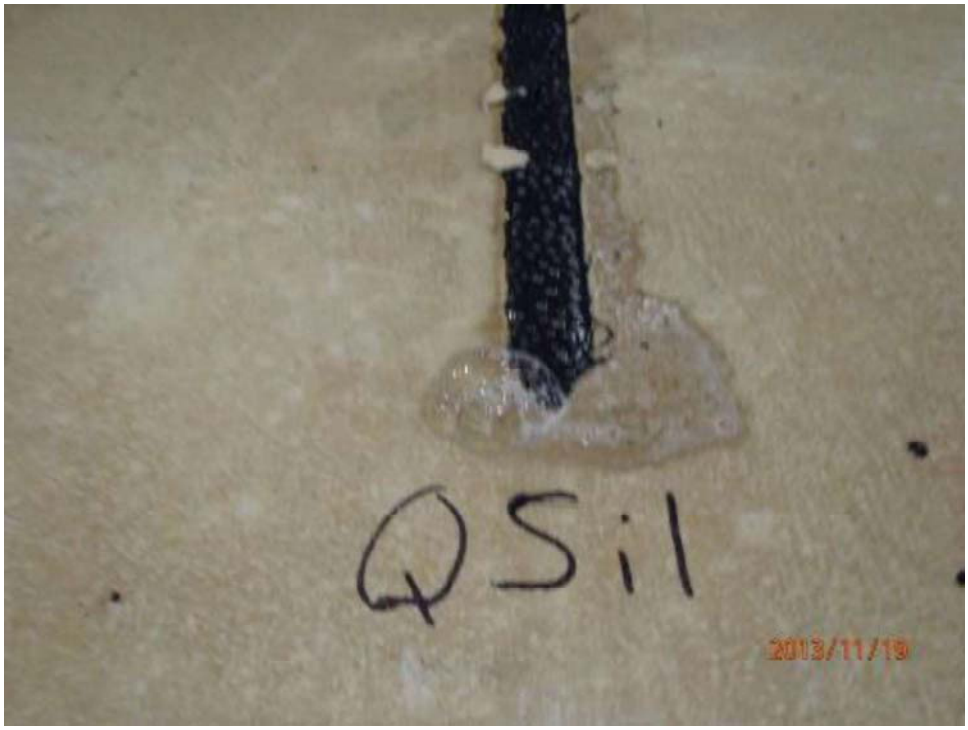

Intertek
2013/11/19


TEST GAUGE
2013/11/19


TEST GAUGE
2013/11/19


P 1


P2
2013/11/19


QSil
2013/11/19


P3
2013/11/19

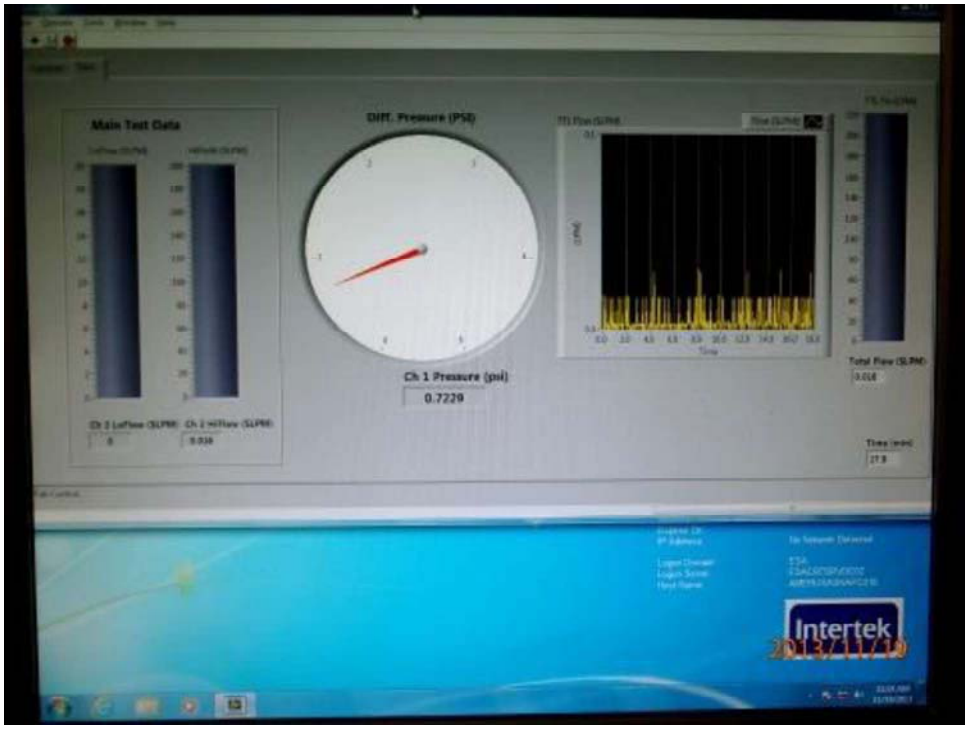

DC-732
2013/11/19


P3
P4
2013/11/19

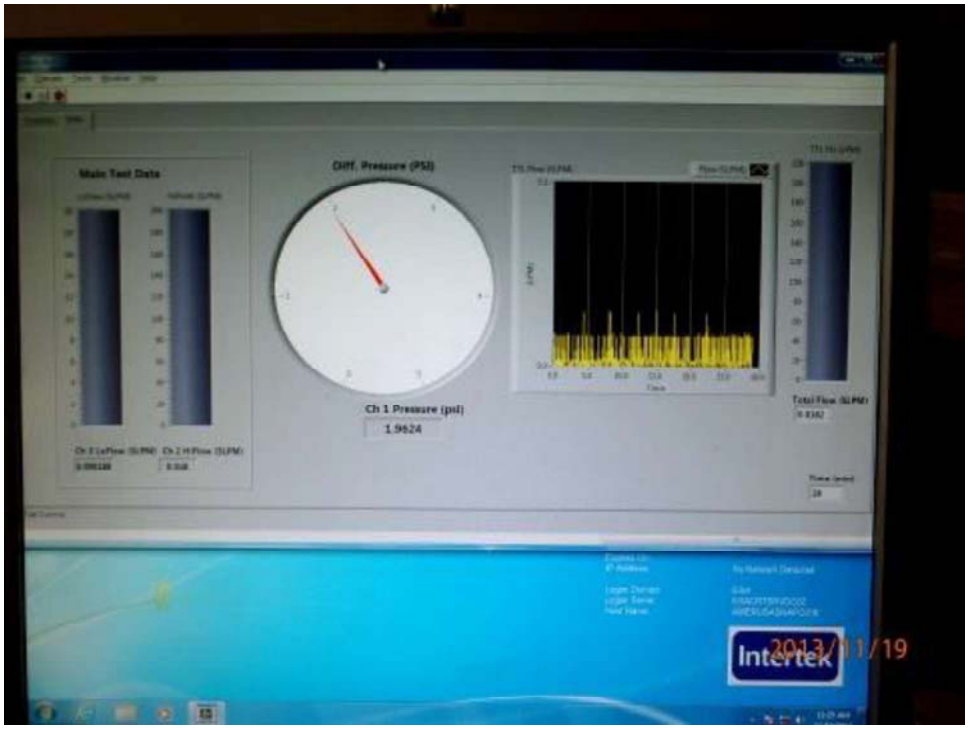

D2-190
2013/11/19


C-170
Q5.1
~~Q206196~~ LSG
9213021
2013/11/19


2013/11/19


Main Test Data
Diff. Pressure (PSI)
Ch 1 Pressure (psi)
0.7229
Intertek


9213021
2013/11/19


Main Test Data
Diff. Pressure (PSI)
Ch 1 Pressure (psi)
1.9624
Intertek
2013/11/19


TEST GAUGE
2013/11/19


C-170
Q511
DC-732
~~T206196~~
9213021
2013/11/19

APPENDIX E
Test Plan

Controlled Document

20004-019 (11/20/2012)

AREVA

AREVA NP Inc.

Engineering Information Record

Document No.: 51 - 9213021 - 000

Detailed Test Plan for Conducting MOX Fire-Pressure Test 3

[redacted]

Mike Dey
Staff Engineer

[redacted]

Michael A. Brown
Quality Supervisor

Page 1 of 29

AREVA

20004-019 (11/20/2012)
Document No.: 51-9213021-000

Detailed Test Plan for Conducting MOX Fire-Pressure Test 3

Safety Related? ☒ YES ☐ NO

Does this document establish design or technical requirements? ☐ YES ☒ NO

Does this document contain assumptions requiring verification? ☐ YES ☒ NO

Does this document contain Customer Required Format? ☐ YES ☒ NO

Signature Block

Name and Title/Discipline	Signature	P/LP, R/LR, A-CRF, A	Date	Pages/Sections Prepared/Reviewed/ Approved or Comments
Aaron Adrian Princ Des Eng Spec II / PEYF1-A	[redacted]	P	10-21-13	All
Vic Kaldenbach Princ Des Eng Spec II / PEYF1-A	[redacted]	R	10/21/2013	All
Scott Groesbeck Manager Tech Ops / PEYF1-A	[redacted]	A	10/21/13	All
Perry Calos Project Manager / IBL-A	[redacted]	A	10/21/13	All

Note: P/LP designates Preparer (P), Lead Preparer (LP)
R/LR designates Reviewer (R), Lead Reviewer (LR)
A-CRF designates Project Manager Approver of Customer Required Format (A-CRF)
A designates Approver/RTM Verification of Reviewer Independence

MOX Services concurrence [redacted] 21 oct 13
Name / Title Date

Record of Revision

Revision No.	Pages/Sections/ Paragraphs Changed	Brief Description / Change Authorization
000	All	Initial Issue. This document contains the main body of the report (pages 1-18), Appendix A (5 pages), Appendix B (4 pages), Appendix C (2 pages), for a total of 29 pages.

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(continued)

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List of Tables

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ACRONYMS

CGD	Commercial Grade Dedication
CGI	Commercial Grade Item
IROFS	Items Relied On For Safety
MOX	Mixed Oxide
MFFF	Mixed Oxide Fuel Fabrication Facility
QL	Quality Level
SSC	Structures, Systems and Components
w.g.	Water Gauge

Penetration Seal Materials

DC-170	Dow Corning Sylgard® 170 Silicone Elastomer
QSil 5558MC	Quantum Silicones QSil 5558MC Silicone Elastomer
DC-732	Dow Corning® 732 Multi-Purpose Sealant
DC-790	Dow Corning® 790 Silicone Building Sealant

AREVA

Document No.: 51-9213021-000

Detailed Test Plan for Conducting MOX Fire-Pressure Test 3

BACKGROUND

AREVA NP (AREVA) is assisting Shaw AREVA MOX Services (MOX Services) in the development and implementation of a penetration seal program for the Mixed Oxide Fuel Fabrication Facility (MFFF). One aspect of the MOX penetration seal program includes conducting various types of qualification tests of penetration seal assemblies to substantiate the performance capabilities of specific penetration seal designs. Fire-Pressure testing is one type of qualification testing that needs to be performed in order to demonstrate that MOX penetration seal designs can withstand anticipated fire-induced pressures without catastrophic failure resulting in open penetrations. Other types of qualification testing, such as fire testing, pressure testing, and testing for seismic qualification of penetration seal assemblies, are addressed by other test plans.

1.0 PURPOSE

The purpose of this test plan is to define the test assembly, test methods and acceptance criteria for conducting a fire-pressure test in support of the MOX penetration seal program. Fire-pressure tests are unique in that a fire-pressure test is comprised of two separate tests; a modified fire test, followed by a pressure test.

This test plan defines the test methods, acceptance criteria and test report documentation requirements for conducting MOX Fire-Pressure Test 3. Additionally, this detailed test plan defines the roles and responsibilities of MOX Services, AREVA, the selected testing laboratory, and any other subcontracted entity engaged in support of fire-pressure testing efforts.

This detailed test plan also describes the procurement plan for materials associated with Fire-Pressure Test 3 and identifies the entities responsible for procuring the various components of the test assemblies based on the quality level assigned to each component.

This test plan also establishes minimum quality requirements for the penetration seal materials used in the test assemblies and links quality requirements in the AREVA QA program to customer/project quality requirements.

2.0 OBJECTIVE

The primary objective of this test plan is to evaluate the ability of select penetration seal designs to withstand various pressure levels after being subjected to a fire exposure (fire test). To accomplish this, the test assembly will be subjected to a fire exposure as described in Sections 9.1 and 9.2, and then the same test assembly will be subjected to a pressure test as described in Sections 9.3 and 9.4.

The specific configurations to be tested are described below. Critical characteristics and the associated limiting parameters that will be substantiated by a successful test are also provided.

Note: The test assembly to be used for MOX Fire-Pressure Test 3 is to be the same test assembly that was constructed and used for MOX Pressure Test 7 [Reference 12.7], and subsequently tested again in MOX Seismic Pressure Test 5 [Reference 12.8]. Since MOX Pressure Test 7 and Seismic Pressure Test 5 have already been successfully completed without any damage to the test assembly, no changes or modifications need to be made to the test assembly.

2.1 Test Deck Description

The test deck will consist of a 12" thick concrete slab measuring approximately 96" x 96" (8' x 8') [Note: Final test slab size to be determined by Intertek and documented in the final test report]. Within this slab there will be four (4) 36" x 1" openings. One side of each opening shall have a 3/4" bevel. Details for the four penetrations are provided in Section 2.2 and Appendix A. All of the penetrations will be unlined (bare concrete). The test deck will be horizontally oriented during both the fire endurance test and the subsequent pressure test.

Drawings showing the general layout of the test deck (test slab) for this pressure test can be found in Appendix A.

2.2 Test Description

There are four openings to be sealed and tested in MOX Fire-Pressure Test 3.

- Penetration P1: This penetration is to be a 36" x 1" precast opening. One side of the opening will have a 3/4" bevel, the other side of the opening will not be beveled. Both sides of the opening will be sealed using 3/4" depth Dow Corning Sylgard® 170 Silicone Elastomer (DC-170) backed by 1" depth of Unifrax Fiberfrax® Durablanket® S.
- Penetration P2: This penetration is to be a 36" x 1" precast opening. One side of the opening will have a 3/4" bevel, the other side of the opening will not be beveled. Both sides of the opening will be sealed using 3/4" depth Quantum Silicones QSil 5558MC Silicone Elastomer (QSil 5558MC) backed by 1" depth of Unifrax Fiberfrax® Durablanket® S.
- Penetration P3: This penetration is to be a 36" x 1" precast opening. One side of the opening will have a 3/4" bevel, the other side of the opening will not be beveled. Both sides of the opening will be sealed using 3/4" depth Dow Corning 732 Multi-Purpose Sealant backed by 1" depth of Unifrax Fiberfrax® Durablanket® S.
- Penetration P4: This penetration is to be a 36" x 1" precast opening. One side of the opening will have a 3/4" bevel, the other side of the opening will not be beveled. Both sides of the opening will be sealed using 3/4" depth Dow Corning 790 Silicone Building Sealant backed by 1" depth of Unifrax Fiberfrax® Durablanket® S.

2.3 Critical Characteristics and Limiting Parameters Being Tested

Fire-Pressure Test 3 is being conducted to demonstrate that typical gap/joint seal designs with a gap/joint width up to 1" can withstand anticipated fire-induced pressures. Gap/joint openings at MOX may be beveled or non-beveled. Where the openings are beveled, the bevel provides a greater surface area for sealant bonding, and therefore, is expected to result in a more robust seal design than non-beveled openings. For this reason, the beveled side of the test assembly will be subjected to fire, which is expected to result in the non-beveled side being relied upon to withstand the pressure test following the fire exposure test.

A successful fire-pressure test will substantiate both beveled and non-beveled gap/joint seals where the gap/joint is up to 1" in width for any of the following gap/joint seal designs. The gap/joint seal must be installed on both sides of the barrier.

- A beveled gap/joint up to 1" wide sealed using 3/4" depth Dow Corning Sylgard® 170 Silicone Elastomer (DC-170) backed by 1" depth of Unifrax Fiberfrax® Durablanket® S.
- A non-beveled gap/joint up to 1" wide sealed using 3/4" depth Dow Corning Sylgard® 170 Silicone Elastomer (DC-170) backed by 1" depth of Unifrax Fiberfrax® Durablanket® S.
- A beveled gap/joint up to 1" wide sealed using 3/4" depth Quantum Silicones QSil 5558MC Silicone Elastomer (QSil 5558MC) backed by 1" depth of Unifrax Fiberfrax® Durablanket® S.
- A non-beveled gap/joint up to 1" wide sealed using 3/4" depth Quantum Silicones QSil 5558MC Silicone Elastomer (QSil 5558MC) backed by 1" depth of Unifrax Fiberfrax® Durablanket® S.
- A beveled gap/joint up to 1" wide sealed using 3/4" depth Dow Corning 732 Multi-Purpose Sealant backed by 1" depth of Unifrax Fiberfrax® Durablanket® S.

- A non-beveled gap/joint up to 1" wide sealed using 3/4" depth Dow Corning 732 Multi-Purpose Sealant backed by 1" depth of Unifrax Fiberfrax® Durablanket® S.
- A beveled gap/joint up to 1" wide sealed using 3/4" depth Dow Corning 790 Silicone Building Sealant backed by 1" depth of Unifrax Fiberfrax® Durablanket® S.
- A non-beveled gap/joint up to 1" wide sealed using 3/4" depth Dow Corning 790 Silicone Building Sealant backed by 1" depth of Unifrax Fiberfrax® Durablanket® S.

3.0 ACCEPTANCE CRITERIA

The requirements for fire rated penetration seals are discussed in DCS01-BRA-DS-TRD-B-01365-0, *Technical Requirements Document for MFFF Penetration Seals* [Reference 12.5]. These requirements include the need for fire barrier penetration seals to be F-rated, commensurate with the hourly rating of the fire barrier in which they are installed. Additionally, these requirements also discuss the need for fire barrier penetration seals to withstand different forms of pressure concurrent with a fire (i.e., fire induced pressures and pressures from clean agent system discharge).

The MOX qualification strategy for concurrent fire and pressure conditions is to fire test penetration seals following consensus codes and standards committed to by the MOX project (ASTM E 814-94b [Reference 12.9]), while invoking the "standard pressure condition" from standard test method ASTM E 814-94b for maintaining furnace pressure (i.e., furnace pressure at 0.01 in. wg greater than the pressure on the unexposed side of the test assembly).

Separate penetration seal assemblies will be pressure tested using detailed test plans for conducting pressure tests.

Finally, some additional test assemblies, such as the assembly to be tested under this test plan, will undergo a limited duration fire test (30 minute duration) with the fire tested specimens then subjected to subsequent pressure tests.

The results of fire testing, pressure testing and combination limited duration fire tests followed by pressure testing of the same assembly will serve as the overall qualification for penetration seals required for concurrent fire and pressure conditions.

Based on the above, the specific acceptance criteria to be used for combination fire-pressure testing shall be as follows:

1. During the limited duration fire endurance portion of the test, the fire stops (penetration seals) shall have withstood the fire test for the limited 30 minute duration without permitting the passage of flame through openings, or the occurrence of flaming on any element of the unexposed side of the fire stops (penetration seals).

2. After the limited duration fire test, any residual flaming on the exposed side of the test assembly shall be extinguished with water. Following flame extinguishment, the fire stops (penetration seals) shall remain in place such that the unexposed side of the penetration remains completely sealed.

3. During the pressure test, the fire stops (penetration seals) are allowed to leak. However, the fire stops (penetration seals) shall remain in place (i.e., shall not become dislodged from the opening or otherwise catastrophically fail).

4.0 RESPONSIBILITIES

The following roles and responsibilities apply to this test plan.

4.1 MOX Services

4.1.1 Provide review and concurrence of this detailed fire-pressure test plan.

4.1.2 Provide concurrence for any revisions made to this test plan during test specimen construction activities.

4.1.3 Provide some of the materials for test assembly construction from MOX Services surplus or scrap (if available).

4.1.4 Witness the fire-pressure test if desired.

4.2 AREVA

4.2.1 Develop and revise (if necessary) this detailed fire-pressure test plan.

4.2.2 Provide management and oversight of all aspects of the MOX penetration seal test program.

4.2.3 Select the testing facility and establish sub-contract agreements. The testing laboratory selected for performance of this test is Intertek Testing Services NA, Inc., Elmendorf, TX.

4.2.4 Provide engineering instructions to the testing laboratory for performance of the test including test parameters, acceptance criteria, requirements for documenting the test results in a final test report, etc.

4.2.5 Procure all primary penetration seal materials, devices and components (i.e., any materials, devices and components intended to replicate future Safety Related (QL-1) designs to be installed in the MOX facility) as designated in the procurement plan section (Section 5.0) of this test plan.

4.2.6 Notify MOX Services at least 10 days prior to test date to facilitate MOX Services decision to witness the test.

4.2.7 Witness test.

4.2.8 Perform post-test examinations.

4.2.9 Review, approve and issue final test reports.

4.3 Testing Laboratory (Intertek Testing Services NA, Inc.)

4.3.1 Notify AREVA at least 5 days prior to the start of test assembly construction activities.

4.3.2 Construct test decks in accordance with this test plan and AREVA direction.

4.3.3 Procure test deck materials and any other test assembly components identified under the Testing Laboratory scope in the procurement plan section (Section 5.0) of this test plan.

4.3.4 Procure testing equipment necessary for pressure testing services in accordance with this test plan and verify that the testing equipment is properly calibrated.

4.3.5 Provide fire and pressure testing services in accordance with this test plan.

4.3.6 Assist AREVA, as necessary, in conducting detailed post-test destructive examinations of the test assemblies.

4.3.7 Dispose of test assemblies upon completion of the tests.

4.3.8 Generate final test reports in accordance with test plan requirements (Section 11.0).

4.4 Other Subcontracted Entities

There are no other Subcontractors for this pressure test plan.

5.0 PROCUREMENT PLAN

This penetration seal fire-pressure test plan involves many elements beyond the penetration seal material being qualified. Some of these elements include the test deck or test slab, various fasteners for securing laboratory instrumentation to the test assembly, etc. Not all elements of the test assembly are required to be procured to the same quality level as the penetration seal material, which must be capable of satisfying the quality requirements of the end product (i.e., QL-1 qualified penetration seal assemblies for plant applications). The following procurement plan takes into consideration the required quality level of the various materials required for this penetration seal pressure test and prescribes an approach for material procurement which considers cost, schedule and quality requirements.

5.1 Penetration Seal Materials

The vast majority of penetration seals that will be installed throughout the MFFF are designated QL-1. MOX Services defines QL-1 in PP9-1, *SSC Quality Levels & Marking Design Documents* [Reference 12.1] as follows:

> *QL-1 SSCs are typically IROFS (all IROFS are QL-1 and may be either SSCs or Administrative Controls) credited in the Integrated Safety Analysis with a required function to prevent or mitigate design basis events such that high-consequence events are made highly unlikely; intermediate-consequence events are made unlikely; or to prevent criticality. For example, the failure of an IROFS item could cause:*
>
> 1. *Loss of a primary confinement feature leading to release of material resulting in exceeding 10CFR70.61 performance requirements;*
> 2. *Failure to satisfy the double contingency principle for the prevention of a criticality accident; or*
> 3. *Loss of other safety function required to meet 10CFR70.61 performance requirements.*

This definition correlates with the following definition of "Nuclear Safety Related" in AREVA Administrative Procedure (AP) 1702-25, *Assignment of Nuclear Safety Classification to Products and Services* [Reference 12.2]:

> *Definition of "Nuclear Safety Related"*
>
> *Company products and services are considered to be nuclear safety related if they involve the evaluation, specification, design or change in design, operation, or performance of structures, systems, and components which must function directly, or must support other systems which function, to ensure any of the following:*
>
> - *The integrity of the reactor coolant pressure boundary*
> - *The capability to shut down the reactor and maintain it in a safe shutdown condition*
> - *The capability to prevent or mitigate the consequences of accidents which could result in potential offsite radiation exposures greater than accepted limits.*

On this basis, permanent penetration seal materials used in this test program shall be procured by AREVA or supplied by MOX Services and suitably base-lined so that future procurements of the same commercial materials can undergo the commercial grade dedication process in support of Nuclear Safety Related (i.e., MOX QL-1) plant installations. Only the primary seal material specified as a part of the final seal design and which are left in place during testing become an integral part of the seal assembly and need to be base-lined for future dedication of similarly procured materials.

The quality level of the penetration seal materials procured for this test plan is **Non-Safety**.

Note: Commercial Grade Dedication (CGD) must be performed for Commercial Grade Items (CGIs) used in Safety Related applications when procured from suppliers where specific quality controls for nuclear applications cannot be imposed in a practical manner in accordance with 56-9141754-001, *AREVA NP Inc. Quality Assurance Program* [Reference 12.3]. However, none of the seal materials to be procured and used in the test program are intended or approved for installation in the MOX facility. Therefore, CGD of penetration seal materials used for test purposes is not required.

For this fire-pressure test, the following materials shall be procured by AREVA and base-lined for future dedication activities.

1. Unifrax Fiberfrax® Durablanket® S
2. Dow Corning® 732 Multi-Purpose Sealant
3. Dow Corning® 790 Silicone Building Sealant
4. Dow Corning Sylgard® 170 Silicone Elastomer (DC-170)
5. Quantum Silicones QSil 5558MC Silicone Elastomer (QSil 5558MC)

5.2 Test Deck/Test Slab

The test deck will be used to simulate a fire barrier in which the penetration seal assemblies may be installed. The test deck is not considered an integral part of the penetration seal assembly being tested and therefore is not intended to replicate MOX-specific plant conditions and not considered integral in bounding the performance of the penetration seal assemblies (e.g., concrete blend, compressive strength, rebar size and spacing). The test deck will be comprised of normal weight reinforced concrete.

The openings cast into the test deck will simulate certain features consistent with MOX penetrations (e.g., painted or coated interior finishes, beveled edges, etc.) as defined by the test plan drawings contained in Appendix A.

The testing laboratory shall be responsible for procuring all materials and components associated with the construction of the test deck, unless otherwise specified below. The test deck shall comply with the requirements of the approved test plan drawings contained in Appendix A, and in accordance with the testing facility's Quality Assurance Program.

The quality level of the test deck is **Non-safety**.

5.3 Penetrating Items

There are no penetrating items (e.g., conduits, cable trays and wire ways) associated with this fire-pressure test.

6.0 SPECIAL PRECAUTIONS

6.1 Precautions for Construction of Test Assemblies

Observe testing facilities safe work practices for construction, lifting, and moving of test assemblies.

6.2 Precautions for Installation of Seal Assemblies

Observe specific precautions recommended by seal material manufacturers as noted on product literature and material safety data sheets contained in AREVA NP Inc. Document 01-9198306, *Installation Instruction Manual for MOX Penetration Seal Test Program* [Reference 12.4].

6.3 Precautions for Conducting Pressure Test

Proper safety precautions shall be exercised to preclude personnel from direct exposure to loss of pressure events, unexpected disengaging of testing equipment from the test deck, and all other related hazards.

7.0 PREREQUISITES

7.1 General Test Configuration Requirements

The test assembly, including slab layout and penetration seal configurations shall be as specified by AREVA and in accordance with the drawings and information contained in Appendix A of this test plan, and AREVA NP Inc. Document 01-9198306, *Installation Instruction Manual for MOX Penetration Seal Test Program* [Reference 12.4].

7.2 Safety Related Materials

Penetration seal materials that are purchased **Non-Safety** for this test program but are to be base-lined for future Nuclear Safety Related via the Commercial Grade Dedication process are indicated on the AREVA Bill of Materials (Appendix B.1).

7.3 Dimensioned Drawings

All test articles shall conform to the dimensioned drawings supplied by AREVA and contained in Appendix A of this test plan. Any differences between designed and constructed/tested assemblies shall be noted in final drawings contained within the test report.

7.4 Test Configuration

All test articles shall be securely fastened to the test apparatus by the laboratory. All openings shall be sealed in accordance with test plan instructions, drawings (Appendix A) and AREVA Document 01-9198306 [Reference 12.4].

8.0 TEST ASSEMBLY CONSTRUCTION

8.1 Test Slab Construction

The Testing Laboratory shall construct the test slab, including location and size of openings and placement of penetrating items, in accordance with the drawings contained in Appendix A of this Test Plan.

AREVA QC (or approved designee) shall conduct an inspection of the test slab for compliance with the approved Test Plan drawings prior to installation of individual penetration seal test assemblies. Any differences between the approved Test Plan drawings and the as-built test slab configuration shall be corrected (if deemed necessary by the AREVA Test Engineer) or noted by the QC Inspector (if correction is not required). Completion of this verification shall be documented as required by AREVA NP Inc. Document 01-9198306, *Installation Instruction Manual for MOX Penetration Seal Test Program* [Reference 12.4].

8.2 Penetration Seal Installation

AREVA (or approved designee) shall install the penetration seal test assemblies in accordance with the drawings contained in Appendix A of this Test Plan and in accordance with AREVA NP Inc. Document 01-9198306, *Installation Instruction Manual for MOX Penetration Seal Test Program* [Reference 12.4].

QA/QC verification of penetration seal installations shall be documented as required by AREVA NP Inc. Document 01-9198306, *Installation Instruction Manual for MOX Penetration Seal Test Program* [Reference 12.4].

8.3 Pre-Test Verifications

Prior to conducting the fire-pressure test for each test assembly, the AREVA Test Engineer shall sign-off indicating that the test article (test penetration) is complete and ready for testing as required by AREVA NP Inc. Document 01-9198306, *Installation Instruction Manual for MOX Penetration Seal Test Program* [Reference 12.4].

9.0 PROCEDURE

9.1 Fire Endurance Test

The fire endurance test portion of the fire-pressure test shall comply with the pertinent requirements of *ASTM E 814-94b* [Reference 12.9]. Specifically:

- The fire environment within the furnace shall be in accordance with the standard time temperature curve shown in Fig. 1 of *ASTM E 814-94b* for 30 minutes.
- The furnace temperature shall be the average temperature from readings taken from thermocouples symmetrically distributed within the test furnace to show the temperature near all parts of the test assembly. Placement of furnace thermocouples shall comply with *ASTM E 814-94b* requirements.
- Furnace temperature shall be recorded at intervals not exceeding 5 minutes during the test.
- The accuracy of the furnace control shall comply with the requirements of *ASTM E-814-94b*.
- Temperatures monitored by engineering thermocouples shall be read and recorded at intervals of 5 minutes or less.
- The furnace pressure shall comply with the Standard Pressure Condition provisions of *ASTM E 814-94b* (i.e., furnace pressure at least +0.01 inches wg with respect to the unexposed side of the test assembly).

Engineering thermocouples shall be installed as determined during test assembly construction and their locations shall be documented in the final test report. Since the penetrations being tested only require an F rating, engineering thermocouple data is not tied to any test acceptance criteria. Engineering thermocouple data will be used for analysis purposes, such as designing test assemblies for subsequent fire tests or evaluating penetration seal installations that fall outside the parameters of fire tested configurations.

9.2 Hose Stream Test

There is no formal hose stream required for this fire-pressure test.

Following the 30 minute fire endurance portion of the test, the test assembly shall be promptly removed from the furnace chamber and any residual flaming on the exposed side of the test assembly shall be extinguished with water. Depending upon the amount of flaming, a garden hose may be sufficient to extinguish the flames. In the event a larger diameter hose is needed, a hose equipped with an adjustable spray nozzle should be used. Care shall be taken not to impart an excessive amount of force on the test assembly during extinguishment of any residual flaming.

9.3 Pressure Test Apparatus

The pressure test apparatus to be used for the pressure portion of this fire-pressure test shall be one of the two pressure bonnets constructed and used for MOX pressure and seismic pressure tests. One of the hemispherical 72" diameter steel pressure vessels shall be attached to the unexposed side of the test assembly. This will require the fire tested assembly to be inverted from the orientation used during the fire test. The pressure bonnet shall be used to induce the testing pressures above atmospheric pressure based on Table 9-1. A spray bottle with a soapy-water solution shall be used to detect leakage on the exposed side of the test assembly. Hold times and acceptance criteria shall be as defined in Table 9-1.

9.4 Pressure Test Process

The anticipated fire-induced differential pressures, as they apply to MFFF penetration seal designs, are discussed in DCS01-BRA-DS-TRD-B-01365-0 [Reference 12.5] and in calculation DCS01-ASI-DS-CAL-R-10552 [Reference 12.6]. Most areas of the facility are bounded by a fire induced differential pressure of +/- 7.0 inches w.g. Plant areas with higher fire induced differential pressures are identified in calculation DCS01-ASI-DS-CAL-R-10552 [Reference 12.6]. The maximum fire-induced differential pressure in any plant area is -14.7 inches w.g.

The pressure levels specified in Table 9-1 are to be used in the pressure test portion of this fire-pressure test. The 10 inch w.g. pressure is intended to bound the +/- 7.0 inches w.g. with margin. The 20 inches w.g. pressure is intended to bound the maximum fire-induced compartment pressure of -14.7 inches w.g. with margin.

A hold time of 5 minutes has been established for each pressure level to ensure that sufficient time at pressure is maintained to; 1) confirm that no leakage occurs at that pressure, or 2) stabilize make up air to maintain the pressure and identify the apparent location of the leak.

Table 9-1: Differential Pressure Test Levels

Test Stage	Differential Pressure (inch w.g.)	Required Hold Time (minutes)	Acceptance Criteria	Basis for the Selected Differential Pressure
1	10.0	5	Seal Remains In Place	Testing at this differential pressure bounds the +/- 7.0 inches w.g. pressure used as the screening pressure cutoff for fire induced pressures [Reference 12.6].
2	20.0	5	Seal Remains In Place	Testing at this differential pressure bounds the – maximum compartment fire-induced pressure of -14.7 inches w.g. pressure per the fire-induced pressure calculation [Reference 12.6].

The test assembly shall be attached to the pressure test apparatus and subjected to the pressures identified in Table 9-1 as described below. For Test Stages 1 and 2 the side of the test deck which was not exposed to the furnace during the fire test be pressurized in accordance with Sections 9.2.1 through 9.2.4 below.

9.4.1 The test assembly shall be attached to the pressure test apparatus and subjected to air pressure test stages at the select pressure levels identified in Table 9-1, beginning with the Stage 1 pressure of 10.0 inches w.g. Once this pressure has been obtained, the pressure shall be maintained for the hold time specified in Table 9-1. Any leakage observed during the hold time shall be noted.

9.4.2 Once the designated hold time has been achieved, the pressure shall be increased to the

next pressure level identified in Table 9-1 (Stage 2, 20.0 inches w.g.) and held for the designated hold time. Any leakage observed during this hold time shall be noted.

9.4.3 Following completion of Stage 2 pressure testing, the test may continue at the discretion of the AREVA test engineer and the testing laboratory manager in charge. Subsequent pressures and hold times shall be recorded as directed by the AREVA test engineer.

9.4.4 If at any pressure level (or test stage) the penetration seal becomes dislodged from the opening or otherwise catastrophically fails, the pressure test shall be terminated and the time to failure and pressure at which the failure occurred shall be recorded.

9.5 Post Test Examination

Following completion of the pressure test, visual and destructive (if deemed necessary) post-test examinations shall be performed. These examinations shall include, but not necessarily be limited to, the following:

Visual observations of penetration seal condition including:

- Integrity of seal and conditions on both sides of the penetration
- Location of any penetration seal degradation
- Condition of seal to barrier interface
- Condition of seal to penetrating item(s) interface (if applicable)

Once visual observations are complete, destructive examinations may be used to obtain additional information or gain extra insights into seal performance during the pressure test.

10.0 DATA SYSTEMS

During the pressure test, the various data systems connected to the test apparatus (blowers, anemometers, manometers, etc.) shall be controlled and monitored by the testing laboratory. Data recorded for these components shall be compiled and contained in the pressure test report.

11.0 TEST REPORT

The testing laboratory shall submit a report on the results of both the fire and pressure test portions of this fire-pressure test. The test report shall contain the collected data and required quality control documentation. The final test report shall be prepared in sufficient detail to summarize the total testing activity. The final report shall include as a minimum:

- Date of tests (fire and pressure)
- Location of tests
- Description of test apparatus and test articles
- Calibration documentation for all data systems connected to the test apparatus
- Test procedures used
- Acceptance criteria
- Provide quality control records
- Results of the fire and pressure tests
- Color digital photographs of the test project

12.0 REFERENCES

12.1 Shaw AREVA MOX Services Procedure PP9-1, Revision 14, *SSC Quality Levels & Marking Design Documents*

12.2 AREVA NP Inc. Procedure 1702-25, Revision 018, *Assignment of Nuclear Safety Classification to Products and Services*

12.3 AREVA NP Inc. Document 56-9141754-001, *AREVA NP Inc. Quality Assurance Program*

12.4 AREVA NP Inc. Document 01-9198306 (latest revision), *Installation Instruction Manual for MOX Penetration Seal Test Program*

12.5 Shaw AREVA MOX Services Document DCS01-BRA-DS-TRD-B-01365-0, *Technical Requirements Document for MFFF Penetration Seals*

12.6 Shaw AREVA MOX Services Calculation DCS01-ASI-DS-CAL-R-10552-0, *Fire Induced Room Pressure Analysis*

12.7 AREVA NP Inc. Document 51-9206196-001, *Detailed Test Plan for Conducting MOX Pressure Test 7*

12.8 AREVA NP Inc. Document 51-9209291-000, *Detailed Test Plan for Conducting MOX Seismic Pressure Test 5*

12.9 ASTM E 814-94b, *Standard Test Method for Fire Tests of Through-Penetration Fire Stops*, American Society for Testing and Materials

Retrieval of Reference Documents

References 12.1, 12.5, 12.6 and 12.9 of this document were not entered into the AREVA NP Records Management system because they can be retrieved using the Shaw AREVA MOX Services Records Management system or are readily retrievable industry codes/standards. These documents have been authorized for use as design information in this document with the AREVA NP Project Manager's written authorization as indicated by the PM's signature on Page 2.

APPENDIX A: TEST DECK/TEST SLAB DRAWINGS

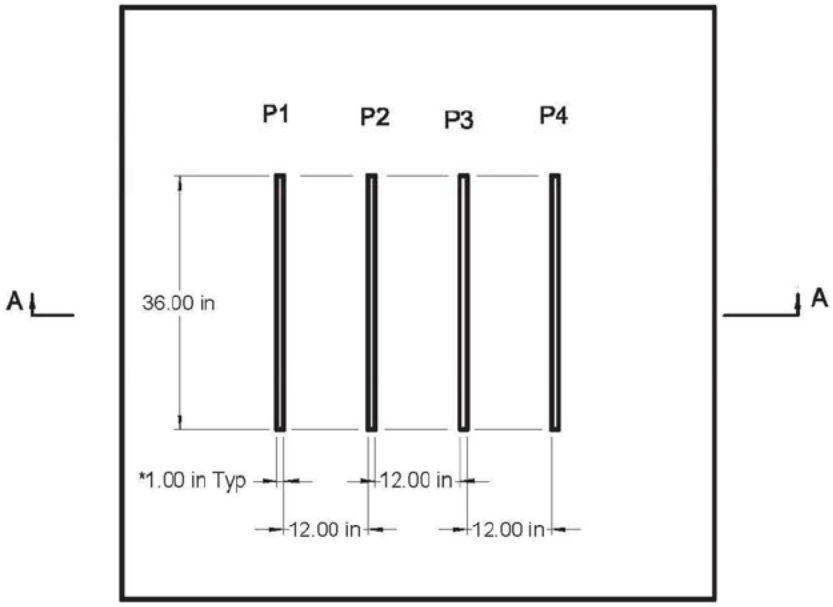
The test deck (test slab) for Fire-Pressure Test 3 is depicted on page A-2.

AREVA

Document No.: 51-9213021-000

Detailed Test Plan for Conducting MOX Fire-Pressure Test 3

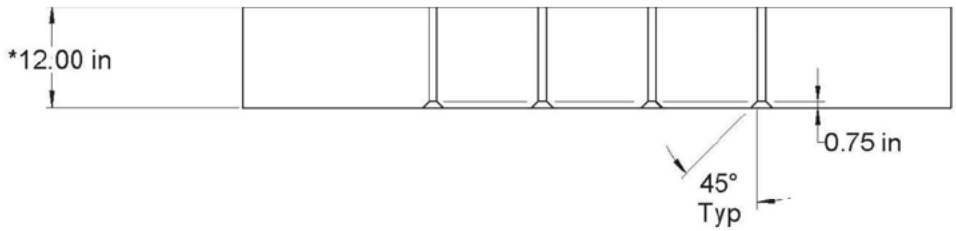
Fire-Pressure Test 3



Section View is on
Page A-3.

NOTES:

1. TOLERANCE ON ALL SLAB DIMENSIONS IS +/- 1/4"
2. * INDICATES DIMENSIONS TO BE VERIFIED BY AREVA QC.



Section A-A

NOTES:

1. TOLERANCE ON ALL SLAB DIMENSIONS IS +/- 1/4"
2. * INDICATES DIMENSIONS TO BE VERIFIED BY AREVA QC
3. ALL GAPS BEVELED ¾" X 45° ON BOTTOM SIDE OF SLAB.

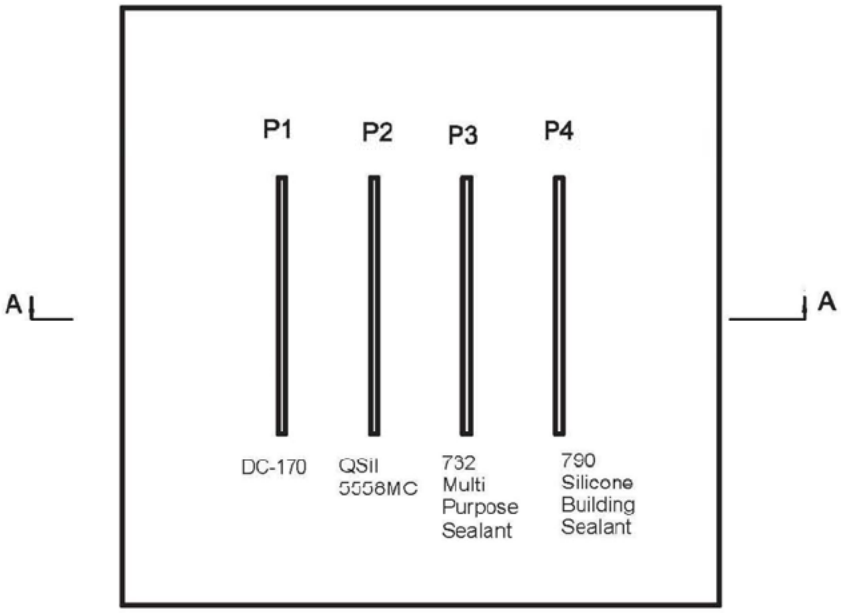
AREVA

Document No.: 51-9213021-000

Detailed Test Plan for Conducting MOX Fire-Pressure Test 3

Fire-Pressure Test 3

Penetration Seal Material



Section View is on Page A-5.

NOTES:

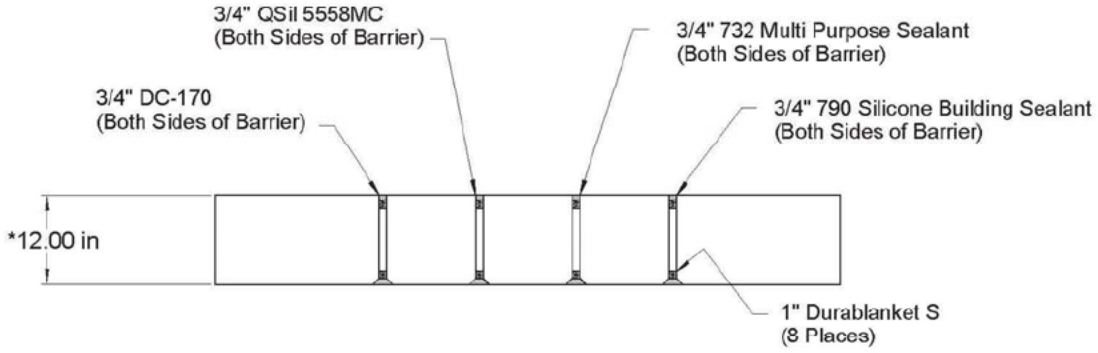
1. TOLERANCE ON ALL SLAB DIMENSIONS IS +/- 1/4"
2. * INDICATES DIMENSIONS TO BE VERIFIED BY AREVA QC.

Intertek

AREVA

Document No.: 51-9213021-000

Detailed Test Plan for Conducting MOX Fire-Pressure Test 3



Section A-A

NOTES:

1. TOLERANCE ON ALL SLAB DIMENSIONS IS +/- 1/4"
2. * INDICATES DIMENSIONS TO BE VERIFIED BY AREVA QC.

AREVA

Document No.: 51-9213021-000

Detailed Test Plan for Conducting MOX Fire-Pressure Test 3

APPENDIX B: BILL OF MATERIALS

This appendix contains the Bill of Materials for this fire test. The Bill of Materials in Section B.1 identifies materials to be provided by AREVA. The Bill of Materials in Section B.2 identifies materials to be provided by MOX Services. The Bill of Materials in Section B.3 identifies materials to be provided by Intertek.

B.1 Table Bill of Materials for AREVA Supplied Items

Bill of Material for AREVA Supplied Items					
Item	**Description**	**Part Number**	**Quantity**	**Units**	**Total**
1	Unifrax Fiberfrax® Durablanket® S – 6 lbs/cu. ft., 1" thick, 48" wide, 25 linear feet	764522000	1	Roll	1 Roll
2	Dow Corning® 732 Multi-Purpose Sealant	N/A	1	Case	1 Case
3	Dow Corning® 790 Multi-Purpose Sealant	N/A	1	Case	1 Case
4	Quantum Silicones QSil 5558MC Silicone Elastomer (50lb part A, 50lb part B, 100lb set)	N/A	1	Set	1 Set
5	Dow Corning Sylgard® 170 Silicone Elastomer (50lb part A, 50lb part B, 100lb set)	N/A	1	Set	1 Set

B.2 Bill of Materials for MOX Services Supplied Items

Bill of Material for MOX Services Supplied Items					
Item	Description	Part Number	Quantity	Units	Total
	None				

B.3 Bill of Materials for Intertek Supplied Items

Bill of Material for Intertek Supplied Items*					
Item	**Description**	**Part Number**	**Quantity**	**Units**	**Total**
	None				

* *This BOM applies to Intertek Supplied Items other than materials required to construct the test slab. Construction of the test slab, including procurement of any materials required for the test slab, is the responsibility of Intertek.*

AREVA

Document No.: 51-9213021-000

Detailed Test Plan for Conducting MOX Fire-Pressure Test 3

APPENDIX C: DESIGN VERIFICATION CHECKLIST

22410-8 (02/25/2013) *Page 1 of 2*

AREVA

DESIGN VERIFICATION CHECKLIST

Document Identifier 51 - 9213021 - 000

Title Detailed Test Plan for Conducting MOX Fire-Pressure Test 3

1.	Were the inputs correctly selected and incorporated into design or analysis?	☒ Y	☐ N	☐ N/A
2.	Are assumptions necessary to perform the design or analysis activity adequately described and reasonable? Where necessary, are the assumptions identified for subsequent re-verifications when the detailed design activities are completed? Note: If there are no assumptions (of any type), then N/A shall be checked.	☐ Y	☐ N	☒ N/A
3.	Are the appropriate quality and quality assurance requirements specified? Or, for documents prepared per AREVA NP Inc. procedures, have the procedural requirements been met?	☒ Y	☐ N	☐ N/A
4.	If the design or analysis cites or is required to cite requirements or criteria based upon applicable codes, standards, specific regulatory requirements, including issue and addenda, are these properly identified, and are the requirements/criteria for design or analysis met?	☒ Y	☐ N	☐ N/A
5.	Have applicable construction and operating experience been considered?	☒ Y	☐ N	☐ N/A
6.	Have the design interface requirements been satisfied?	☒ Y	☐ N	☐ N/A
7.	Was an appropriate design or analytical method used?	☒ Y	☐ N	☐ N/A
8.	Is the output reasonable compared to inputs?	☒ Y	☐ N	☐ N/A
9.	Are the specified parts, equipment and processes suitable for the required application?	☒ Y	☐ N	☐ N/A
10.	Are the specified materials compatible with each other and the design environmental conditions to which the material will be exposed?	☒ Y	☐ N	☐ N/A
11.	Have adequate maintenance features and requirements been specified?	☐ Y	☐ N	☒ N/A
12.	Are accessibility and other design provisions adequate for performance of needed maintenance and repair?	☐ Y	☐ N	☒ N/A
13.	Has adequate accessibility been provided to perform the in-service inspection expected to be required during the plant life?	☐ Y	☐ N	☒ N/A
14.	Has the design properly considered radiation exposure to the public and plant personnel?	☐ Y	☐ N	☒ N/A
15.	Are the acceptance criteria incorporated in the design documents sufficient to allow verification that design requirements have been satisfactorily accomplished?	☒ Y	☐ N	☐ N/A
16.	Have adequate preoperational and subsequent periodic test requirements been appropriately specified?	☐ Y	☐ N	☒ N/A
17.	Are adequate handling, storage, cleaning and shipping requirements specified?	☒ Y	☐ N	☐ N/A
18.	Are adequate identification requirements specified?	☒ Y	☐ N	☐ N/A
19.	Is the document prepared and being released under the AREVA NP Inc. Quality Assurance Program? If not, are requirements for record preparation review, approval, retention, etc., adequately specified?	☒ Y	☐ N	☐ N/A

22410-8 (02/25/2013) *Page 2 of 2*

DESIGN VERIFICATION CHECKLIST

Document Identifier 51 - 9213021 - 000

Comments on the preceding responses:
N/A

Verified By:	Victor E. Kaldenbach	[redacted]	10/17/2013
(First, MI, Last)	Printed / Typed Name	Signature	Date

APPENDIX F

Commercial Grade Dedication-Related Documents

The vast majority of penetration seals that will be installed throughout the MFFF will be designated as quality level QL-1. For this reason, permanent penetration seal materials used in this test program were procured by AREVA or supplied by MOX Services and suitably base-lined so that future procurements of the same commercial materials can undergo the Commercial Grade Dedication process in support Nuclear Safety Related (i.e., MOX QL-1) plant installations.

Only the primary seal material(s) that were specified as a part of the final penetration seal design and left in place during the test needed to be base-lined for future dedication of similarly procured materials. For this test, the following AREVA documents contain information associated with materials that underwent the base-lining process. These documents establish material critical characteristics as a baseline for future Commercial Grade Dedication.

- AREVA Document 51-9212659-000, “Dow Corning Sylgard 170 Silicone Elastomer Critical Characteristics”
- AREVA Document 51-9212663-000, “Quantum Silicones QSil 5558MC Silicone Elastomer Critical Characteristics”
- AREVA Document 51-9212666-000, “Dow Corning 732 Multi-Purpose Sealant Critical Characteristics”
- AREVA Document 51-9212668-000, “Dow Corning 790 Silicone Building Sealant Critical Characteristics”
- AREVA Document 51-9212670-000, “Unifrax Durablanket S Critical Characteristics”

These documents are available from the AREVA Records Management System or the MOX Records Management System.

APPENDIX G
Quality Documents

The test assembly for Fire-Pressure Test 3 was the same assembly tested first as Pressure Test 7. For QC Records of the installation, Certificates of Conformance of the Sealant materials and QA Receiving documentation of the assembly materials, please see the Appendices in Pressure Test 7 (Intertek Report No. 101276459SAT-001C; AREVA document 58-9223086-000).

LIST OF CALIBRATED EQUIPMENT: FIRE TEST

Description	Serial No.	Calibration Due Date
Thermo-Hygrometer	130548237	9/19/2015
Data Acquisition System	48JF0082	3/11/2014
Pressure Transducer	3588750	3/26/2014
Stop watch	130176939	3/29/2015

Build B
Horizontal

ilac-MRA ACCREDITED Calibration Certificate No. 1750.01

Calibration complies with ISO/IEC 17025, ANSI/NCSL Z540-1, and 9001

Cert. No.: 4096-5373559

Traceable® Certificate of Calibration for Digital Humidity/Temp. Meter

Manufactured for and distributed by: Fisher Scientific, 300 Industry Drive, Pittsburgh, PA 15275-1001

Instrument Identification:

Model Numbers: 11-661-13, FB61254, 245C5 S/N: 130548237 Manufacturer: Control Company

Standards/Equipment:

Description	Serial Number	Due Date	NIST Traceable Reference
Chilled Mirror Hygrometer	31874/H2048MCR	6/14/15	11081
Digital Thermometer	41334977/41335007	9/26/13	4000-4643062

Certificate Information:

Technician: 104 Procedure: CAL-17 Cal Date: 9/19/13 **Cal Due: 9/19/15**

Test Conditions: 23.0°C 51.0 %RH 1013 mBar

Calibration Data: (New Instrument)

Unit(s)	Nominal	As Found	In Tol	Nominal	As Left	In Tol	Min	Max	±U	TUR
%RH		N.A.		42.95	42	Y	39	47	1.30	3.1:1
°C		N.A.		24.218	24	Y	23	25	0.590	1.7:1

This Instrument was calibrated in compliance with ISO/IEC 17025:2005 and ANSI/NCSL Z540-1-1994 Part 1.

A Test Uncertainty Ratio of at least 4:1 is maintained unless otherwise stated and is calculated using the expanded measurement uncertainty. Uncertainty evaluation includes the instrument under test and is calculated in accordance with the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM). The uncertainty represents an expanded uncertainty using a coverage factor k=2 to approximate a 95% confidence level. In tolerance conditions are based on test results falling within specified limits with no reduction by the uncertainty of the measurement. The results contained herein relate only to the item calibrated. This certificate shall not be reproduced except in full, without written approval of Control Company.

The calibration results published in this certificate were obtained using equipment capable of producing results that are traceable to NIST and through NIST to the International System of Units (SI).

Nominal=Standard's Reading; As Left=Instrument's Reading; In Tol=In Tolerance; Min/Max=Acceptance Range; ±U=Expanded Measurement Uncertainty; TUR=Test Uncertainty Ratio; Accuracy=±(Max-Min)/2; Min = As Left Nominal(Rounded) - Tolerance; Max = As Left Nominal(Rounded) + Tolerance; Date=MM/DD/YY

[redacted]
Nicol Rodriguez, Quality Manager

[redacted]
Aaron Judice, Technical Manager

Maintaining Accuracy:

In our opinion once calibrated your Digital Humidity/Temp. Meter should maintain its accuracy. There is no exact way to determine how long calibration will be maintained. Digital Humidity/Temp. Meters change little, if any at all, but can be affected by aging, temperature, shock, and contamination.

Recalibration:

This device was calibrated using a single test point. Should additional test points be required, please contact Control Company for factory calibration and re-certification traceable to National Institute of Standards and Technology.

CONTROL COMPANY 4455 Rex Road Friendswood, TX 77546 USA
Phone 281 482-1714 Fax 281 482-9448 service@control3.com www.control3.com

Intertek

16015 Shady Falls Road
Elmendorf, TX 78112
210-635-8100 210-635-8101 fax

Certificate of Verification

Verification Date:	**9/11/2013**
Re-verification Date:	**3/11/2014**
Manufacturer:	**Yokogawa**
Model No.:	**300 Channel DAU**
Serial No.:	**48JF0082**
Equipment Description:	**300 Channel Data Acquisition System**
Calibration Sources:	**Tegam SN: T-156701, due 6/13/2014.**
Performance:	**See the attached sheet**

Verification Performed By:

[redacted]

Verification Approved By:

[redacted]

Project Engineer

This Data Acquisition System was verified following the Draft "Work Instruction for Verifying Yokogawa Darwin Data Acquisition Systems" dated 8/28/2013

CERTIFICATE NO: 54676-0009

Page 1 of 1

SYSTEM SCALE CORPORATION
SSC LAB DIVISION

CERTIFICATE OF CALIBRATION

ACLASS ACCREDITED CALIBRATION
Certificate # AC-1756

SSC LAB DIVISION certifies that this instrument conforms to original manufacturers specifications or to tolerances indicated below and has been calibrated using standards with accuracies traceable to a National Measurement Institute, or to accepted values of natural physical constants, or have been derived by ratio techniques. This certificate complies with ISO / IEC 17025:2005 & ANSI/NCSLI Z540-1. Unless otherwise stated, the M & T E for which this certificate is issued, based on interpretation of data, was found to meet the required specification. The expanded measurement uncertainty is reported at k=2, 95% confidence level.

Customer:	INTERTEK	Date Received:	02/21/2013
Location:	16015 SHADY FALLS RD. ELMENDORF TX 78112	Date of Issue/Calibration:	03/26/2013
		Next Calibration Due:	03/26/2014
PO #:02192013		Metrologist:	Sean Rainey

Manufacturer:	SETRA	Model:	2641R25WB2ST1C
Nomenclature:	TRANSDUCER- PRESSURE	Serial Number:	3588750
Range:	± 0.25"WC	Equipment ID:	3588750

Calibration Data Temp 68°F ± 1°F Humidity <50%RH

Calibration Accuracy± 1% FS

Note:A=Reading plus Uncertainty exceeds tolerance limits.

Note: if the AS LEFT column is blank, no adjustments were required.

Note: Many factors may cause out of calibration condition prior to due date.The Calibration interval has been specified by the Customer. Current procedures and methods utilized by SSC Lab Division are approved by the Customer.

APPLIED	AS FOUND	AS LEFT	UNCERTAINTY	PROCEDURE #
2.5 V 0" W.C.	2.507	2.507	± 0.035 VDC	NA17-20MX-157 1 AUG 2011
0 V -0.25" W.C.	0.001	0.001	± 0.035 VDC	
5 V 0.25" W.C.	5.019	5.019	± 0.035 VDC	

Standard(s)	Description	Calibration Date	Expiration Date	Traceability Number
SSC30LD029	CALIBRATOR- PRESSURE	5/4/2011	5/4/2013	50650-0010
SSC30LD113	TRANSDUCER- PRESSURE	10/15/2012	10/15/2014	CAL122077

[redacted]
Cindy Glover
Production Supervisor

Comments:

CERTIFICATE NO: 55020-0001

Page 1 of 2

SYSTEM SCALE
DYNAPAC
SSC LAB DIVISION

CERTIFICATE OF CALIBRATION

ACLASS ACCREDITED CALIBRATION

Certificate # AC-1756

SSC LAB DIVISION certifies that this instrument conforms to original manufacturers specifications or to tolerances indicated below and has been calibrated using standards with accuracies traceable to a National Measurement Institute, or to accepted values of natural physical constants, or have been derived by ratio techniques. This certificate complies with ISO / IEC 17025:2005 & ANSI/NCSLI Z540-1. Unless otherwise stated, the M & T E for which this certificate is issued, based on interpretation of data, was found to meet the required specification. The expanded measurement uncertainty is reported at k=2, 95% confidence level.

Customer:	INTERTEK	Date Received:	04/19/2013
Location:	16015 SHADY FALLS RD. ELMENDORF TX 78112	Date of Issue/Calibration:	05/14/2013
		Next Calibration Due:	05/14/2014
PO #:04172013		Metrologist:	Mark Wassner

Manufacturer:	McDANIEL CONTROLS INC.	Model:	0-100 PSI
Nomenclature:	GAGE- PRESSURE	Serial Number:	06LE003
Range:	0-100 PSI	Equipment ID:	06LE003

Calibration Data Temp 68°F ± 1°F Humidity <50%RH

Calibration Accuracy:± 1 DIV

Note:A=Reading plus Uncertainty exceeds tolerance limits.

Note: if the AS LEFT column is blank, no adjustments were required.

Note: Many factors may cause out of calibration condition prior to due date. The Calibration interval has been specified by the Customer. Current procedures and methods utilized by SSC Lab Division are approved by the Customer.

APPLIED	AS FOUND	AS LEFT	UNCERTAINTY	PROCEDURE #
UUT VALUE	STANDARD VALUE	STANDARD VALUE		TO33K6-4-427-1 30 MAY 2012
20.0 PSI	22.92	21.81A	2.9	
40.0 PSI	42.45	41.41A	2.9	
60.0 PSI	61.54A	60.67A	2.9	
80.0 PSI	80.27A	79.68A	2.9	
96.0 PSI	96.48A	94.65A	2.9	

CERTIFICATE NO: 55020-0001

Page 2 of 2

SYSTEM 1 SCALE
CORPORATION
SSC LAB DIVISION

CERTIFICATE OF CALIBRATION

ACLASS ACCREDITED
CALIBRATION
Certificate # AC-1756

SSC LAB DIVISION certifies that this instrument conforms to original manufacturers specifications or to tolerances indicated below and has been calibrated using standards with accuracies traceable to a National Measurement Institute, or to accepted values of natural physical constants, or have been derived by ratio techniques. This certificate complies with ISO / IEC 17025:2005 & ANSI/NCSLI Z540-1. Unless otherwise stated, the M & T E for which this certificate is issued, based on interpretation of data, was found to meet the required specification. The expanded measurement uncertainty is reported at k=2, 95% confidence level.

Standard(s)	Description	Calibration Date	Expiration Date	Traceability Number
SSC30LD029	CALIBRATOR- PRESSURE	5/8/2013	5/8/2015	55040-0002
SSC30LD031	TRANSDUCER- PRESSURE	5/9/2013	5/9/2015	55040-0003

[redacted]

Cindy Glover
Production Supervisor

Comments:

[redacted] 4/4/13

ilac-MRA ACCREDITED Calibration Certificate No. 1750.01

Calibration complies with ISO 9001 ISO/IEC 17025 AND ANSI/NCSL Z540-1

Cert. No.: 1045-5005294

Traceable® Certificate of Calibration for Watr/Shock Res Stpwch

Manufactured for and distributed by: Fisher Scientific, P.O. Box 1768, Pittsburgh, PA 15230

Instrument Identification:

Model: S40799-7 S/N: 130176939 Manufacturer: Control Company

Standards/Equipment:

Description	Serial Number	Due Date	NIST Traceable Reference
Non-Contact Frequency Counter	26.66879	7/02/13	1000320243

Certificate Information:

Technician: 150 Procedure: CAL-01 Cal Date: 3/29/13 **Cal Due: 3/29/15**

Test Conditions: 22.5°C 42.0 %RH 1020 mBar

Calibration Data: (New Instrument)

Unit(s)	Nominal	As Found	In Tol	Nominal	As Left	In Tol	Min	Max	±U	TUR
Sec/24hr		N.A.		0.000	-0.000	Y	-0.040	0.040	0.130	>4:1

This Instrument was calibrated using Instruments Traceable to National Institute of Standards and Technology.

A Test Uncertainty Ratio of at least 4:1 is maintained unless otherwise stated and is calculated using the expanded measurement uncertainty. Uncertainty evaluation includes the instrument under test and is calculated in accordance with the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM). The uncertainty represents an expanded uncertainty using a coverage factor k=2 to approximate a 95% confidence level. In tolerance conditions are based on test results falling within specified limits with no reduction by the uncertainty of the measurement. The results contained herein relate only to the item calibrated. This certificate shall not be reproduced except in full, without written approval of Control Company.

Nominal=Standard's Reading; As Left=Instrument's Reading; In Tol=In Tolerance; Min/Max=Acceptance Range; ±U=Expanded Measurement Uncertainty; TUR=Test Uncertainty Ratio; Accuracy=±(Max-Min)/2; Min = Nominal(Rounded) - Tolerance; Max = Nominal(Rounded) + Tolerance; Date=MM/DD/YY

[redacted] Nicol Rodriguez, Quality Manager

[redacted] Aaron Judice, Technical Manager

Maintaining Accuracy:

In our opinion once calibrated your Watr/Shock Res Stpwch should maintain its accuracy. There is no exact way to determine how long calibration will be maintained. Watr/Shock Res Stpwchs change little, if any at all, but can be affected by aging temperature, shock, and contamination.

Recalibration:

For factory calibration and re-certification traceable to National Institute of Standards and Technology contact Control Company.

CONTROL COMPANY 4455 Rex Road Friendswood, TX 77546 USA
Phone 281 482-1714 Fax 281 482-9448 service@control3.com www.control3.com

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REPORT OF CALIBRATION

To: INTERTEK TESTING SERVICES

16015 SHADY FALLS ROAD
ELMENDORF, TX
78112

Date of Calibration: 2/14/2013
Job #: P99193-SJ
Item #: 1
Spool #: S0134186
Footage: 1100
Part #: PW30080 G/G-24-KK SP
Customer PO: USA20-0000215766Q

All Temperatures in this report are based on the International Temperature Scale of 1990 (ITS-90) with reference junctions maintained at 0ºC (32ºF) The product listed above was calibrated utilizing techniques consistent with the guidelines set forth in ANSI/NCSL Z540-1, ASTM E220-07A, ASTM E230-03, ANSI MC96.1, and AMS-2750 rev D, and are in compliance. Calibration results are traceable to the National Institute of Standards and Technology (NIST) and meet the deviation tolerances for acceptable calibration, if authorized below.

Nominal Value Set Point °F	UUT/Inside Test Sensor °F	Correction Factor Inside °F	UUT/Outside Test Sensor °F	Correction Factor Outside °F	Average In/Out Correction Factor °F	Special Tolerance °F
200.0	200.0	0.0	200.0	0.0	0.0	2.0
400.0	400.1	-0.1	400.0	0.0	-0.1	2.0
600.0	599.6	0.4	599.4	0.6	0.5	2.4
800.0	800.5	-0.5	800.3	-0.3	-0.4	3.2
1000.0	1001.2	-1.2	1000.9	-0.9	-1.1	4.0

The calibration results apply to the item(s) listed. Calibration is ISO:IEC17025:2005 Accredited unless calibration points and/or profile falls outside of the stated Scope of Accreditation. *Correction factor is used to adjust measurement instrumentation readings to match NIST reference values. ISO 9001:2008 certified by LRQA. Certificate Number: UQA0111712.

Measurement uncertainty is expressed as an expanded uncertainty at 95% confidence level K=2 and is +/- 0.5ºC from -196ºC to 0ºC, +/- 1.3ºC to 1100ºC and +/- 2.0ºC from 1100ºC to 1400ºC

THIS IS TO CERTIFY THE MATERIAL FURNISHED ON THIS SHIPMENT IS IN SATISFACTORY CONDITION, AND IN CONFORMANCE WITH THE REQUIREMENTS, SPECIFICATIONS, & DRAWINGS OF THE ABOVE REFERENCED CUSTOMER PURCHASE ORDER. SAMPLING WAS PERFORMED PER CUSTOMERS REQUEST. AS APPLICABLE, INSPECTION AND TEST RECORDS ARE ON FILE AND AVAILABLE FOR CUSTOMER REVIEW

DIGITAL MULTIMETER
MODEL: AGILENT: 3458A
SERIAL NUMBER: US28032293
CALIBRATION DUE DATE: APRIL 30, 2014
Room Temperature: 72°F (±5°F)
Relative Humidity: < 60%

Calibrated by: AM

REFERENCE STANDARD THERMOCOUPLE TYPE K

NIST TRACEABILITY AVAILABLE UPON REQUEST
TEST # 279113

[redacted]

Approved By: Dante Bedlones Cal. Lab. Manager

Page 8 of 22

TEW&C **TE Wire & Cable LLC** PMC Thermocouple

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REPORT OF CALIBRATION

To: INTERTEK TESTING SERVICES

16015 SHADY FALLS ROAD
ELMENDORF, TX
78112

Date of Calibration: 2/14/2013
Job #: P99193-SJ
Item #: 1
Spool #: S0134189
Footage: 1000
Part #: PW30080 G/G-24-KK SP
Customer PO: USA20-0000215766Q

All Temperatures in this report are based on the International Temperature Scale of 1990 (ITS-90) with reference junctions maintained at 0°C (32°F) The product listed above was calibrated utilizing techniques consistent with the guidelines set forth in ANSI/NCSL Z540-1, ASTM E220-07A, ASTM E230-03, ANSI MC96.1, and AMS-2750 rev D, and are in compliance. Calibration results are traceable to the National Institute of Standards and Technology (NIST) and meet the deviation tolerances for acceptable calibration, if authorized below.

Nominal Value	UUT/Inside	Correction	UUT/Outside	Correction	Average In/Out	Special
Set Point	Test Sensor	Factor Inside	Test Sensor	Factor Outside	Correction Factor	Tolerance
°F	°F	°F	°F	°F	°F	°F
200.0	199.9	0.1	199.9	0.1	0.1	2.0
400.0	400.1	-0.1	400.0	0.0	-0.1	2.0
600.0	599.6	0.4	599.7	0.3	0.4	2.4
800.0	800.3	-0.3	800.3	-0.3	-0.3	3.2
1000.0	1000.8	-0.8	1000.9	-0.9	-0.9	4.0

The calibration results apply to the item(s) listed. Calibration is ISO:IEC17025:2005 Accredited unless calibration points and/or profile falls outside of the stated Scope of Accreditation. *Correction factor is used to adjust measurement instrumentation readings to match NIST reference values. ISO 9001:2008 certified by LRQA. Certificate Number: UQA0111712.

Measurement uncertainty is expressed as an expanded uncertainty at 95% confidence level K=2 and is +/- 0.5°C from -196°C to 0°C, +/- 1.3°C to 1100°C and +/- 2.0°C from 1100°C to 1400°C

THIS IS TO CERTIFY THE MATERIAL FURNISHED ON THIS SHIPMENT IS IN SATISFACTORY CONDITION, AND IN CONFORMANCE WITH THE REQUIREMENTS, SPECIFICATIONS, & DRAWINGS OF THE ABOVE REFERENCED CUSTOMER PURCHASE ORDER. SAMPLING WAS PERFORMED PER CUSTOMERS REQUEST. AS APPLICABLE, INSPECTION AND TEST RECORDS ARE ON FILE AND AVAILABLE FOR CUSTOMER REVIEW

DIGITAL MULTIMETER
MODEL: AGILENT: 3458A
SERIAL NUMBER: US28032293
CALIBRATION DUE DATE: APRIL 30, 2014
Room Temperature: 72°F (±5°F)
Relative Humidity: < 60%

Calibrated by: AM

REFERENCE STANDARD THERMOCOUPLE TYPE K

NIST TRACEABILITY AVAILABLE UPON REQUEST
TEST # 279113

[redacted]

Approved By: Dante Bedlones Cal. Lab. Manager

Page 11 of 22

LIST OF CALIBRATED EQUIPMENT: Pressure Test

Description	Serial No.	Calibration Due Date
Thermo-Hygrometer	130548237	9/19/2015
Data Acquisition System	18041FE	1/16/2014*
Pressure Transducer	406707	7/16/2014*
Mass Flowmeter	4270050001001	2/1/2014*
Mass Flowmeter	4270050003001	2/7/2014*
Stop watch	122601005	10/23/2014

* See Intertek Corrective Action Request (CAR) 51-AMER-SAT-2014-INT and AREVA Contract Variation Approval Request (CVAR) 87-9224669-000

[redacted]

ilac-MRA A2LA ACCREDITED
Calibration
Certificate No. 1750.01

Calibration complies with ISO/IEC 17025, ANSI/NCSL Z540-1, and 9001

Cert. No.: 4094-3993529

Traceable® Certificate of Calibration for Digital Humidity/Temp. Meter

Manufactured for and distributed by: Fisher Scientific, 300 Industry Drive, Pittsburgh, PA 15275-1001

Instrument Identification:

Model Numbers: 11-661-11, FB61252, 255TB S/N: 111901142 Manufacturer: Control Company

Standards/Equipment:

Description	Serial Number	Due Date	NIST Traceable Reference
Chilled Mirror Hygrometer	31674/H2048MCR	5/12/12	9193
Digital Thermometer	90969500	9/14/12	4000-3893285

Certificate Information:

Technician: 104 Procedure: CAL-17 Cal Date: 11/02/11 **Cal Due: 11/02/13**

Test Conditions: 22.5°C 45.0 %RH 1017 mBar

Calibration Data: (New Instrument)

Unit(s)	Nominal	As Found	In Tol	Nominal	As Left	In Tol	Min	Max	±U	TUR
°C		N.A.		23.667	23	Y	23	25	0.590	1.7:1
%RH		N.A.		41.450	41	Y	37	45	0.000	0.0:1

This Instrument was calibrated using Instruments Traceable to National Institute of Standards and Technology.

A Test Uncertainty Ratio of at least 4:1 is maintained unless otherwise stated and is calculated using the expanded measurement uncertainty. Uncertainty evaluation includes the instrument under test and is calculated in accordance with the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM). The uncertainty represents an expanded uncertainty using a coverage factor k=2 to approximate a 95% confidence level. In tolerance conditions are based on test results falling within specified limits with no reduction by the uncertainty of the measurement. The results contained herein relate only to the item calibrated. This certificate shall not be reproduced except in full, without written approval of Control Company.

Nominal=Standard's Reading; As Left=Instrument's Reading; In Tol=In Tolerance; Min/Max=Acceptance Range; ±U=Expanded Measurement Uncertainty; TUR=Test Uncertainty Ratio; Accuracy=±(Max-Min)/2; Min = Nominal(Rounded) - Tolerance; Max = Nominal(Rounded) + Tolerance; Date=MM/DD/YY

[redacted]

[redacted]

Maintaining Accuracy:

In our opinion once calibrated your Digital Humidity/Temp. Meter should maintain its accuracy. There is no exact way to determine how long calibration will be maintained. Digital Humidity/Temp. Meters change little, if any at all, but can be affected by aging, temperature, shock, and contamination.

Recalibration:

For factory calibration and re-certification traceable to National Institute of Standards and Technology contact Control Company.

CONTROL COMPANY 4455 Rex Road Friendswood, TX 77546 USA
Phone 281 482-1714 Fax 281 482-9448 service@control3.com www.control3.com

Certificate of Calibration

Certificate Number:	2994344	**Date:**	28-MAY-2014
Serial Number: **Description:**	18041FE CCA,USB-6210	**Part Number:**	194710E-04L
Calibration Date:	06-DEC-2012	**Shelf Life:**	0 Days
Calibration Due Date*:	-	**Recommended Calibration Interval:**	12 Months
Temperature:	22.26 °C	**Humidity:**	40.7% RH

Standards Used

Manufacturer	Model	Tracking Number	Calibration Date	Calibration Due
NATIONAL INSTRUMENTS	PXI-4070	6712	26-JUN-12	26-JUN-13
NATIONAL INSTRUMENTS	PXI-6259	6871	27-JUN-12	27-JUN-13
NATIONAL INSTRUMENTS	PXI-5421	7591	25-JUN-12	25-JUN-13
VAISALA	HMT331	7885	24-MAY-12	24-MAY-13

National Instruments certifies that at the time of test, the above product was calibrated in accordance with applicable National Instruments procedures. Th procedures are designed to ensure that the product listed above meets or exceeds National Instruments specifications.

We further certify that the environment in which this product was calibrated is maintained within the operating specifications of the instrument(s) standards. The measurement standards used during calibration are traceable to NIST and/or other International Measurement Institutes (NMI's) that signatories of the International Committee of Weights and Measure (CIPM) Mutual Recognition Agreement (MRA).

The information shown on this certificate applies only to the instrument identified above and this certificate may not be reproduced, except in full, withou prior written consent of National Instruments.

*Optional field. ***Calibration Due Date*** may be established by combining the *Recommended Calibration Interval*, *Calibration Date* and, when applic accounting for *Shelf Life*. Shelf life defines how long an instrument may be stored, after calibration, without impact to its specifications.

The instrument's Calibration Due Date can be calculated using the following methods:

a) If date placed in service is within *Calibration Date* + *Shelf Life*: *Calibration Due Date* = date placed in service + *Recommended Calibration Interval*

b) If date placed in service is outside *Calibration Date* + *Shelf Life*: *Calibration Due Date* = *Calibration Date* + *Shelf Life* + *Recommended Calibration Interval*

For questions or comments, please contact National Instruments Technical Support.

[redacted]

Andrew Krupp
Vice President, Quality and Continuous Improvement

OMEGADYNE INC.
CERTIFICATE OF CALIBRATION

Model Number: PX409-005DWUV
Serial Number: 406707
Date: 7/15/2011
Job: R3274

Capacity: 5.00 PSID
Excitation: 10.00 Vdc
Technician: KAPOME

Pressure Connection: 1/4-18 NPT Male

WIRING CODE

Electrical Connection: Integral Cable 4-Cond
BLACK = - EXCITATION
WHITE = + SIGNAL
GREEN = - SIGNAL
RED = + EXCITATION

CALIBRATION WORKSHEET

NOTES

Pressure PSID	OUTPUT mVdc
0.00	0.007
2.50	50.008
5.00	100.016
2.50	50.007
0.00	0.007

NIST Traceable Number(s): C-1954, C-1289

Omegadyne Inc. certifies that the above instrumentation has been calibrated and tested to meet or to exceed the published specifications. This calibration was performed using instrumentation and standards that are traceable to the National Institute of Standards and Technology. This document also ensures that all testing performed complies with MIL-STD 45662-A, ISO 10012-1, and ANSI/NCSL Z540-1-1994 requirements. After Final Calibration our products are stored in an environmentally controlled stock room and are considered in bonded storage. Depending on environmental conditions and severity of use, factory calibration is recommended every one to three years after the initial service installation date.

[redacted]

Accepted and Certified By

7/15/2011
Date

OMEGA ENGINEERING, INC.
An OMEGA Technologies Company
ONE OMEGA DRIVE, BOX 4047, STAMFORD, CT, U.S.A. 06907-0047
(203) 359-1660 TELEX: 996404 CABLE: OMEGA FAX: (203) 359-7700
http://www.omega.com e-mail: info@omega.com

CERTIFICATE OF ACCURACY

This is to certify that meter serial number 4270050001001 is certified to an accuracy of +/- 1 % of 20 SCFM of N2 and has been calibrated using standards whose accuracies are traceable to the National Institute of Standards and Technology (N.I.S.T.) according to our procedures.

All traceable certifications and related procedures for the equipment used are on file.

Barometer Number:	n/a
Vol-U-Meter Number:	Base 1920 Cell 1898
Type of Gas:	N2
Gas Used for Calibration:	N2
Pressure Gauge Number:	1122
Timer Number:	n/a
Thermometer Number:	n/a
Voltmeter:	NA
Calibrated By:	[redacted]
Date Calibrated:	9-1-13

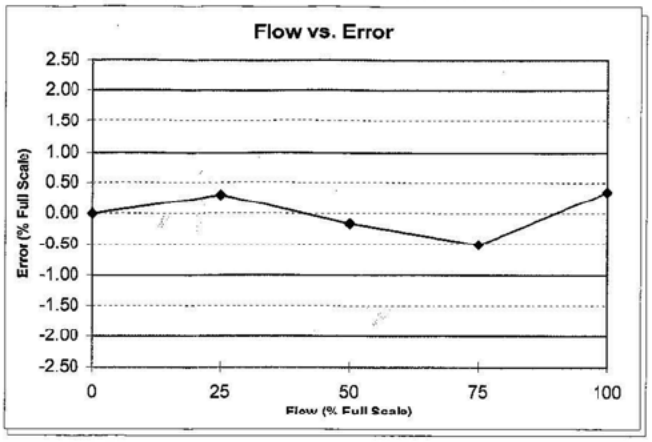
Uncertainty of measurements: +/- 0.3 % of reading

Calibrations were performed under a controlled Quality System Manual, which incorporates the requirements of ISO Guide 25, ISO 10012-1, ISO 9001 (1994) and ISO 13485. The released ISO 13485 registration (Medical Devices – Quality Management Systems – System Requirements for Regulatory Purposes) includes Design Controls and Metrology Systems.

0122220B FM-1011 REV B

OMEGA ENGINEERING, INC.
An OMEGA Technologies Company
ONE OMEGA DRIVE, BOX 4047, STAMFORD, CT, U.S.A. 06907-0047
(203) 359-1660 TELEX: 995404 CABLE OMEGA FAX: (203) 359-7700
http://www.omega.com e-mail: info@omega.com

Mass Flowmeter/Flow Controller Calibration Data Sheet



Calibration Data

Setpoint (SLPM)	Flow Signal (Volts)	Device Flow (SLPM)	Actual Flow (SLPM)	% FS Error * (%)
00.00	0.000	00.00	00.00	0.00
05.00	1.253	05.01	05.07	0.30
10.00	2.502	10.01	09.98	-0.16
15.00	3.752	15.01	14.91	-0.50
20.00	5.000	20.00	20.07	0.35

* % Full Scale (FS) Error = (100)(Actual Flow - Device Flow) / Full Scale Flow

DATE	2/1/2013
TIME	7:59:59 AM
Shop Order No.	427005
Serial No.	4270050001001

GAS

Nameplate (Actual)	Nitrogen
Surrogate (Calibration)	Nitrogen (N2)

STANDARD CONDITIONS

Std. Pressure	101.32 kPa (760 Torr)
Std. Temperature	21.1 °C

PRESSURE

Inlet (P_1)	20 PSIG
Outlet (P_2)	N/A

TEMPERATURE

Calib. Temperature	21.9 °C
Oper. Temperature	70 °F

Max. Flow Rate	20 SLPM
Gas Factor	1

Calibrator	MT
Flow Standard	PICO 1898-1
Unit Accuracy	1.0 FS & 0.0 Rate
Calib. Attitude	Horizontal (base down)

LEAK TEST DATA

Inboard (Externally Pressurized) Helium Leak Rate: < 1 x 10^{-8} atm cc/sec
Vacuum Pressure: < 5 milliTorr

Tested By: [redacted] **Date:** 2-1-13

FM-1119 Rev. K

OMEGA ENGINEERING, INC.
An OMEGA Technologies Company
ONE OMEGA DRIVE, BOX 4047, STAMFORD, CT, U.S.A. 06907-0047
(203) 359-1660 TELEX: 996404 CABLE: OMEGA FAX: (203) 359-7700
http://www.omega.com e-mail: info@omega.com

CERTIFICATE OF ACCURACY

This is to certify that meter serial number 427005000300l is certified to an accuracy of +/- 1 % of 200 slpm of N2 and has been calibrated using standards whose accuracies are traceable to the National Institute of Standards and Technology (N.I.S.T.) according to our procedures.

All traceable certifications and related procedures for the equipment used are on file.

Barometer Number:	1667
Vol-U-Meter Number:	613
Type of Gas:	N2
Gas Used for Calibration:	N2
Pressure Gauge Number:	1950
Timer Number:	1876
Thermometer Number:	985
Voltmeter:	NA
Calibrated By:	[redacted]
Date Calibrated:	2-7-13

Uncertainty of measurements: +/- 0.3 % of reading

Calibrations were performed under a controlled Quality System Manual, which incorporates the requirements of ISO Guide 25, ISO 10012-1, ISO 9001 (1994) and ISO 13485. The released ISO 13485 registration (Medical Devices – Quality Management Systems – System Requirements for Regulatory Purposes) includes Design Controls and Metrology Systems.

0122220B FM-1011 REV B

OMEGA ENGINEERING, INC.
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MASS FLOWMETER/FLOW CONTROLLER CALIBRATION DATA SHEET

SPECIFICATIONS

MODEL #: FMA-875A-V-NIST

SERIAL #: 4270050003001

FLOW RANGE: 200 SLPM

OPERATING TEMPERATURE: 70 F

NAMEPLATE (PROCESS) GAS: N2

SURROGATE (CALIBRATION) GAS: N2

STANDARD TEMPERATURE: 21.1 C

STANDARD PRESSURE: 101.32 kPa (760 Torr)

P1 (INLET PRESSURE): 20 PSIG

P2 (OUTLET PRESSURE): N/A

CALIBRATION TEMPERATURE: 18.7 C

CALIBRATION ATTITUDE (calibration attitude checked):

- ☒ Horizontal (base down)
- ☐ Horizontal (upside down)
- ☐ Horizontal (front down)
- ☐ Horizontal (back down)
- ☐ Vertical (inlet up)
- ☐ Vertical (inlet down)

CALIBRATION ACCURACY: ± 1 % OF FULL SCALE FLOW

CALIBRATION DATA

% FULL SCALE (Nominal)	FLOW SIGNAL OUTPUT (signal type checked) ☒ Vdc ☐ mAdc	STANDARD VOLUMETRIC FLOW (Units: SLPM)		ERROR * (% Full Scale)
		DEVICE	MEASURED	
100	5.000	200.000	200.079	.5395
75	3.750	150.000	149.317	-.3415
50	2.500	100.000	100.488	.2440
25	1.250	50.000	50.852	.4260
0	0.00	0.000	0.000	-----

* % FULL SCALE ERROR = (100) (MEASURED FLOW - DEVICE FLOW) ÷ FULL SCALE FLOW

CALIBRATED BY: [redacted] DATE: 2-7-13

LEAK TEST DATA

INBOARD (EXTERNALLY-PRESSURIZED) HELIUM LEAK RATE: $<1 \times 10^{-8}$ atm cc/sec

VACUUM PRESSURE: <5 millitorr

TESTED BY: [redacted] DATE: 2-1-13

FM-355-OE Rev. 0

[redacted] 5/15/13

ilac-MRA ACCREDITED Calibration Certificate No. 1750.01

Calibration complies with ISO 9001 ISO/IEC 17025 AND ANSI/NCSL Z540-1

Cert. No.: 1042-4689088

Traceable® Certificate of Calibration for Waterproof Stopwatch

Manufactured for and distributed by: Fisher Scientific, 300 Industry Drive, Pittsburgh, PA 15275-1001

Instrument Identification:

Model Numbers: 0666256, FB70240 S/N: 122601005 Manufacturer: Control Company

Standards/Equipment:

Description	Serial Number	Due Date	NIST Traceable Reference
Non-contact Frequency Counter	26.6 2025	3/06/13	1000313632

Certificate Information:

Technician: 67 Procedure: CAL-01 Cal Date: 10/23/12 **Cal Due: 10/23/14**

Test Conditions: 22.5°C 45.0 %RH 1015 mBar

Calibration Data: (New Instrument)

Unit(s)	Nominal	As Found	In Tol	Nominal	As Left	In Tol	Min	Max	±U	TUR
Sec/24hr		N.A.		0.000	-0.600	Y	-8.640	8.640	0.130	>4:1

This Instrument was calibrated using Instruments Traceable to National Institute of Standards and Technology.

A Test Uncertainty Ratio of at least 4:1 is maintained unless otherwise stated and is calculated using the expanded measurement uncertainty. Uncertainty evaluation includes the instrument under test and is calculated in accordance with the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM). The uncertainty represents an expanded uncertainty using a coverage factor k=2 to approximate a 95% confidence level. In tolerance conditions are based on test results falling within specified limits with no reduction by the uncertainty of the measurement. The results contained herein relate only to the item calibrated. This certificate shall not be reproduced except in full, without written approval of Control Company.

Nominal=Standard's Reading; As Left=Instrument's Reading; In Tol=In Tolerance; Min/Max=Acceptance Range; ±U=Expanded Measurement Uncertainty; TUR=Test Uncertainty Ratio; Accuracy=±(Max-Min)/2; Min = Nominal(Rounded) - Tolerance; Max = Nominal(Rounded) + Tolerance; Date=MM/DD/YY

[redacted] Nicol Rodriguez, Quality Manager [redacted] Technical Manager

Maintaining Accuracy:

In our opinion once calibrated your Waterproof Stopwatch should maintain its accuracy. There is no exact way to determine how long calibration will be maintained. Waterproof Stopwatchs change little, if any at all, but can be affected by aging, temperature, shock, and contamination.

Recalibration:

For factory calibration and re-certification traceable to National Institute of Standards and Technology contact Control Company.

CONTROL COMPANY 4455 Rex Road Friendswood, TX 77546 USA
Phone 281 482-1714 Fax 281 482-9448 service@control3.com www.control3.com

TEST ARTICLE ATTRIBUTE CHECKLIST

PROJECT NO: G101266224-005 **CLIENT :** AREVA

Project Description FIRE/PRESSURE #3 (USES P7 SCAB)

		SAT	UNSAT
I.	**ASSEMBLY**		
	Proper materials used	X	
	Material documentation complete	X	
	Configuration/dimensions in accordance w/ approved drawings	X	
	Description of assembly: FIRE/PRESSURE #3		
II.	**ELECTRICAL CABLE**		
	Correct material used	N/A	
	Material documentation complete		
	Correct cable lay-in and fill requirements		
	Description of electrical cable:		
III.	**THERMOCOUPLES**		
	Correct thermocouple type, certs received	X	
	Thermocouples positioned in accordance with test plan	X	
	Adequately labeled and secured	X	
	Quality Assurance verification done	X	
	Description of thermocouples: TYPE K		
IV.	**FIRE BARRIER**		
	Name or type of material VARIOUS		
	INTERTEK received material documentation provided by Client	X	
	Materials provided by INTERTEK properly documented	X	
	Materials installed by INTERTEK in accordance with test plan	X	
	INTERTEK Quality Assurance responsibilities determined	X	
	QA responsibilities of Client installation determined	X	
	Moisture check required ..... Yes ___ No X		
	Special requirements		

V. FINAL PREBURN VERIFICATION

Final visual inspection & approval (initials) INTERTEK [redacted] Client [redacted]

CALIBRATION DOCUMENTATION (S/N and calibration due date)

Data Acquisition Equipment: SEE TEST DATA PACKAGE

Other Measurement Devices:

Temperature 66 Humidity 68 Date 11-15-13 Time of Test start 10:40 AM

INTERTEK pre-burn checklist performed by [redacted]

Client representative present to witness test [redacted]

Note: Verification to be made using initials by INTERTEK Quality Assurance or test personnel.

09-013-12/30/03

TEST ARTICLE ATTRIBUTE CHECKLIST

PROJECT NO: G101266224-005B **CLIENT:** AREVA

Project Description FIRE PRESSURE 3 (USES SLAB FROM PT 7 & 5)

		SAT	UNSAT
I.	**ASSEMBLY**		
	Proper materials used	X	
	Material documentation complete	X	
	Configuration/dimensions in accordance w/ approved drawings	X	
	Description of assembly: MOX FIRE PRESSURE 3 POST FIRE → PRESSURE TEST		
II.	**ELECTRICAL CABLE**		
	Correct material used	N/A	
	Material documentation complete		
	Correct cable lay-in and fill requirements		
	Description of electrical cable:		
III.	**THERMOCOUPLES**		
	Correct thermocouple type, certs received	N/A	
	Thermocouples positioned in accordance with test plan		
	Adequately labeled and secured		
	Quality Assurance verification done		
	Description of thermocouples:		
IV.	**FIRE BARRIER**		
	Name or type of material DC120, QS:1, DC732, DC790		
	INTERTEK received material documentation provided by Client	X	
	Materials provided by INTERTEK properly documented	X	
	Materials installed by INTERTEK in accordance with test plan	X	
	INTERTEK Quality Assurance responsibilities determined	X	
	QA responsibilities of Client installation determined	X	
	Moisture check required ..... Yes ___ No X		
	Special requirements		

V. FINAL PREBURN VERIFICATION

Final visual inspection & approval (initials) INTERTEK [redacted] Client [redacted]

CALIBRATION DOCUMENTATION (S/N and calibration due date)

Data Acquisition Equipment: ~~SEE TEST DATA PACKAGE~~

Other Measurement Devices:

Temperature 68 Humidity 46 Date 11-19-13 Time of Test start 1120

INTERTEK pre-burn checklist performed by [redacted]

Client representative present to witness test [redacted]

Note: Verification to be made using initials by INTERTEK Quality Assurance or test personnel.

09-013-12/30/03

Intertek

TEST ACTIVITIES EVENT LOG

Note:
This Log is used to document the date and note the significant events during the completion of Test Project #G101266224SAT-005 for AREVA NP, Inc.

Page 1 of 1

ITEM	DATE	INIT'L
Concrete poured by Alamo Concrete	9/3/13	MD
Concrete conditioned	9/9/13	MD
Critical attributes of test slab verified	9/24/13	MD
Seals poured	9/24/13	MD
Completed seal assembly verified against the test plan	9/25/13	MD
Pressure Test #7 stage 1a-4a conducted on the top side	9/30/13	MD
Pressure Test #7 stage 5a conducted on the top side	10/1/13	MD
Seismic Test #5 conducted on re-purposed assembly used in Pressure Test #7	10/1/13	MD
Assembly re-purposed for Fire-Pressure Test #3	10/1/13	MD
Thermocouples installed and locations verified against the test plan	11/14/13	MD
Fire-Pressure Test #3 (Fire Test) conducted	11/15/13	MD
Fire-Pressure Test #3 (Pressure Test) conducted	11/19/13	MD

9/12 NQAP-007.7.3

Certificate of Conformance

Client Name: AREVA NP Inc. Date: September 4, 2014

Project No: G101266224SAT-005

Intertek Testing Services NA (Intertek) has conducted testing for AREVA NP Inc., on the fire and pressure resistance capabilities of Unifrax Fiberfrax® Durablanket® S (Durablanket), Dow Corning® Sylgard® 170 Silicone Elastomer (DC-170), Quantum Silicones QSil 5558MC Silicone Elastomer (QSil 5558MC), Dow Corning® 732 Multi-Purpose Sealant (DC-732) and Dow Corning® 790 Silicone Building Sealant (DC-790) through a 12" thick concrete deck for compliance with the applicable requirements of and in accordance with AREVA NP Inc. Document No. 51-9213021-000, *Detailed Test Plan for Conducting MOX Fire-Pressure Test 3*. This test took place on November 15 through November 19, 2013.

The materials, processes), and deliverable(s) in this project were managed under and conform to the test laboratory's 10CFR50 Appendix B Quality Assurance Program.

[redacted]

Michael A Brown
Quality Supervisor

September 4, 2014
Date

Intertek Testing Laboratory
16015 Shady Falls Road, Elmendorf TX 78112
210-635-8100

Quality Assurance Statement

Intertek is devoted to engineering, inspection, quality assurance and testing of building materials, products and assemblies. Intertek has developed and implemented a Quality Assurance Program designed to provide its clients with a planned procedure of order and document processing for inspection and testing services it provides to assure conformity to requirements, codes, standards and specifications. The Program is designed to meet the intent of ANSI 45.2 Quality Assurance Program Requirements for Nuclear Power Plants, and complies with the requirements of the ASME Code, SPPE, Military Standards and other less stringent programs. It is the Laboratory's intention to adhere strictly to this Program, to assure that the services offered to its clients remains of the highest quality and accuracy possible.

All QA Surveillance documents remain on file at the Laboratory, and are available for inspection by authorized personnel in the performance of an on-site QA Audit. All materials, services and supplies used herein were obtained with appropriate QA Certifications of Compliance.

REVISION SUMMARY

DATE	SUMMARY
September 4, 2014	Original Issue Date