TEST REPORT

Accepted for Use

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RENDERED TO

AREVA NP Inc.
4100 International Plaza
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AREVA	AREVA NP Inc.
	58-9224208-000

PRODUCTS EVALUATED: Dow Corning® Sylgard 170 Silicone Elastomer, Quantum Silicones QSil 5558MC Silicone Elastomer and Dow Corning® 790 Silicone Building Sealant

EVALUATION PROPERTY: Fire and Pressure Resistance (Fire-Pressure Test 5)

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. 51-9218186-000, *Detailed Test Plan for Conducting MOX Fire-Pressure Test 5.*

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 Dow Corning® Sylgard 170 Silicone Elastomer (DC-170), Quantum Silicones QSil 5558MC Silicone Elastomer (QSil 5558MC) 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. 51-9218186-000, *Detailed Test Plan for Conducting MOX Fire-Pressure Test 5.* This test took place February 13 through February 18, 2014.

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 11 without any changes. Refer to AREVA Doc. 58-9224202-000 or Intertek Test Report No. 101276459SAT-019 for details on Pressure Test 11.

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 three shipments: June 21 and November 7, 2013 and January 7, 2014**.** 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
DC-790	0007643997	11/29/2014
QSil 5558 MC	131014	11/4/2014

Information regarding receiving dates and origin of all the materials in the assembly can be found in Appendix F: Quality Documents of Pressure Test 11 (Intertek Test Report 101276459SAT-019; AREVA Doc. 58-9224202-000). All samples were received in good condition at the Evaluation Center.

3.2. SAMPLE AND ASSEMBLY DESCRIPTION

The assembly used in this test was the same assembly tested as Pressure Test 11, and then tested again as Seismic Pressure Test 9, before finally being repurposed for Fire-Pressure Test 5.

A detailed description of the concrete deck and penetrations can be found in AREVA NP Inc. Document No. 51-9218186-000 *Detailed Test Plan for Conducting MOX Fire-Pressure Test 5*

which is contained in Appendix E, For assembly drawings, refer to the final report for Pressure Test 11 (Intertek Test Report No. 101276459SAT-019; AREVA Doc. 58-9224202-000). 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).

The openings sealed and tested in Fire-Pressure Test 5 were 14" x 20" blockouts in the test deck lined with ABC wall material (Structo-Crete).

Penetration P1 - Test penetration P1 was a 14" x 20" concrete opening containing no penetrating items. Structo-Crete panels were installed within the opening. Structo-Crete panels are generally provided with one side smoother than the other (as a result of the manufacturing process). Two sides of the penetration were lined with the smoother side of the Structo-Crete panels facing the seal material and two sides with the smoother side facing away. This penetration was sealed with an 8" depth of Dow Corning Sylgard® 170 Silicone Elastomer (DC-170) with no permanent damming.

Penetration P2 - Test penetration P2 was a 14" x 20" concrete opening containing no penetrating items. Structo-Crete panels were installed within the opening. Structo-Crete panels are generally provided with one side smoother than the other (as a result of the manufacturing process). Two sides of the penetration were lined with the smoother side of the Structo-Crete panels facing the seal material and two sides with the smoother side facing away. This penetration was sealed with an 8" depth of Quantum Silicones QSil 5558MC Silicone Elastomer (QSil 5558MC) with no permanent damming.

While not described in the test plan, the following application of DC-790 was made to enhance the pressure tightness of the Structo-Crete-to-concrete and Structo-Crete-to-Structo-Crete interfaces of the test assembly. Prior to installation of the Structo-Crete panels, two (approximate ½") beads of DC-790 were applied circumferentially near the midpoint of the concrete penetrations. The Structo-Crete panels were then anchored into place and a fillet of DC-790 was applied to the vertical seams between panels to ensure that the elastomer material didn't leak through the gaps. Finally, a fillet of DC-790 was applied around the perimeter of the Structo-Crete-to-concrete interface above and below the slab. The DC-790 did not affect the elastomer-to-Structo-Crete adherence, but was installed to improve Structo-Crete-to-concrete pressure resistance.

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 5. 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 5 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

Five (5) 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

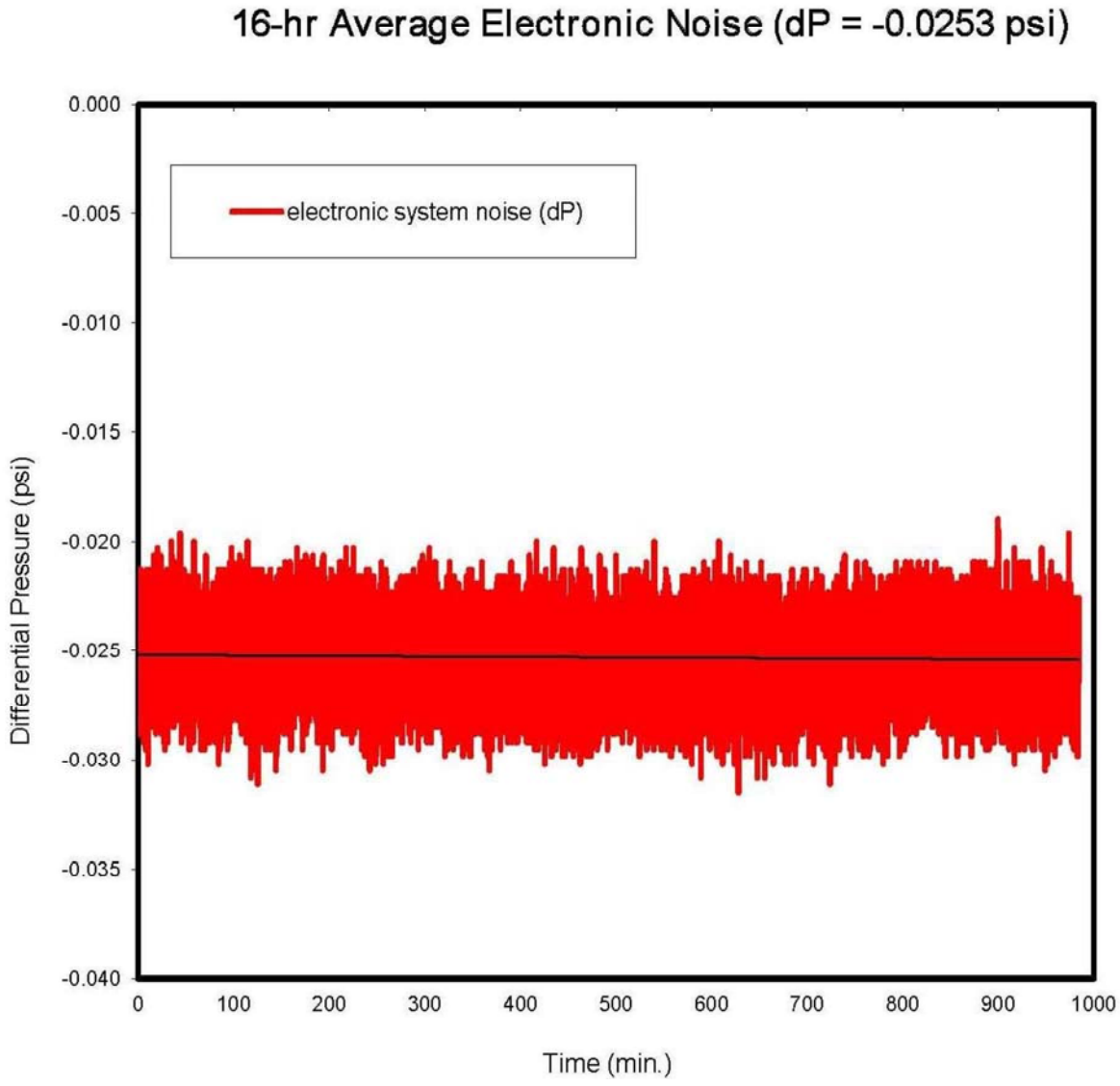
Omega Engineering, Inc., Stamford, CT
Model No. FMA-875A-V-NIST
Serial No. 4270050003001
0-200 lpm

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. 51-9218186-000, *Detailed Test Plan for Conducting MOX Fire-Pressure Test 5*.

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 inches 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' x 7') horizontal furnace on February 13, 2014. Scott Groesbeck from AREVA was present to witness the test. The ambient temperature at the start of the test was 57°F, with a relative humidity of 49%.

The furnace was fired at 11:10 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 the unexposed 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 prior to conducting the subsequent pressure test.

Following the fire test, it was observed that the exposed side of both penetrations showed signs of minor seal charring (~1/4"-1/2").

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 exposed side of 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 11:25 a.m. on February 18, 2014. Scott Groesbeck representing AREVA NP Inc. was present to witness the test. The ambient temperature at the start of the test was 72°F, with a relative humidity of 73%.

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. Leakage was detected and is described below:

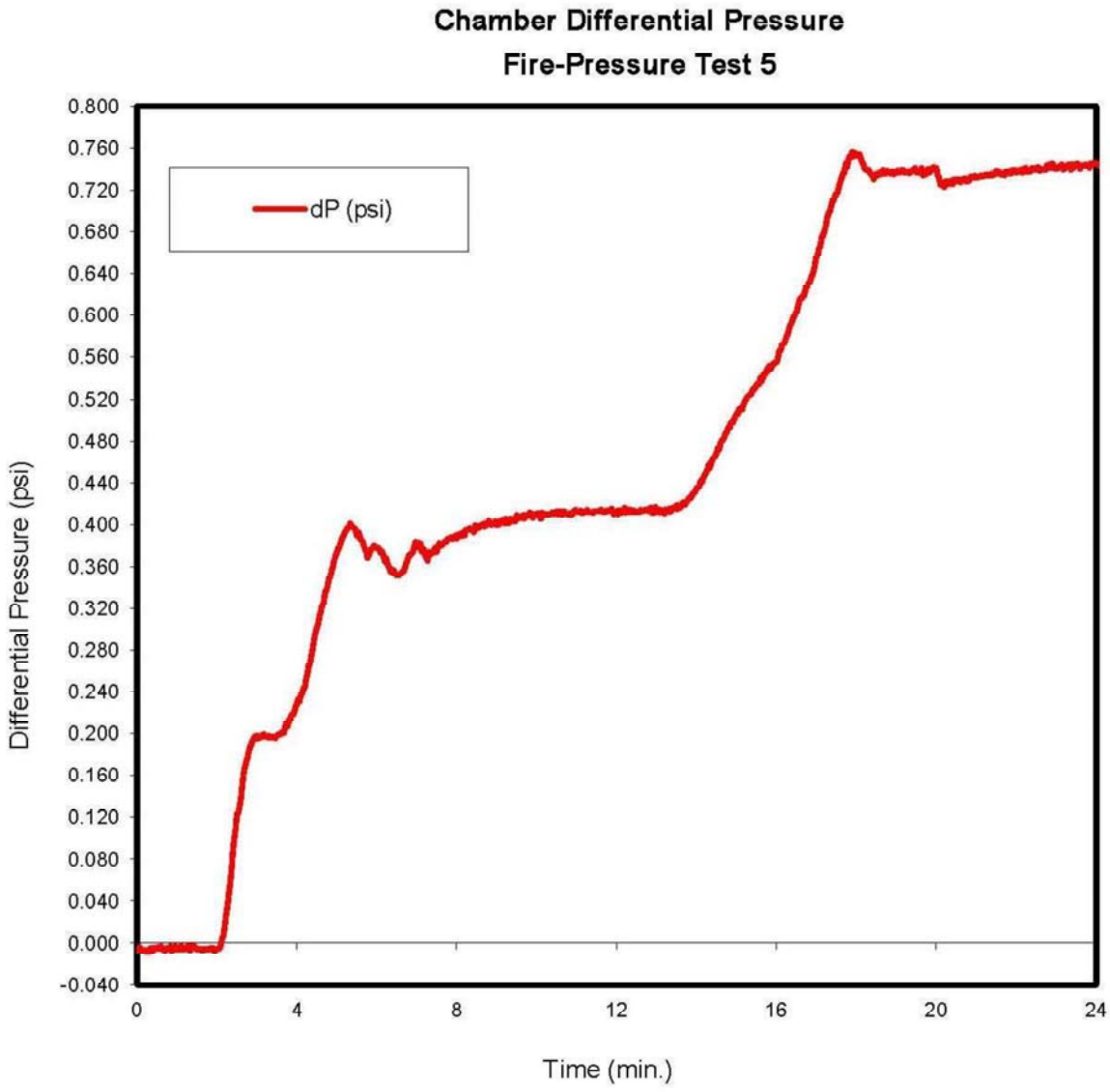
Stage 1 (10" WC): Penetration 1 has minor leakage at two corners of the seal where it interacts with the DC-790 caulk at the Structo-Crete, and at 1 screw location in the Structo-Crete (not part of the penetration seal assembly).

Penetration 2 has leaks but they are only at screw locations (not part of the penetration seal assembly).

Stage 2 (20" WC): Both penetrations have the same leakage points as observed during Stage 1.

The graph and table on the following page(s) provide a summary of results and observations for the two pressure stages.

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



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
  - There was a char layer approximately ¼-½" thick on the surface but no cracks or through openings present.
- 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.
- Condition of seal to barrier interface
  - No visual changes were observed.
- Condition of seal to penetrating item interfaces
  - There were no penetrating items.

6 Conclusion

Intertek Testing Services NA (Intertek) has conducted testing for AREVA NP Inc., on the fire and pressure resistance capabilities of Dow Corning® Sylgard 170 Silicone Elastomer (DC-170), Quantum Silicones QSil 5558MC Silicone Elastomer (QSil 5558MC) 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. 51-9218186-000, *Detailed Test Plan for Conducting MOX Fire-Pressure Test 5.* This evaluation took place February 13 through February 18, 2014.

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: 

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Reviewed by: 

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Quality Supervisor

APPENDIX A
Assembly Drawings

Fire-Pressure Test 5 was the same assembly constructed and first tested as Pressure Test 11. For detailed drawings of the test assembly please refer to Intertek Test Report No. 101246459SAT-019; AREVA Doc. 58-9224202-000.

APPENDIX B
Thermocouple Layout

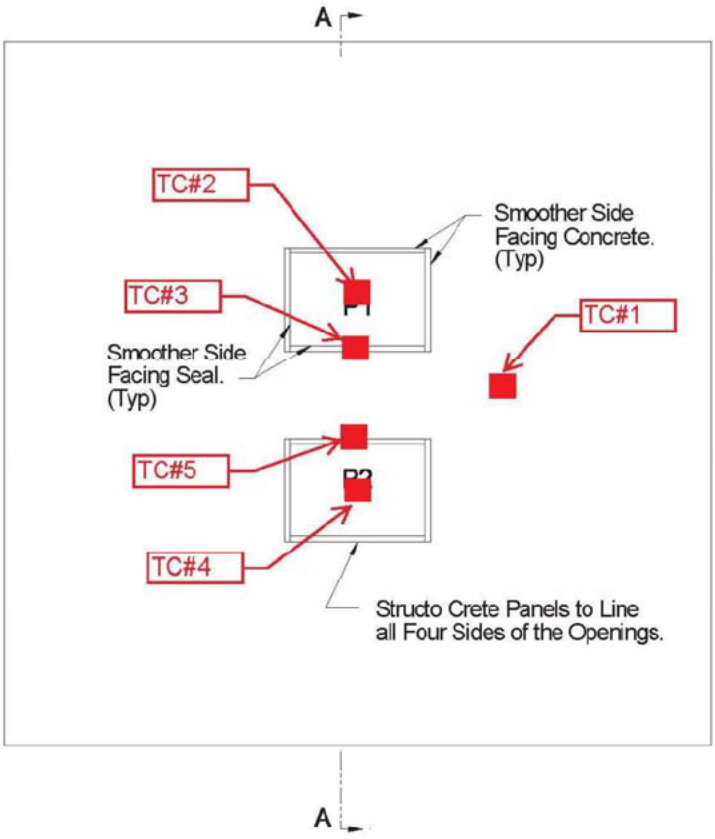
Fire-Pressure 5 TC Locations

Pen. No.	TC No.	TC Location	Mark No.
SLAB	TC#1	Surface - Test Slab	
Pen 1	TC#2	Surface - DC-170	
Pen 1	TC#3	Interface - Sructo-Crete 1" Above Seal	
Pen 2	TC#4	Surface - QSil 5558MC	
Pen 2	TC#5	Interface - Sructo-Crete 1" Above Seal	

AREVA

Document No.: 51-9215844-000

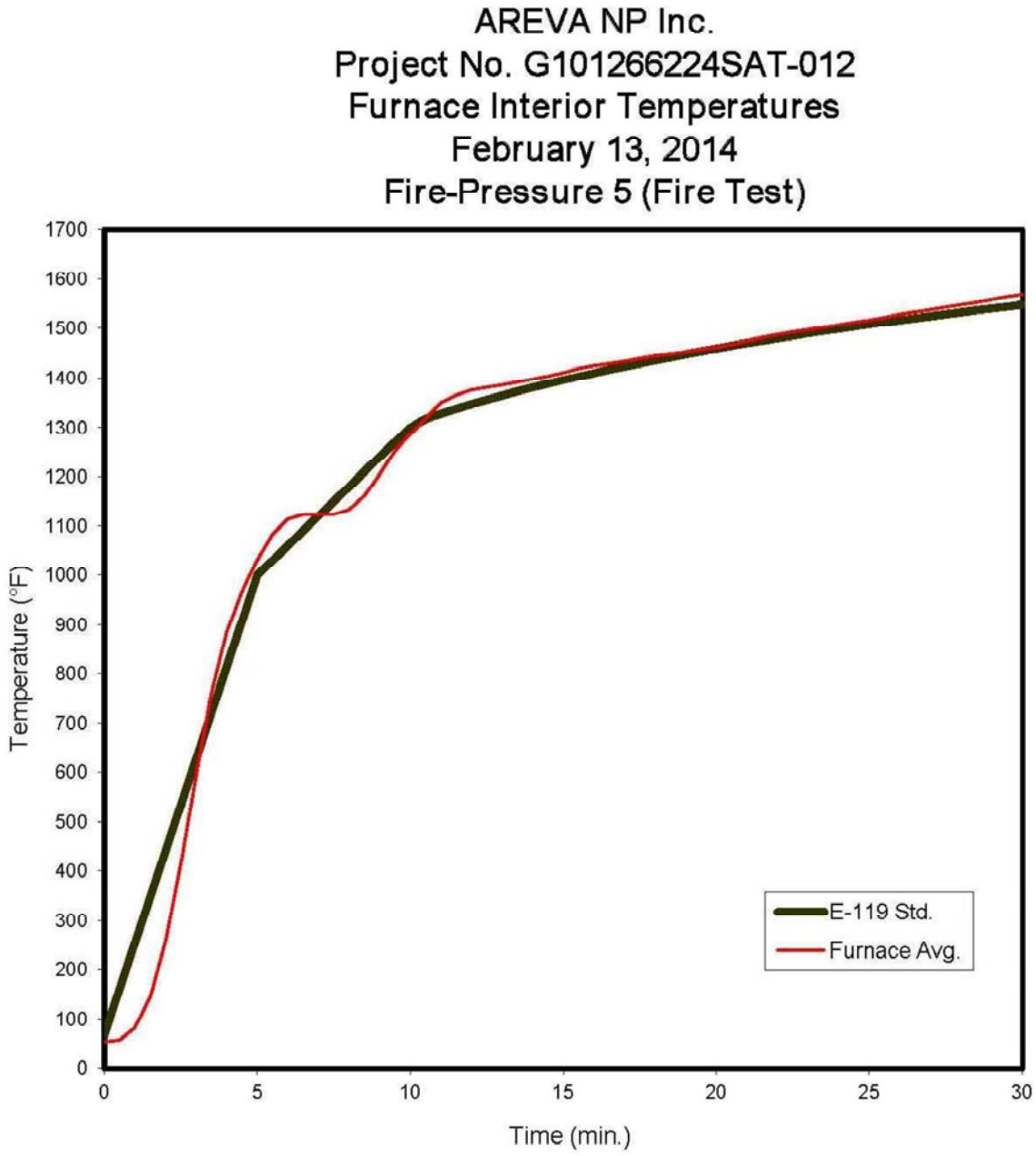
Pressure Test 11



NOTES:

1. TOLERANCE ON ALL SLAB DIMENSIONS IS +/- 1/4"
2. * INDICATES DIMENSIONS TO BE VERIFIED BY AREVA QC.
3. SEE PAGE B-3 FOR SECTION A - A.

APPENDIX C1
Temperature Data


AREVA NP Inc.
Project No. G101266224SAT-012
Furnace Interior Temperatures
February 13, 2014
Fire-Pressure 5 (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-012 February 13, 2014

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)	TC #2 (°F)	TC #3 (°F)	TC #4 (°F)	TC #5 (°F)
0	68	55	50	50	54	65	0.067	3.232	51	52	53	52	54
0.5	161	58	52	53	57	71	-0.069	1.871	51	52	53	52	54
1	254	83	66	76	85	105	-0.080	1.758	51	52	53	52	54
1.5	348	144	106	136	151	184	-0.202	0.545	51	52	53	53	54
2	441	256	188	242	266	327	-0.081	1.749	51	52	53	52	54
2.5	534	414	307	391	420	538	-0.011	2.455	51	52	53	53	54
3	627	594	462	560	590	762	-0.017	2.388	51	52	53	52	54
3.5	720	761	636	715	752	939	-0.040	2.157	51	52	53	52	53
4	814	885	792	828	878	1041	-0.079	1.772	51	52	53	53	54
4.5	907	968	909	904	957	1100	-0.033	2.231	51	52	53	53	53
5	1000	1031	1003	960	1008	1153	0.009	2.649	51	52	53	52	53
5.5	1030	1082	1079	1006	1050	1194	-0.017	2.387	51	52	53	52	53
6	1060	1113	1126	1040	1085	1201	-0.082	1.739	51	52	53	53	53
6.5	1090	1123	1144	1060	1100	1186	-0.102	1.54	51	52	53	53	53
7	1120	1124	1148	1073	1106	1168	-0.066	1.901	51	52	53	53	53
7.5	1150	1123	1147	1084	1108	1153	-0.004	2.519	51	52	53	52	53
8	1180	1133	1148	1101	1121	1163	-0.011	2.448	51	52	53	52	53
8.5	1210	1162	1173	1122	1143	1208	-0.024	2.321	51	52	53	52	53
9	1240	1205	1217	1156	1177	1269	0.020	2.762	51	52	53	53	53
9.5	1270	1253	1269	1198	1215	1328	0.007	2.627	51	52	53	53	53
10	1300	1287	1313	1225	1241	1367	-0.071	1.854	51	52	53	52	53
10.5	1317	1318	1351	1253	1265	1402	0.000	2.559	51	52	53	52	53
11	1328	1350	1392	1277	1300	1432	-0.019	2.368	51	52	53	53	53
11.5	1337	1365	1416	1291	1313	1439	0.013	2.693	51	52	53	52	53
12	1347	1376	1432	1302	1324	1445	-0.018	2.378	51	52	53	53	53
12.5	1356	1381	1444	1309	1326	1445	-0.007	2.486	51	52	53	52	53
13	1364	1386	1453	1313	1329	1447	0.000	2.555	51	52	53	53	53
13.5	1373	1392	1461	1320	1335	1450	-0.006	2.496	51	52	53	53	53
14	1381	1398	1468	1327	1342	1455	-0.026	2.303	51	52	53	53	53
14.5	1388	1404	1475	1333	1348	1460	-0.011	2.449	51	52	53	53	53
15	1396	1411	1483	1341	1356	1465	-0.004	2.517	51	52	53	53	53
15.5	1403	1419	1490	1350	1364	1473	-0.011	2.453	51	52	53	53	53
16	1410	1425	1495	1357	1373	1475	-0.037	2.186	51	52	53	53	53
16.5	1417	1429	1498	1363	1380	1476	-0.018	2.377	51	52	53	53	53
17	1424	1434	1501	1370	1387	1479	0.011	2.672	51	53	53	53	53
17.5	1430	1440	1504	1378	1394	1483	-0.005	2.509	51	53	53	53	53
18	1436	1445	1507	1384	1402	1487	-0.040	2.163	51	53	53	53	53
18.5	1442	1449	1510	1389	1406	1490	0.019	2.751	51	53	54	53	53
19	1448	1453	1515	1393	1409	1493	0.011	2.67	51	53	53	53	54
19.5	1454	1458	1519	1399	1415	1498	-0.010	2.457	51	53	54	53	54
20	1459	1462	1523	1403	1418	1502	0.008	2.64	51	53	54	53	53
20.5	1465	1468	1529	1409	1425	1508	-0.002	2.541	51	53	54	53	54
21	1470	1475	1536	1417	1431	1514	-0.008	2.477	52	53	54	53	54
21.5	1475	1482	1542	1425	1440	1520	-0.004	2.522	52	53	54	53	54
22	1480	1488	1547	1432	1447	1524	-0.015	2.409	51	53	54	53	54
22.5	1485	1493	1552	1438	1454	1529	0.016	2.723	51	53	54	53	54
23	1490	1498	1557	1444	1459	1532	-0.032	2.244	52	53	54	53	54

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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)	TC #2 (°F)	TC #3 (°F)	TC #4 (°F)	TC #5 (°F)
23.5	1495	1503	1560	1450	1466	1536	-0.058	1.982	52	53	54	53	54
24	1499	1508	1563	1456	1473	1540	-0.017	2.39	52	53	54	53	54
24.5	1504	1513	1567	1463	1479	1543	-0.010	2.461	52	53	54	54	54
25	1508	1517	1570	1469	1485	1545	-0.030	2.264	52	53	54	54	54
25.5	1513	1523	1573	1477	1493	1550	-0.014	2.422	52	53	54	54	54
26	1517	1529	1576	1484	1500	1555	-0.008	2.477	52	53	54	54	54
26.5	1521	1534	1580	1489	1504	1561	-0.025	2.313	52	53	54	54	54
27	1525	1539	1585	1495	1509	1565	0.006	2.619	52	53	55	54	54
27.5	1529	1544	1590	1501	1513	1570	-0.033	2.23	52	53	55	54	54
28	1533	1548	1595	1505	1518	1575	-0.026	2.303	52	53	55	54	54
28.5	1537	1553	1599	1511	1523	1580	-0.015	2.408	52	53	55	54	54
29	1541	1559	1604	1518	1530	1585	-0.010	2.459	52	53	55	54	54
29.5	1545	1564	1609	1524	1536	1588	-0.012	2.442	52	53	55	54	54
30	1549	1569	1614	1528	1540	1594	-0.048	2.079	52	53	55	54	54

APPENDIX C2
Pressure Data

AREVA NP Inc. Project No. G101266224SAT-012 February 18, 2014

Time (min)	Ch 1 dP (psi)	Ch 2 High Flow (LPM)	Ch 3 Low Flow (LPM)	Total Flow (LPM)
0	-0.0072	0.0198	0	0.0198
0.0333	-0.0082	0	0	0
0.0667	-0.0036	0	0	0
0.1	-0.0075	0	0	0
0.1333	-0.0078	0	0.0008	0.0008
0.1667	-0.0078	0	0.0008	0.0008
0.2	-0.0065	0	0	0
0.2333	-0.0092	0.0067	0	0.0067
0.2667	-0.0075	0	0	0
0.3	-0.0092	0	0	0
0.3333	-0.0042	0.0067	0.0008	0.0075
0.3667	-0.0075	0.0067	0.0008	0.0075
0.4	-0.0075	0	0.0008	0.0008
0.4333	-0.0042	0	0.0008	0.0008
0.4667	-0.0049	0.0198	0	0.0198
0.5	-0.0036	0	0.0008	0.0008
0.5333	-0.0055	0	0.0008	0.0008
0.5667	-0.0046	0	0	0
0.6	-0.0026	0.0067	0	0.0067
0.6333	-0.0059	0	0.0008	0.0008
0.6667	-0.0062	0	0	0
0.7	-0.0075	0.0067	0.0008	0.0075
0.7333	-0.0046	0	0.0008	0.0008
0.7667	-0.0059	0	0.0008	0.0008
0.8	-0.0059	0	0.0008	0.0008
0.8333	-0.0029	0	0.0008	0.0008
0.8667	-0.0075	0	0	0
0.9	-0.0055	0	0	0
0.9333	-0.0032	0	0	0
0.9667	-0.0032	0	0	0
1	-0.0062	0.0067	0	0.0067
1.0333	-0.0039	0.0067	0	0.0067
1.0667	-0.0062	0	0	0
1.1	-0.0029	0	0	0
1.1333	-0.0062	0	0	0
1.1667	-0.0059	0	0.0021	0.0021
1.2	-0.0052	0	0.0008	0.0008
1.2333	-0.0039	0.0067	0	0.0067
1.2667	-0.0026	0.0067	0	0.0067
1.3	-0.0062	0	0.0021	0.0021
1.3333	-0.0072	0.0198	0.0008	0.0206
1.3667	-0.0026	0.0067	0.0008	0.0075
1.4	-0.0046	0	0	0
1.4333	-0.0022	0	0.0008	0.0008

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Time (min)	Ch 1 dP (psi)	Ch 2 High Flow (LPM)	Ch 3 Low Flow (LPM)	Total Flow (LPM)
1.4667	-0.0042	0.0067	0	0.0067
1.5	-0.0059	0.0067	0	0.0067
1.5333	-0.0049	0.0067	0.0008	0.0075
1.5667	-0.0052	0.0067	0	0.0067
1.6	-0.0069	0.0198	0	0.0198
1.6333	-0.0055	0.0067	0	0.0067
1.6667	-0.0072	0	0.0008	0.0008
1.7	-0.0049	0	0.0008	0.0008
1.7333	-0.0059	0	0	0
1.7667	-0.0059	0	0.0008	0.0008
1.8	-0.0065	0	0.0008	0.0008
1.8333	-0.0046	0.0067	0.0008	0.0075
1.8667	-0.0055	0	0	0
1.9	-0.0046	0	0	0
1.9333	-0.0078	0	0	0
1.9667	-0.0065	0	0	0
2	-0.0052	0	0	0
2.0333	-0.0052	0.0067	0	0.0067
2.0667	-0.0049	0.0067	0	0.0067
2.1	-0.0016	0	0	0
2.1333	0.0047	0.0198	0.0008	0.0206
2.1667	0.007	0	0	0
2.2	0.0172	0.0198	0	0.0198
2.2333	0.0274	0.0067	0	0.0067
2.2667	0.0363	0.0067	0	0.0067
2.3	0.0471	0	0.0008	0.0008
2.3333	0.0563	0	0	0
2.3667	0.0721	0.0067	0	0.0067
2.4	0.0876	0	0	0
2.4333	0.0988	0.0067	0	0.0067
2.4667	0.11	0	0	0
2.5	0.1238	0.0067	0.0008	0.0075
2.5333	0.1242	0	0	0
2.5667	0.1314	0	0	0
2.6	0.1383	0.0067	0.0008	0.0075
2.6333	0.1502	0.0067	0	0.0067
2.6667	0.1613	0.0067	0	0.0067
2.7	0.1686	0	0	0
2.7333	0.1735	0	0.0008	0.0008
2.7667	0.1768	0.0067	0.0008	0.0075
2.8	0.1841	0	0.0008	0.0008
2.8333	0.1877	0	0.0008	0.0008
2.8667	0.1903	0.0067	0	0.0067
2.9	0.1943	0.0067	0	0.0067

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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	0.1956	0.0067	0	0.0067
2.9667	0.1976	0	0	0
3	0.1979	0	0.0008	0.0008
3.0333	0.1953	0.0067	0	0.0067
3.0667	0.1962	0.0067	0	0.0067
3.1	0.1972	0.0067	0.0021	0.0088
3.1333	0.1976	0	0	0
3.1667	0.1995	0	0	0
3.2	0.1972	0	0	0
3.2333	0.1972	0	0.0021	0.0021
3.2667	0.1966	0.0067	0	0.0067
3.3	0.1976	0.0067	0	0.0067
3.3333	0.1959	0	0.0021	0.0021
3.3667	0.1969	0.0067	0.0008	0.0075
3.4	0.1962	0.0067	0	0.0067
3.4333	0.1966	0.0067	0	0.0067
3.4667	0.1956	0	0	0
3.5	0.1982	0.0067	0.0008	0.0075
3.5333	0.1992	0	0	0
3.5667	0.1992	0	0	0
3.6	0.1999	0	0	0
3.6333	0.2012	0.0198	0.0034	0.0232
3.6667	0.2005	0.0067	0.0008	0.0075
3.7	0.2041	0	0	0
3.7333	0.2094	0	0	0
3.7667	0.2068	0.0067	0	0.0067
3.8	0.213	0.0067	0.0021	0.0088
3.8333	0.212	0	0	0
3.8667	0.2183	0.0198	0.0008	0.0206
3.9	0.2183	0.0067	0	0.0067
3.9333	0.2199	0.0067	0	0.0067
3.9667	0.2252	0	0.0008	0.0008
4	0.2282	0	0	0
4.0333	0.2324	0.0067	0	0.0067
4.0667	0.2305	0	0.0008	0.0008
4.1	0.2374	0	0.0008	0.0008
4.1333	0.2384	0	0	0
4.1667	0.2433	0.0067	0	0.0067
4.2	0.2453	0	0.0008	0.0008
4.2333	0.2529	0.0067	0	0.0067
4.2667	0.2571	0	0	0
4.3	0.2647	0	0	0
4.3333	0.2683	0.0067	0	0.0067
4.3667	0.2759	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)
4.4	0.2818	0	0.0021	0.0021
4.4333	0.2907	0	0.0021	0.0021
4.4667	0.2973	0	0.0008	0.0008
4.5	0.3009	0.0198	0	0.0198
4.5333	0.3062	0	0.0008	0.0008
4.5667	0.3124	0.0067	0	0.0067
4.6	0.3164	0.0067	0.0008	0.0075
4.6333	0.322	0	0.0008	0.0008
4.6667	0.3249	0	0	0
4.7	0.3348	0	0	0
4.7333	0.3371	0	0.0008	0.0008
4.7667	0.3407	0	0.0008	0.0008
4.8	0.348	0.0067	0	0.0067
4.8333	0.3503	0	0.0008	0.0008
4.8667	0.3565	0	0.0008	0.0008
4.9	0.3602	0	0	0
4.9333	0.3654	0.0067	0.0008	0.0075
4.9667	0.3704	0	0	0
5	0.373	0	0	0
5.0333	0.3766	0	0	0
5.0667	0.3786	0	0.0008	0.0008
5.1	0.3825	0	0	0
5.1333	0.3862	0.0067	0	0.0067
5.1667	0.3885	0.0067	0.0008	0.0075
5.2	0.3928	0	0	0
5.2333	0.3941	0.0067	0	0.0067
5.2667	0.3964	0.0067	0	0.0067
5.3	0.3967	0.0067	0	0.0067
5.3333	0.401	0	0	0
5.3667	0.399	0	0.0008	0.0008
5.4	0.3967	0	0.0008	0.0008
5.4333	0.3964	0	0	0
5.4667	0.3951	0.0067	0.0008	0.0075
5.5	0.3891	0.0067	0	0.0067
5.5333	0.3928	0.0067	0	0.0067
5.5667	0.3901	0.0198	0	0.0198
5.6	0.3849	0.0067	0.0008	0.0075
5.6333	0.3845	0.0067	0.0008	0.0075
5.6667	0.3812	0	0.0008	0.0008
5.7	0.3766	0.0067	0	0.0067
5.7333	0.374	0	0.0021	0.0021
5.7667	0.3684	0.0067	0.0008	0.0075
5.8	0.3707	0.0067	0	0.0067
5.8333	0.3743	0.0067	0	0.0067

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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	0.3766	0	0	0
5.9	0.3773	0.0198	0.0008	0.0206
5.9333	0.3796	0	0	0
5.9667	0.3786	0.0198	0	0.0198
6	0.377	0.0198	0	0.0198
6.0333	0.3779	0	0.0008	0.0008
6.0667	0.3753	0.0067	0.0008	0.0075
6.1	0.3727	0	0	0
6.1333	0.3743	0.0067	0.0008	0.0075
6.1667	0.37	0.0198	0	0.0198
6.2	0.3651	0.0067	0.0008	0.0075
6.2333	0.3677	0.0067	0	0.0067
6.2667	0.3631	0.0067	0.0008	0.0075
6.3	0.3605	0	0.0008	0.0008
6.3333	0.3565	0.0198	0	0.0198
6.3667	0.3549	0	0	0
6.4	0.3572	0.0067	0	0.0067
6.4333	0.3559	0	0.0008	0.0008
6.4667	0.3519	0.0067	0.0021	0.0088
6.5	0.3516	0	0.0008	0.0008
6.5333	0.3513	0.0067	0	0.0067
6.5667	0.3519	0.0067	0.0008	0.0075
6.6	0.3542	0.0067	0.0008	0.0075
6.6333	0.3552	0.0067	0	0.0067
6.6667	0.3556	0	0	0
6.7	0.3582	0	0.0008	0.0008
6.7333	0.3635	0.0067	0	0.0067
6.7667	0.3664	0.0067	0	0.0067
6.8	0.37	0	0	0
6.8333	0.3714	0	0.0008	0.0008
6.8667	0.3723	0.0067	0.0008	0.0075
6.9	0.373	0	0	0
6.9333	0.3786	0	0.0021	0.0021
6.9667	0.3829	0	0	0
7	0.3779	0	0.0008	0.0008
7.0333	0.3819	0.0067	0	0.0067
7.0667	0.3822	0	0.0008	0.0008
7.1	0.3809	0.0198	0.0008	0.0206
7.1333	0.3737	0	0.0008	0.0008
7.1667	0.376	0.0067	0	0.0067
7.2	0.3733	0	0.0008	0.0008
7.2333	0.3684	0.0067	0	0.0067
7.2667	0.3658	0.0067	0.0008	0.0075
7.3	0.3733	0.0198	0	0.0198

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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	0.3707	0.0067	0	0.0067
7.3667	0.3727	0	0.0008	0.0008
7.4	0.3727	0	0.0008	0.0008
7.4333	0.3756	0	0	0
7.4667	0.3776	0.0067	0.0008	0.0075
7.5	0.374	0.0067	0	0.0067
7.5333	0.3793	0	0.0021	0.0021
7.5667	0.3819	0	0.0021	0.0021
7.6	0.3812	0.0067	0	0.0067
7.6333	0.3796	0.0067	0	0.0067
7.6667	0.3819	0	0	0
7.7	0.3832	0	0.0008	0.0008
7.7333	0.3832	0.0198	0.0008	0.0206
7.7667	0.3858	0	0.0008	0.0008
7.8	0.3865	0	0	0
7.8333	0.3858	0.0067	0.0008	0.0075
7.8667	0.3878	0	0.0008	0.0008
7.9	0.3862	0.0067	0.0008	0.0075
7.9333	0.3868	0.0198	0	0.0198
7.9667	0.3895	0.0067	0	0.0067
8	0.3865	0	0.0008	0.0008
8.0333	0.3901	0.0067	0	0.0067
8.0667	0.3908	0.0067	0	0.0067
8.1	0.3911	0	0	0
8.1333	0.3885	0.0067	0	0.0067
8.1667	0.3928	0.0198	0.0021	0.0219
8.2	0.3895	0	0.0008	0.0008
8.2333	0.3951	0	0	0
8.2667	0.3941	0.0067	0	0.0067
8.3	0.3951	0.0067	0.0008	0.0075
8.3333	0.3964	0	0	0
8.3667	0.3951	0.0067	0.0008	0.0075
8.4	0.3944	0.0067	0.0008	0.0075
8.4333	0.3928	0.0067	0.0008	0.0075
8.4667	0.3993	0	0	0
8.5	0.396	0	0	0
8.5333	0.3967	0	0.0008	0.0008
8.5667	0.397	0	0	0
8.6	0.3987	0	0.0008	0.0008
8.6333	0.3997	0	0.0008	0.0008
8.6667	0.4007	0	0.0008	0.0008
8.7	0.398	0.0067	0	0.0067
8.7333	0.399	0	0.0008	0.0008
8.7667	0.4016	0.0067	0	0.0067

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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	0.4036	0	0.0021	0.0021
8.8333	0.401	0.0067	0.0008	0.0075
8.8667	0.3997	0	0.0008	0.0008
8.9	0.4013	0	0.0008	0.0008
8.9333	0.4003	0	0	0
8.9667	0.403	0.0067	0	0.0067
9	0.3993	0.0067	0	0.0067
9.0333	0.4023	0	0	0
9.0667	0.4003	0	0.0008	0.0008
9.1	0.403	0	0.0008	0.0008
9.1333	0.4043	0.0067	0.0021	0.0088
9.1667	0.403	0.0067	0.0008	0.0075
9.2	0.4013	0.0067	0.0008	0.0075
9.2333	0.4053	0	0	0
9.2667	0.401	0.0198	0	0.0198
9.3	0.4013	0.0067	0	0.0067
9.3333	0.4053	0	0.0008	0.0008
9.3667	0.4033	0.0067	0	0.0067
9.4	0.4033	0.0067	0	0.0067
9.4333	0.403	0	0	0
9.4667	0.403	0.0067	0.0008	0.0075
9.5	0.4086	0.0067	0	0.0067
9.5333	0.4059	0	0	0
9.5667	0.4059	0.0067	0	0.0067
9.6	0.4079	0.0067	0.0008	0.0075
9.6333	0.4059	0.0067	0	0.0067
9.6667	0.4089	0.0067	0.0008	0.0075
9.7	0.4059	0.0067	0.0021	0.0088
9.7333	0.4086	0	0	0
9.7667	0.4079	0.0198	0	0.0198
9.8	0.4089	0	0	0
9.8333	0.4115	0	0.0021	0.0021
9.8667	0.4099	0.0067	0	0.0067
9.9	0.4066	0.0067	0.0008	0.0075
9.9333	0.4095	0	0.0008	0.0008
9.9667	0.4089	0.0198	0.0008	0.0206
10	0.4092	0.0067	0	0.0067
10.0333	0.4109	0.0067	0.0021	0.0088
10.0667	0.4095	0	0.0008	0.0008
10.1	0.4053	0	0.0008	0.0008
10.1333	0.4112	0.0067	0	0.0067
10.1667	0.4089	0	0	0
10.2	0.4086	0	0.0008	0.0008
10.2333	0.4099	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	0.4102	0	0.0008	0.0008
10.3	0.4092	0.0198	0	0.0198
10.3333	0.4095	0	0.0008	0.0008
10.3667	0.4109	0	0	0
10.4	0.4115	0	0.0008	0.0008
10.4333	0.4095	0.0067	0	0.0067
10.4667	0.4105	0.0067	0.0008	0.0075
10.5	0.4125	0.0067	0.0008	0.0075
10.5333	0.4095	0.0067	0	0.0067
10.5667	0.4125	0	0.0008	0.0008
10.6	0.4118	0.0198	0	0.0198
10.6333	0.4089	0.0067	0	0.0067
10.6667	0.4128	0	0.0008	0.0008
10.7	0.4118	0	0.0008	0.0008
10.7333	0.4099	0	0.0021	0.0021
10.7667	0.4099	0	0.0008	0.0008
10.8	0.4092	0	0	0
10.8333	0.4109	0	0.0021	0.0021
10.8667	0.4086	0	0	0
10.9	0.4105	0.0067	0	0.0067
10.9333	0.4125	0.0067	0.0008	0.0075
10.9667	0.4141	0.0067	0.0008	0.0075
11	0.4128	0	0.0008	0.0008
11.0333	0.4122	0	0	0
11.0667	0.4118	0	0.0008	0.0008
11.1	0.4135	0.0067	0	0.0067
11.1333	0.4105	0.0067	0	0.0067
11.1667	0.4109	0	0.0008	0.0008
11.2	0.4122	0	0.0008	0.0008
11.2333	0.4118	0	0	0
11.2667	0.4141	0.0067	0	0.0067
11.3	0.4118	0	0.0008	0.0008
11.3333	0.4109	0	0.0008	0.0008
11.3667	0.4118	0.0067	0	0.0067
11.4	0.4109	0.0198	0	0.0198
11.4333	0.4125	0	0	0
11.4667	0.4118	0.0067	0.0008	0.0075
11.5	0.4128	0.0198	0	0.0198
11.5333	0.4122	0	0.0008	0.0008
11.5667	0.4135	0	0.0021	0.0021
11.6	0.4141	0	0	0
11.6333	0.4138	0	0.0008	0.0008
11.6667	0.4118	0	0.0021	0.0021
11.7	0.4122	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)
11.7333	0.4122	0.0067	0.0008	0.0075
11.7667	0.4135	0.0198	0.0008	0.0206
11.8	0.4128	0	0.0008	0.0008
11.8333	0.4125	0	0.0008	0.0008
11.8667	0.4151	0	0.0008	0.0008
11.9	0.4125	0	0.0008	0.0008
11.9333	0.4095	0.0067	0	0.0067
11.9667	0.4115	0	0	0
12	0.4132	0.0067	0	0.0067
12.0333	0.4095	0	0	0
12.0667	0.4138	0	0	0
12.1	0.4138	0.0067	0.0021	0.0088
12.1333	0.4112	0	0.0008	0.0008
12.1667	0.4135	0	0	0
12.2	0.4161	0	0	0
12.2333	0.4112	0	0.0008	0.0008
12.2667	0.4145	0.0198	0.0008	0.0206
12.3	0.4122	0	0	0
12.3333	0.4145	0	0	0
12.3667	0.4115	0.0067	0	0.0067
12.4	0.4122	0.0067	0	0.0067
12.4333	0.4135	0	0.0008	0.0008
12.4667	0.4118	0.0067	0	0.0067
12.5	0.4125	0	0.0008	0.0008
12.5333	0.4122	0	0	0
12.5667	0.4115	0.0067	0	0.0067
12.6	0.4141	0.0198	0	0.0198
12.6333	0.4125	0.0067	0	0.0067
12.6667	0.4128	0	0.0008	0.0008
12.7	0.4141	0	0.0008	0.0008
12.7333	0.4145	0	0.0021	0.0021
12.7667	0.4135	0	0.0008	0.0008
12.8	0.4128	0	0	0
12.8333	0.4155	0.0067	0	0.0067
12.8667	0.4161	0	0	0
12.9	0.4109	0.0067	0.0008	0.0075
12.9333	0.4112	0	0	0
12.9667	0.4165	0.0067	0.0008	0.0075
13	0.4128	0.0067	0	0.0067
13.0333	0.4118	0.0067	0	0.0067
13.0667	0.4112	0	0	0
13.1	0.4141	0	0	0
13.1333	0.4138	0.0067	0	0.0067
13.1667	0.4128	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)
13.2	0.4105	0.0067	0	0.0067
13.2333	0.4148	0	0.0008	0.0008
13.2667	0.4141	0.0067	0	0.0067
13.3	0.4151	0.0067	0.0008	0.0075
13.3333	0.4122	0	0.0008	0.0008
13.3667	0.4132	0.0067	0	0.0067
13.4	0.4158	0	0.0008	0.0008
13.4333	0.4158	0.0067	0.0008	0.0075
13.4667	0.4148	0.0067	0.0008	0.0075
13.5	0.4184	0.0067	0	0.0067
13.5333	0.4148	0.0067	0.0008	0.0075
13.5667	0.4178	0.0067	0	0.0067
13.6	0.4161	0	0.0008	0.0008
13.6333	0.4194	0.0067	0.0008	0.0075
13.6667	0.4211	0.0198	0.0008	0.0206
13.7	0.4188	0.0067	0	0.0067
13.7333	0.4207	0	0	0
13.7667	0.4224	0.0198	0.0008	0.0206
13.8	0.425	0.0067	0	0.0067
13.8333	0.4263	0.0067	0.0008	0.0075
13.8667	0.4253	0.0198	0	0.0198
13.9	0.4293	0	0	0
13.9333	0.4299	0.0067	0.0021	0.0088
13.9667	0.4313	0.0067	0.0008	0.0075
14	0.4346	0	0	0
14.0333	0.4355	0.0067	0	0.0067
14.0667	0.4365	0	0	0
14.1	0.4415	0	0.0021	0.0021
14.1333	0.4402	0	0.0008	0.0008
14.1667	0.4448	0	0.0021	0.0021
14.2	0.4464	0	0.0034	0.0034
14.2333	0.4494	0.0067	0	0.0067
14.2667	0.4517	0	0	0
14.3	0.4569	0	0.0021	0.0021
14.3333	0.454	0.0067	0.0008	0.0075
14.3667	0.4596	0.0067	0	0.0067
14.4	0.4622	0	0	0
14.4333	0.4642	0.0067	0	0.0067
14.4667	0.4658	0.0198	0	0.0198
14.5	0.4685	0	0.0008	0.0008
14.5333	0.4734	0	0	0
14.5667	0.4721	0	0	0
14.6	0.4783	0	0.0008	0.0008
14.6333	0.4803	0.0067	0	0.0067

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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	0.4813	0	0	0
14.7	0.4843	0.0067	0	0.0067
14.7333	0.4879	0.0067	0	0.0067
14.7667	0.4889	0.0067	0	0.0067
14.8	0.4938	0.0067	0	0.0067
14.8333	0.4925	0.0067	0	0.0067
14.8667	0.4981	0	0	0
14.9	0.4974	0.0067	0.0008	0.0075
14.9333	0.5007	0	0	0
14.9667	0.5034	0	0.0008	0.0008
15	0.5063	0.0067	0.0021	0.0088
15.0333	0.5057	0.0067	0	0.0067
15.0667	0.5103	0	0	0
15.1	0.5113	0	0	0
15.1333	0.5099	0	0	0
15.1667	0.5139	0.0067	0	0.0067
15.2	0.5168	0	0.0021	0.0021
15.2333	0.5201	0	0	0
15.2667	0.5218	0.0067	0	0.0067
15.3	0.5228	0	0.0008	0.0008
15.3333	0.5247	0	0	0
15.3667	0.5247	0.0067	0	0.0067
15.4	0.528	0.0067	0	0.0067
15.4333	0.5294	0	0	0
15.4667	0.5303	0	0	0
15.5	0.5333	0	0.0008	0.0008
15.5333	0.5346	0	0.0021	0.0021
15.5667	0.5343	0	0	0
15.6	0.5399	0	0.0008	0.0008
15.6333	0.5369	0.0067	0	0.0067
15.6667	0.5405	0	0	0
15.7	0.5445	0	0.0008	0.0008
15.7333	0.5442	0.0067	0	0.0067
15.7667	0.5488	0	0.0008	0.0008
15.8	0.5468	0.0067	0.0008	0.0075
15.8333	0.5521	0	0	0
15.8667	0.5494	0	0	0
15.9	0.5534	0.0067	0.0008	0.0075
15.9333	0.554	0.0067	0.0008	0.0075
15.9667	0.5554	0.0067	0.0021	0.0088
16	0.555	0	0.0008	0.0008
16.0333	0.5583	0.0067	0.0008	0.0075
16.0667	0.5652	0	0	0
16.1	0.5662	0.0067	0	0.0067

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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	0.5712	0	0	0
16.1667	0.5725	0.0067	0.0008	0.0075
16.2	0.5735	0.0198	0	0.0198
16.2333	0.5781	0	0.0021	0.0021
16.2667	0.5807	0.0198	0	0.0198
16.3	0.5843	0	0	0
16.3333	0.5899	0	0	0
16.3667	0.5912	0.0067	0	0.0067
16.4	0.5952	0	0	0
16.4333	0.5985	0	0	0
16.4667	0.6005	0	0	0
16.5	0.6028	0.0067	0	0.0067
16.5333	0.608	0.0067	0	0.0067
16.5667	0.6133	0.0067	0.0021	0.0088
16.6	0.6163	0	0	0
16.6333	0.6159	0.0198	0	0.0198
16.6667	0.6189	0.0067	0	0.0067
16.7	0.6192	0	0.0008	0.0008
16.7333	0.6265	0	0	0
16.7667	0.6268	0	0	0
16.8	0.6311	0	0	0
16.8333	0.6321	0	0	0
16.8667	0.637	0.0198	0.0008	0.0206
16.9	0.639	0.0198	0.0008	0.0206
16.9333	0.6423	0.0067	0.0008	0.0075
16.9667	0.6502	0	0.0008	0.0008
17	0.6564	0	0.0008	0.0008
17.0333	0.6577	0	0	0
17.0667	0.6643	0	0.0008	0.0008
17.1	0.6676	0.0067	0.0008	0.0075
17.1333	0.6752	0.0067	0.0008	0.0075
17.1667	0.6762	0.0198	0.0008	0.0206
17.2	0.6811	0	0	0
17.2333	0.6854	0.0067	0.0008	0.0075
17.2667	0.6936	0.0067	0	0.0067
17.3	0.6982	0	0.0008	0.0008
17.3333	0.6989	0	0	0
17.3667	0.7038	0.0067	0.0008	0.0075
17.4	0.7091	0	0.0008	0.0008
17.4333	0.7111	0.0067	0	0.0067
17.4667	0.715	0.0067	0.0008	0.0075
17.5	0.717	0	0	0
17.5333	0.719	0	0	0
17.5667	0.7242	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)
17.6	0.7278	0.0067	0	0.0067
17.6333	0.7328	0	0.0008	0.0008
17.6667	0.7357	0.0067	0.0008	0.0075
17.7	0.7364	0	0.0008	0.0008
17.7333	0.7453	0.0067	0.0008	0.0075
17.7667	0.7413	0.0067	0	0.0067
17.8	0.7479	0	0	0
17.8333	0.7519	0	0	0
17.8667	0.7529	0.0067	0	0.0067
17.9	0.7562	0.0067	0.0008	0.0075
17.9333	0.7519	0.0067	0.0008	0.0075
17.9667	0.7552	0	0	0
18	0.7525	0	0.0021	0.0021
18.0333	0.7539	0	0	0
18.0667	0.7542	0.0067	0.0008	0.0075
18.1	0.7512	0.0198	0	0.0198
18.1333	0.7473	0.0067	0.0008	0.0075
18.1667	0.7446	0	0.0021	0.0021
18.2	0.7404	0.0067	0.0008	0.0075
18.2333	0.739	0	0.0021	0.0021
18.2667	0.7394	0.0067	0	0.0067
18.3	0.739	0	0.0008	0.0008
18.3333	0.7361	0	0	0
18.3667	0.7351	0.0067	0	0.0067
18.4	0.7341	0.0067	0.0021	0.0088
18.4333	0.7305	0	0	0
18.4667	0.7331	0.0067	0	0.0067
18.5	0.7351	0	0.0008	0.0008
18.5333	0.7341	0.0067	0	0.0067
18.5667	0.7354	0	0	0
18.6	0.7364	0.0198	0.0008	0.0206
18.6333	0.7348	0	0	0
18.6667	0.7387	0.0067	0	0.0067
18.7	0.7377	0	0	0
18.7333	0.7354	0	0	0
18.7667	0.7381	0	0	0
18.8	0.7374	0.0067	0	0.0067
18.8333	0.7361	0	0	0
18.8667	0.7357	0	0.0008	0.0008
18.9	0.7371	0.0067	0.0008	0.0075
18.9333	0.7348	0	0.0008	0.0008
18.9667	0.7374	0	0	0
19	0.7367	0.0067	0.0021	0.0088
19.0333	0.7384	0.0067	0	0.0067

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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	0.7364	0.0067	0	0.0067
19.1	0.7381	0	0.0008	0.0008
19.1333	0.7384	0	0	0
19.1667	0.739	0.0067	0.0021	0.0088
19.2	0.7364	0.0067	0	0.0067
19.2333	0.7361	0	0	0
19.2667	0.7374	0.0067	0	0.0067
19.3	0.7374	0	0.0008	0.0008
19.3333	0.7357	0.0067	0.0008	0.0075
19.3667	0.7381	0.0067	0	0.0067
19.4	0.7377	0	0.0008	0.0008
19.4333	0.7384	0.0067	0.0008	0.0075
19.4667	0.7407	0	0	0
19.5	0.7367	0.0198	0	0.0198
19.5333	0.7374	0	0	0
19.5667	0.7364	0.0067	0.0008	0.0075
19.6	0.7381	0.0067	0	0.0067
19.6333	0.7404	0.0067	0	0.0067
19.6667	0.7341	0	0.0008	0.0008
19.7	0.7361	0.0067	0	0.0067
19.7333	0.7348	0.0067	0	0.0067
19.7667	0.739	0	0.0008	0.0008
19.8	0.7397	0.0198	0	0.0198
19.8333	0.7367	0.0198	0	0.0198
19.8667	0.7387	0.0067	0.0008	0.0075
19.9	0.7397	0	0	0
19.9333	0.7417	0.0198	0	0.0198
19.9667	0.739	0.0067	0.0008	0.0075
20	0.7407	0.0067	0.0008	0.0075
20.0333	0.7341	0	0.0008	0.0008
20.0667	0.7315	0.0067	0	0.0067
20.1	0.7255	0.0067	0.0008	0.0075
20.1333	0.7249	0	0	0
20.1667	0.7259	0.0067	0.0021	0.0088
20.2	0.7232	0.0067	0	0.0067
20.2333	0.7282	0.0067	0.0008	0.0075
20.2667	0.7255	0	0	0
20.3	0.7275	0	0.0021	0.0021
20.3333	0.7288	0.0067	0	0.0067
20.3667	0.7275	0.0067	0.0021	0.0088
20.4	0.7255	0.0067	0	0.0067
20.4333	0.7295	0	0.0008	0.0008
20.4667	0.7305	0.0198	0	0.0198
20.5	0.7282	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)
20.5333	0.7292	0	0	0
20.5667	0.7305	0	0.0008	0.0008
20.6	0.7278	0.0067	0	0.0067
20.6333	0.7298	0	0.0008	0.0008
20.6667	0.7292	0.0067	0.0008	0.0075
20.7	0.7311	0	0.0008	0.0008
20.7333	0.7305	0.0067	0.0008	0.0075
20.7667	0.7282	0.0198	0	0.0198
20.8	0.7285	0.0067	0	0.0067
20.8333	0.7305	0	0	0
20.8667	0.7328	0.0067	0	0.0067
20.9	0.7318	0.0067	0	0.0067
20.9333	0.7321	0.0067	0	0.0067
20.9667	0.7334	0.0067	0	0.0067
21	0.7321	0.0198	0.0008	0.0206
21.0333	0.7318	0.0067	0.0008	0.0075
21.0667	0.7325	0	0.0008	0.0008
21.1	0.7334	0.0198	0.0008	0.0206
21.1333	0.7328	0.0067	0	0.0067
21.1667	0.7328	0.0067	0	0.0067
21.2	0.7338	0.0198	0	0.0198
21.2333	0.7348	0	0.0008	0.0008
21.2667	0.7341	0.0067	0	0.0067
21.3	0.7338	0.0067	0.0008	0.0075
21.3333	0.7334	0.033	0.0008	0.0338
21.3667	0.7348	0.0067	0	0.0067
21.4	0.7344	0.0067	0	0.0067
21.4333	0.7341	0.0067	0.0021	0.0088
21.4667	0.7357	0	0.0008	0.0008
21.5	0.7381	0.0198	0.0008	0.0206
21.5333	0.7377	0	0	0
21.5667	0.7354	0	0.0008	0.0008
21.6	0.7357	0	0.0008	0.0008
21.6333	0.7344	0.0067	0	0.0067
21.6667	0.7361	0	0	0
21.7	0.7341	0	0	0
21.7333	0.7374	0.0067	0	0.0067
21.7667	0.7357	0.0198	0.0008	0.0206
21.8	0.7361	0	0.0008	0.0008
21.8333	0.7377	0	0.0008	0.0008
21.8667	0.7357	0	0.0008	0.0008
21.9	0.7361	0.0067	0	0.0067
21.9333	0.739	0.0067	0.0008	0.0075
21.9667	0.7387	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)
22	0.7364	0	0	0
22.0333	0.7384	0.0198	0.0008	0.0206
22.0667	0.7371	0	0	0
22.1	0.7371	0.0067	0.0008	0.0075
22.1333	0.7394	0.0067	0	0.0067
22.1667	0.7364	0.0067	0.0008	0.0075
22.2	0.7394	0	0.0008	0.0008
22.2333	0.741	0.0067	0.0008	0.0075
22.2667	0.7371	0.0067	0	0.0067
22.3	0.7374	0	0	0
22.3333	0.7374	0.0067	0.0008	0.0075
22.3667	0.7381	0	0	0
22.4	0.7407	0.0067	0	0.0067
22.4333	0.7404	0.0067	0	0.0067
22.4667	0.7387	0.0198	0	0.0198
22.5	0.7394	0	0.0008	0.0008
22.5333	0.7417	0.0067	0	0.0067
22.5667	0.7384	0	0	0
22.6	0.7381	0.0198	0.0008	0.0206
22.6333	0.74	0.0067	0	0.0067
22.6667	0.74	0.0067	0.0008	0.0075
22.7	0.7394	0	0	0
22.7333	0.739	0.0198	0	0.0198
22.7667	0.7436	0	0.0008	0.0008
22.8	0.7407	0	0.0008	0.0008
22.8333	0.744	0	0	0
22.8667	0.741	0.0067	0	0.0067
22.9	0.7453	0.0067	0	0.0067
22.9333	0.7433	0	0	0
22.9667	0.7397	0	0	0
23	0.74	0	0	0
23.0333	0.7404	0.0067	0	0.0067
23.0667	0.7417	0.0067	0	0.0067
23.1	0.7423	0	0	0
23.1333	0.744	0.0067	0	0.0067
23.1667	0.7394	0.0067	0.0008	0.0075
23.2	0.74	0	0	0
23.2333	0.7413	0	0	0
23.2667	0.7427	0	0	0
23.3	0.744	0	0.0008	0.0008
23.3333	0.741	0.0067	0	0.0067
23.3667	0.7394	0	0	0
23.4	0.7446	0.0067	0	0.0067
23.4333	0.7407	0.0067	0	0.0067

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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	0.7423	0	0.0008	0.0008
23.5	0.7446	0	0	0
23.5333	0.745	0	0	0
23.5667	0.7423	0	0.0008	0.0008
23.6	0.74	0	0	0
23.6333	0.7436	0.0198	0	0.0198
23.6667	0.7436	0.0067	0	0.0067
23.7	0.7423	0.0067	0.0008	0.0075
23.7333	0.7443	0.0198	0.0008	0.0206
23.7667	0.7427	0	0.0008	0.0008
23.8	0.743	0	0.0008	0.0008
23.8333	0.741	0	0.0021	0.0021
23.8667	0.7456	0	0	0
23.9	0.7443	0	0.0008	0.0008
23.9333	0.746	0	0.0021	0.0021
23.9667	0.745	0	0.0008	0.0008
24	0.7443	0	0.0021	0.0021
24.0333	0.7456	0.0067	0.0008	0.0075
24.0667	0.745	0	0	0
24.1	0.7413	0.0067	0.0008	0.0075
24.1333	0.7427	0.0067	0	0.0067
24.1667	0.7453	0.0067	0.0008	0.0075
24.2	0.7469	0	0.0008	0.0008
24.2333	0.7348	0	0	0
24.2667	0.7223	0.0067	0	0.0067
24.3	0.7065	0	0.0008	0.0008
24.3333	0.6706	0	0	0
24.3667	0.6314	0.0067	0.0008	0.0075
24.4	0.5991	0	0.0021	0.0021
24.4333	0.5642	0	0.0008	0.0008
24.4667	0.533	0.0198	0	0.0198
24.5	0.5014	0.033	0.0008	0.0338
24.5333	0.4665	0	0	0
24.5667	0.4342	0	0	0
24.6	0.4056	0	0.0008	0.0008
24.6333	0.3789	0	0	0
24.6667	0.3539	0	0	0
24.7	0.3223	0	0	0
24.7333	0.3019	0	0	0
24.7667	0.2825	0.0067	0	0.0067
24.8	0.2588	0.0067	0	0.0067
24.8333	0.242	0.0198	0.0008	0.0206
24.8667	0.218	0	0	0
24.9	0.2005	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)
24.9333	0.1864	0	0	0
24.9667	0.1748	0	0	0
25	0.16	0	0	0
25.0333	0.1439	0	0.0021	0.0021
25.0667	0.1317	0.0067	0	0.0067
25.1	0.1209	0.0067	0.0008	0.0075
25.1333	0.1097	0.0067	0	0.0067
25.1667	0.1011	0.0067	0.0008	0.0075
25.2	0.0926	0.0067	0	0.0067
25.2333	0.0847	0	0.0008	0.0008
25.2667	0.0721	0	0	0
25.3	0.0679	0.0067	0.0008	0.0075
25.3333	0.0623	0.0067	0	0.0067
25.3667	0.0567	0	0	0
25.4	0.0511	0.0067	0	0.0067
25.4333	0.0484	0	0	0
25.4667	0.0422	0.0067	0	0.0067
25.5	0.0396	0.0067	0	0.0067
25.5333	0.0359	0	0	0
25.5667	0.0323	0	0.0008	0.0008
25.6	0.0284	0.0067	0.0021	0.0088
25.6333	0.0241	0	0.0008	0.0008
25.6667	0.0211	0.0067	0	0.0067
25.7	0.0224	0.0067	0	0.0067
25.7333	0.0191	0	0.0008	0.0008
25.7667	0.0159	0	0.0008	0.0008
25.8	0.0152	0.0067	0	0.0067
25.8333	0.0145	0.0198	0.0008	0.0206
25.8667	0.0139	0	0.0021	0.0021
25.9	0.0089	0	0	0
25.9333	0.008	0	0	0
25.9667	0.008	0.0067	0	0.0067
26	0.0089	0	0.0008	0.0008
26.0333	0.0096	0.0067	0.0008	0.0075
26.0667	0.0083	0.0067	0.0008	0.0075
26.1	0.0063	0	0	0
26.1333	0.0037	0	0	0
26.1667	0.0057	0	0	0
26.2	0.0057	0	0	0
26.2333	0.004	0.0067	0.0008	0.0075
26.2667	0.004	0.0067	0	0.0067
26.3	0.0014	0.0198	0.0008	0.0206
26.3333	0.0043	0	0	0
26.3667	0.004	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)
26.4	0.0017	0.0067	0	0.0067
26.4333	-0.0006	0	0.0008	0.0008
26.4667	-0.0003	0.0067	0	0.0067
26.5	-0.0075	0.0067	0.0008	0.0075
26.5333	-0.0052	0	0.0008	0.0008
26.5667	-0.0075	0.0067	0	0.0067
26.6	-0.0072	0	0	0
26.6333	-0.0078	0.0067	0	0.0067
26.6667	-0.0049	0.0067	0.0008	0.0075
26.7	-0.0036	0	0	0
26.7333	-0.0065	0.0067	0	0.0067
26.7667	-0.0069	0	0	0
26.8	-0.0026	0.0067	0	0.0067
26.8333	-0.0039	0	0	0
26.8667	-0.0003	0	0	0
26.9	-0.0069	0	0.0008	0.0008
26.9333	-0.0065	0.0067	0.0008	0.0075
26.9667	-0.0042	0.0067	0	0.0067
27	-0.0026	0.0067	0.0008	0.0075
27.0333	-0.0059	0	0.0008	0.0008
27.0667	-0.0059	0.0067	0	0.0067
27.1	-0.0055	0.0067	0	0.0067
27.1333	-0.0042	0.0067	0.0008	0.0075
27.1667	-0.0032	0.0067	0	0.0067
27.2	-0.0042	0	0	0
27.2333	-0.0085	0.0067	0.0008	0.0075
27.2667	-0.0059	0	0	0
27.3	-0.0059	0.0067	0	0.0067
27.3333	-0.0046	0	0.0008	0.0008
27.3667	-0.0046	0	0.0008	0.0008
27.4	-0.0042	0	0.0021	0.0021
27.4333	-0.0055	0	0	0
27.4667	-0.0049	0	0.0008	0.0008
27.5	-0.0029	0.0067	0.0008	0.0075
27.5333	-0.0052	0	0.0008	0.0008
27.5667	-0.0049	0	0	0
27.6	-0.0055	0	0.0008	0.0008
27.6333	-0.0072	0	0.0008	0.0008
27.6667	-0.0026	0.0067	0	0.0067
27.7	-0.0062	0	0.0008	0.0008
27.7333	-0.0078	0	0.0008	0.0008
27.7667	-0.0065	0	0.0008	0.0008
27.8	-0.0069	0.0067	0	0.0067
27.8333	-0.0069	0	0.0008	0.0008

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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	-0.0085	0.0067	0	0.0067
27.9	-0.0029	0	0	0
27.9333	-0.0055	0.0067	0	0.0067
27.9667	-0.0013	0.0067	0	0.0067
28	-0.0042	0.0067	0	0.0067
28.0333	-0.0072	0	0	0
28.0667	-0.0036	0	0.0008	0.0008
28.1	-0.0072	0	0.0008	0.0008
28.1333	-0.0042	0.0067	0	0.0067
28.1667	-0.0062	0	0	0
28.2	-0.0069	0	0	0
28.2333	-0.0069	0	0	0
28.2667	-0.0055	0.0067	0	0.0067
28.3	-0.0036	0	0	0
28.3333	-0.0036	0	0	0
28.3667	-0.0049	0.0067	0	0.0067
28.4	-0.0052	0.0067	0	0.0067
28.4333	-0.0069	0.0067	0.0008	0.0075
28.4667	-0.0059	0	0.0008	0.0008
28.5	-0.0069	0.0198	0.0008	0.0206
28.5333	-0.0059	0.0198	0	0.0198
28.5667	-0.0065	0	0	0
28.6	-0.0062	0.0067	0	0.0067
28.6333	-0.0069	0.0198	0	0.0198
28.6667	-0.0059	0	0	0
28.7	-0.0042	0.0067	0.0008	0.0075
28.7333	-0.0059	0	0	0
28.7667	-0.0052	0	0.0021	0.0021
28.8	-0.0039	0	0	0
28.8333	-0.0072	0.0198	0	0.0198
28.8667	-0.0062	0.0198	0	0.0198
28.9	-0.0036	0	0.0008	0.0008
28.9333	-0.0036	0	0.0008	0.0008
28.9667	-0.0082	0.0067	0.0008	0.0075
29	-0.0059	0.0067	0.0008	0.0075
29.0333	-0.0065	0	0	0
29.0667	-0.0036	0.0067	0	0.0067
29.1	-0.0042	0.0067	0	0.0067
29.1333	-0.0082	0	0	0
29.1667	-0.0052	0.0067	0	0.0067
29.2	-0.0052	0.0067	0	0.0067
29.2333	-0.0052	0.0067	0	0.0067
29.2667	-0.0062	0.0067	0.0008	0.0075
29.3	-0.0059	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)
29.3333	-0.0046	0	0.0008	0.0008
29.3667	-0.0042	0	0	0
29.4	-0.0049	0.0067	0.0008	0.0075
29.4333	-0.0052	0	0	0
29.4667	-0.0026	0	0	0
29.5	-0.0075	0	0	0
29.5333	-0.0082	0.0067	0	0.0067
29.5667	-0.0042	0	0	0
29.6	-0.0062	0.0067	0.0008	0.0075
29.6333	-0.0072	0	0.0008	0.0008
29.6667	-0.0065	0	0.0008	0.0008
29.7	-0.0052	0	0	0
29.7333	-0.0039	0.0067	0	0.0067
29.7667	-0.0052	0.0067	0.0008	0.0075
29.8	-0.0046	0.0198	0	0.0198
29.8333	-0.0032	0	0.0008	0.0008
29.8667	-0.0055	0	0	0
29.9	-0.0052	0	0.0021	0.0021
29.9333	-0.0065	0.0067	0.0008	0.0075
29.9667	-0.0049	0.0067	0	0.0067
30	-0.0042	0	0.0008	0.0008
30.0333	-0.0032	0	0	0
30.0667	-0.0055	0	0	0
30.1	-0.0046	0	0	0
30.1333	-0.0029	0.0067	0	0.0067
30.1667	-0.0039	0	0.0008	0.0008
30.2	-0.0065	0	0.0008	0.0008
30.2333	-0.0059	0.0067	0.0008	0.0075
30.2667	-0.0039	0.0067	0	0.0067
30.3	-0.0049	0	0.0008	0.0008
30.3333	-0.0062	0	0.0008	0.0008
30.3667	-0.0059	0	0.0008	0.0008
30.4	-0.0065	0	0	0
30.4333	-0.0082	0.0067	0	0.0067
30.4667	-0.0082	0.0067	0	0.0067
30.5	-0.0085	0.0067	0	0.0067
30.5333	-0.0029	0	0	0
30.5667	-0.0042	0.0067	0.0008	0.0075
30.6	-0.0052	0.0067	0	0.0067
30.6333	-0.0026	0.0067	0	0.0067
30.6667	-0.0059	0	0.0008	0.0008
30.7	-0.0022	0	0.0008	0.0008
30.7333	-0.0069	0.0067	0	0.0067
30.7667	-0.0078	0	0	0

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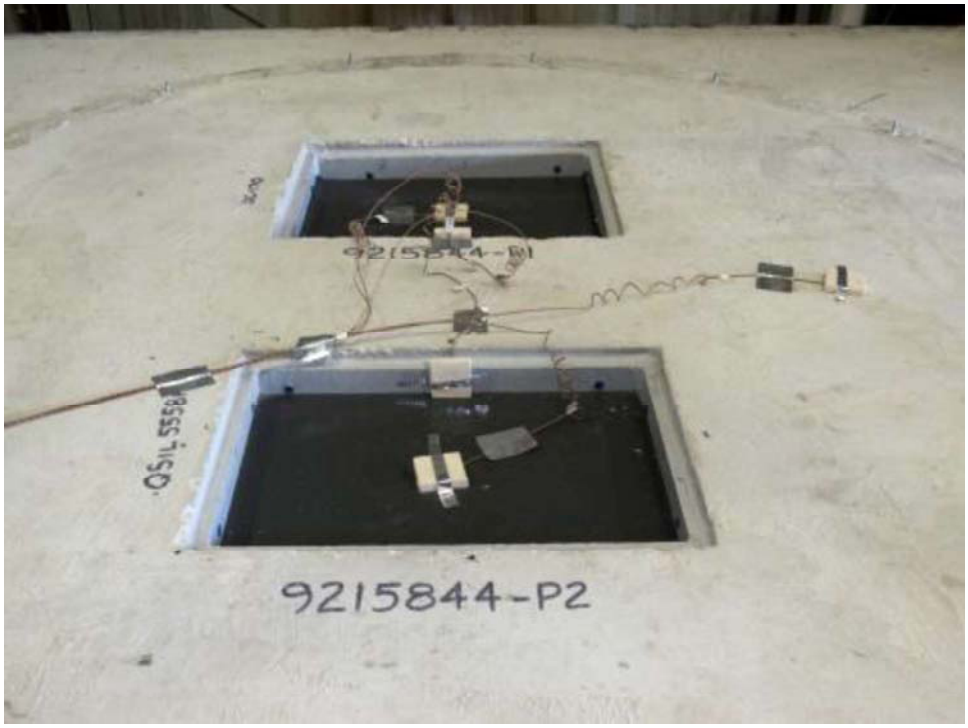
Time (min)	Ch 1 dP (psi)	Ch 2 High Flow (LPM)	Ch 3 Low Flow (LPM)	Total Flow (LPM)
30.8	-0.0049	0	0.0008	0.0008
30.8333	-0.0065	0	0	0
30.8667	-0.0049	0.0067	0	0.0067
30.9	-0.0052	0	0	0
30.9333	-0.0046	0.0067	0	0.0067
30.9667	-0.0039	0	0.0008	0.0008
31	-0.0075	0.0067	0.0008	0.0075
31.0333	-0.0075	0	0	0
31.0667	-0.0046	0.0198	0	0.0198
31.1	-0.0055	0.0067	0	0.0067
31.1333	-0.0062	0.0067	0	0.0067
31.1667	-0.0039	0.0198	0.0008	0.0206
31.2	-0.0075	0.0067	0.0008	0.0075
31.2333	-0.0055	0.0198	0.0008	0.0206
31.2667	-0.0049	0	0.0008	0.0008
31.3	-0.0059	0	0	0
31.3333	-0.0036	0.0198	0	0.0198
31.3667	-0.0055	0	0.0008	0.0008
31.4	-0.0049	0	0	0
31.4333	-0.0055	0.0067	0.0008	0.0075
31.4667	-0.0036	0.0067	0.0008	0.0075
31.5	-0.0052	0	0.0008	0.0008
31.5333	-0.0046	0.0067	0.0008	0.0075
31.5667	-0.0032	0.0067	0	0.0067
31.6	-0.0049	0	0	0

APPENDIX D1
Photographs: Fire Test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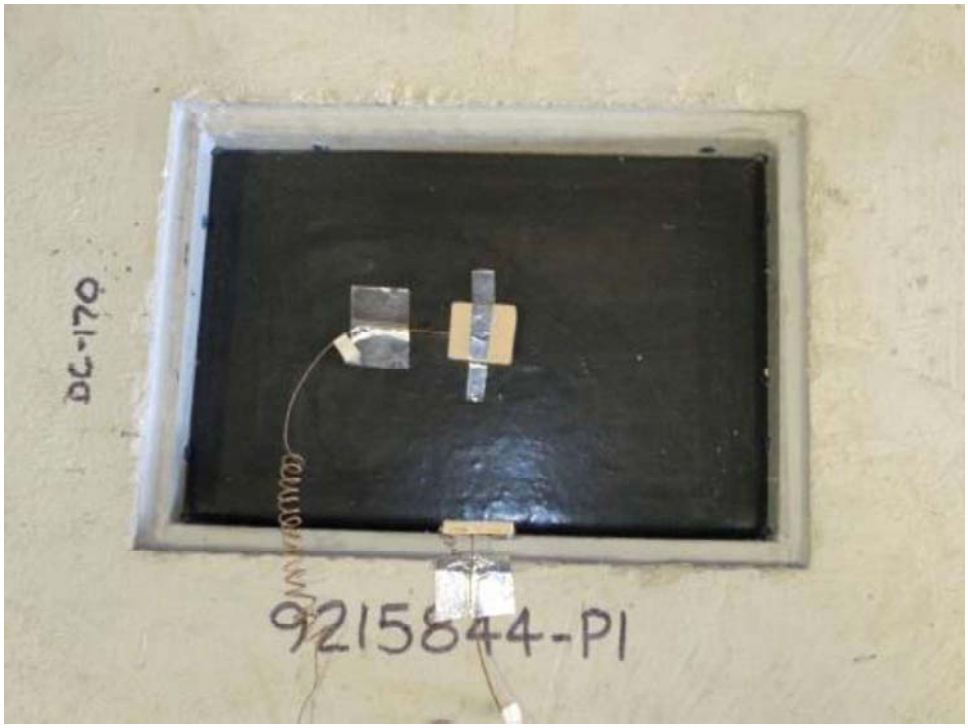
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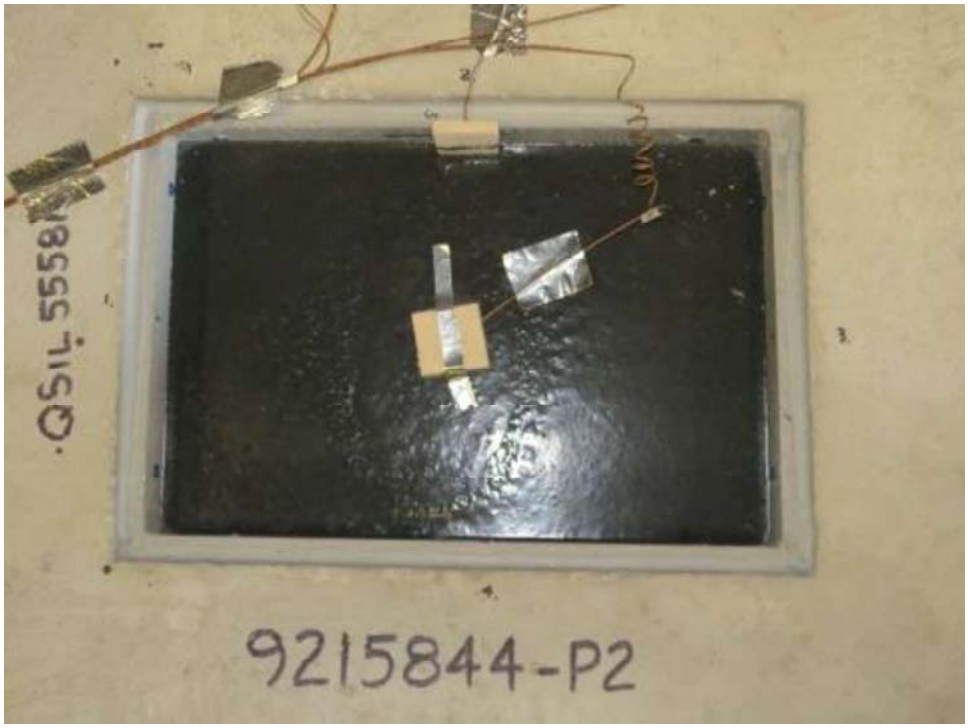
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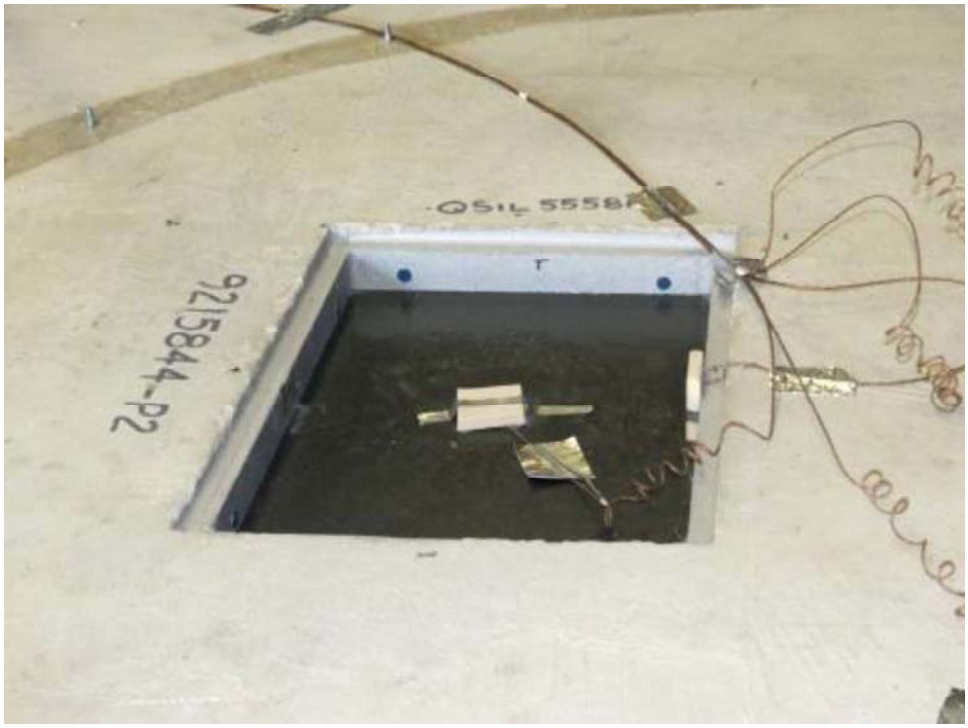
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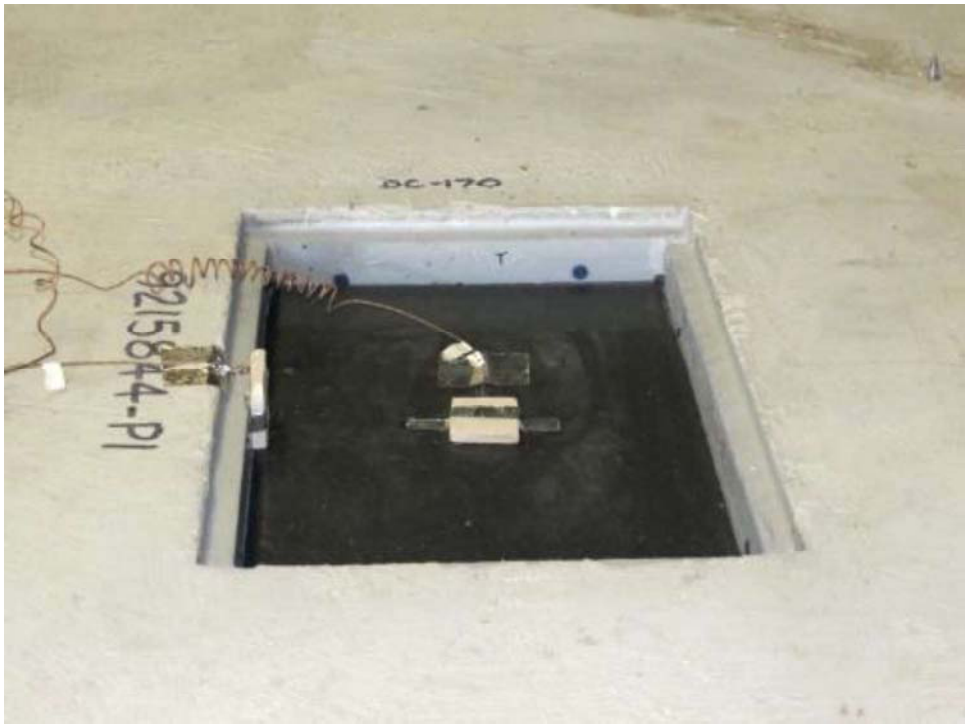

DC-170
9215844-P1

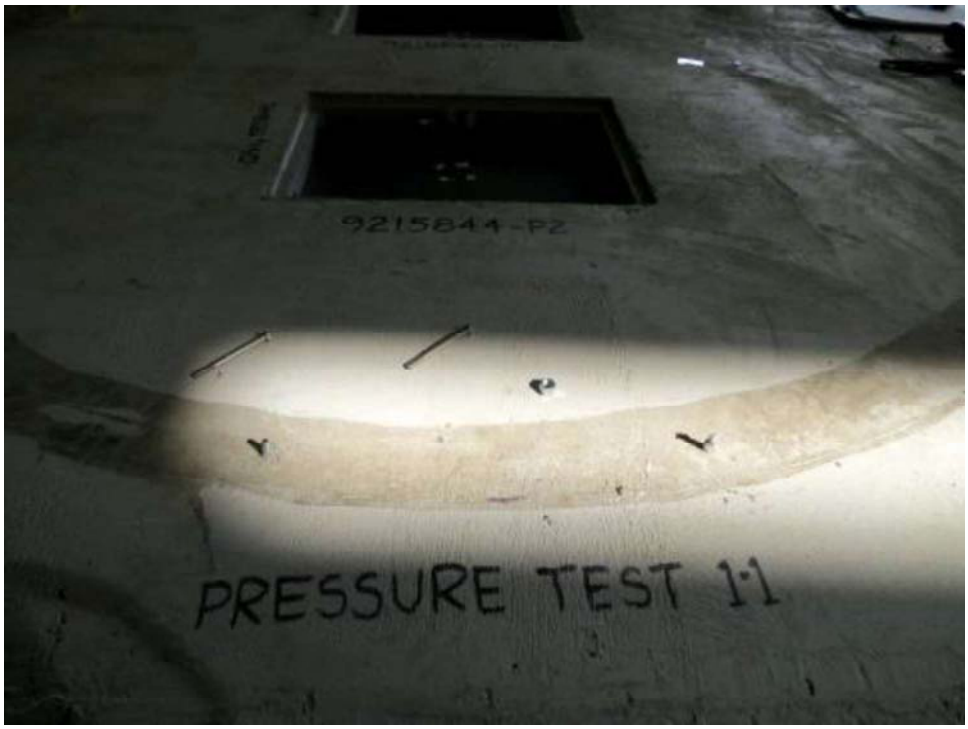

DC-170
9215844-P1


9215844-P1
QSIL 5558
9215844-P2


2014/02/13

APPENDIX D2
Photographs: Pressure Test


9215844-P1
QSIL 555 6MC
9215844-P2


9215844-P2
PRESSURE TEST 1·1


T
2014/02/18


2014/02/18


2014/02/18


P1


P2
2014/02/24


P2
2014/02/24


P1
2014/02/24

APPENDIX E
Test Plan

20004-020 (10/21/2013)

AREVA

AREVA NP Inc.

Engineering Information Record

Document No.: 51 - 9218186 - 000

Detailed Test Plan for Conducting MOX Fire-Pressure Test 5

[redacted]
Mike Dey
Staff Engineer

[redacted]
Michael A. Brown
Quality Supervisor

AREVA

20004-020 (10/21/2013)
Document No.: 51-9218186-000

Detailed Test Plan for Conducting MOX Fire-Pressure Test 5

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	2-4-14	All
Derrick Risner Eng I / PEYF1-A	[redacted]	R	2-4-2014	All
Scott Groesbeck Manager Tech Ops / PEYF1-A	[redacted]	A	2/4/14	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

Project Manager Approval of Customer References (N/A if not applicable)

Name (printed or typed)	Title (printed or typed)	Signature	Date
Perry Calos	Project Manager / IBL-A	[redacted]	2/4/14

MOX Services concurrence: [redacted]neer 05Feb14
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 (1 pages), Appendix B (1 pages), Appendix C (4 pages), and Appendix D (2 pages) for a total of 26 pages.

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(continued)

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ACRONYMS

ABC	Alternate Building Construction
CGD	Commercial Grade Dedication
CGI	Commercial Grade Item
IROFS	Items Relied On For Safety
MOX	Mixed Oxide
MFFF	Mixed Oxide Fuel Fabrication Facility
QA	Quality Assurance
QC	Quality Control
QL	Quality Level
pcf	pounds per cubic foot
psf	pounds per square foot
SSC	Structures, Systems and Components
w.g.	Water Gauge

Penetration Seal Materials

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

AREVA

Document No.: 51-9218186-000

Detailed Test Plan for Conducting MOX Fire-Pressure Test 5

BACKGROUND

AREVA Inc. (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 5. 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 5 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 5 is to be the same test assembly that was constructed and used for MOX Pressure Test 11 [Reference 12.7] and Seismic Pressure Test 9 [Reference 12.9]. If the slab from Pressure Test 11 or Seismic Pressure Test 9 was damaged during testing or is otherwise not available, this test plan will require revision.

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 two openings into which Structo-Crete material will be fastened. The concrete openings will be 14" x 20" without beveled edges. Details for the two penetrations are provided in Section 2.2. The penetrations will be unlined (bare concrete). The test deck will be horizontally oriented with a hemispherical 72" diameter steel pressure vessel mounted on one side of the precast openings in the slab.

Note: It is anticipated that the slab with the silicone elastomer seals used for Pressure Test 11 and Seismic Pressure Test 9 will not be damaged during Pressure Test 11 and Seismic Pressure Test 9 and will be available for reuse in this fire pressure test. For the purpose of Fire-Pressure Test 5, no changes will be made to the silicone elastomer seals installed for Pressure Test 11 [Ref.12.7] and Seismic Pressure Test 9 [Ref. 12.9].

Additionally, most of the openings (penetrations) in the MOX facility have been cast with a ¾" bevel on both sides of the opening. For testing and qualification purposes, this feature is considered aesthetic, and it has no adverse effect on the functional performance of the penetration seal installation. In fact for some applications, such as in the case of seismically qualified penetrations seals, the bevel provides a benefit over non-beveled openings. Beveled edges are cast into concrete openings and do not apply to ABC barriers. Therefore, for the purposes of the penetration seal test program, the bevel feature will not be included for the fire pressure test covered in this test plan.

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

2.2 Test Description

There are two openings in the test deck that will be lined with ABC wall material (Structo-Crete) creating two penetrations to be sealed and tested in Fire-Pressure Test 5.

Penetration P1 - Test penetration P1 is a 14" x 20" concrete opening containing no penetrating items. Structo-Crete panels will be installed within the opening as shown in Appendix B. Structo-Crete panels are generally provided with one side smoother than the other (as a result of the manufacturing process). Two sides of the penetration will be lined with the smoother side of the Structo-Crete panels facing the seal material and two sides with the smoother side facing away. This penetration will be sealed with an 8" depth of Dow Corning Sylgard® 170 Silicone Elastomer (DC-170) with no permanent damming.

Penetration P2 - Test penetration P2 is a 14" x 20" concrete opening containing no penetrating items. Structo-Crete panels will be installed within the opening as shown in Appendix B. Structo-Crete panels are generally provided with one side smoother than the other (as a result of the manufacturing process). Two sides of the penetration will be lined with the smoother side of the Structo-Crete panels facing the seal material and two sides with the smoother side facing away. This penetration will be sealed with an 8" depth of Quantum Silicones QSil 5558MC Silicone Elastomer (QSil 5558MC) with no permanent damming.

The Structo-Crete and penetration seal materials will be located within the openings as shown in Appendix B. The test will be performed with the test deck oriented in the horizontal position and in accordance with Section 9.0

2.3 Critical Characteristics and Limiting Parameters Being Tested

Fire-Pressure Test 5 is being conducted to demonstrate that silicone elastomer penetration seal materials installed in ABC walls where the elastomer interfaces with Structo-Crete panels can withstand anticipated fire-induced pressures. Specifically, the fire-induced pressure resistance of elastomer penetration seal materials (DC-170 and QSil 5558MC) to Structo-Crete interface.

3.0 ASSUMPTIONS AND ACCEPTANCE CRITERIA

3.1 Assumptions

No assumptions were used in the development of this document.

3.2 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 12.8]), 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 fire 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 materials 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. Dow Corning Sylgard® 170 Silicone Elastomer (DC-170)
2. 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 and Appendix B 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 C.1).

7.3 Dimensioned Drawings

All test articles shall conform to the dimensioned drawings supplied by AREVA and contained in Appendix A and Appendix B 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 Appendix B) 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, in accordance with the drawings contained in Appendix A and Appendix B of this Test Plan.

AREVA QC representative (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 ARVEA 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 and Appendix B of this detailed test plan and in accordance with AREVA 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 Inc. Document 01-9198306, Installation Instruction Manual for MOX Penetration Seal Test Program [Reference 12.4]. For the purposes of this test plan, the "seal assemblies" requiring QA/QC verification

under 01-9198306 are limited to the installations of Dow Corning Sylgard® 170 Silicone Elastomer (DC-170) and Quantum Silicones QSil 5558MC Silicone Elastomer (QSil 5558MC).

8.3 Pre-Test Verifications

Prior to conducting this fire pressure test, 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 12.8]. 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 exposed side of the test assembly. 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.

Note: In the event the concrete on the exposed surface of the slab is damaged to the point where the pressure bonnet cannot be attached, the pressure bonnet may be installed on the top (unexposed side) of the fire-tested assembly. If this occurs, it shall be noted in the final test report and the condition of the concrete on the exposed side of the test assembly shall be clearly described in the final test report.

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 preferred side of the test deck to apply the pressure is the same side that was exposed to fire. However, depending upon the condition of the concrete following the 30-minute fire endurance test, it may not be feasible to pressurize the fire side. Therefore, the testing laboratory, in conjunction with the AREVA Test Engineer, shall make the final determination as to which side is to be pressurized and this determination shall be noted in the final test report. The pressure shall be applied in accordance with Sections 9.4.1 through 9.4.4 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 fire pressure test.

10.0 DATA SYSTEMS

During the fire exposure period, all thermocouples (including engineering thermocouples) shall be scanned at time intervals of 15 minutes or less. Data storage for reporting purposes shall comply with ASTM E 814-94b intervals, although furnace thermocouples may be scanned at more frequent intervals, to allow close control of the furnace. Data recorded shall be compiled and contained in the final test report. Additionally, the final test report shall include a description of the data acquisition system used during the test, including identification of software programs used.

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 fire 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, including which side of the assembly was pressurized
- Color digital photographs of the test project

12.0 REFERENCES

References identified with an (*) are maintained within MOX Records System and are not retrievable from AREVA Records Management. These are acceptable references per AREVA Administrative Procedure 0402-01, Attachment 8. See page 2 for Project Manager Approval of customer 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 51-9215844 (latest revision), *Detailed Test Plan for Conducting MOX Pressure Test 11*

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

12.9 AREVA NP Inc. Document 51-9217475 (latest revision), *Detailed Test Plan for Conducting MOX Seismic Pressure Test 9*

APPENDIX A: TEST DECK/TEST SLAB DRAWINGS

It is anticipated that the slab with the silicone elastomer seal material used for Pressure Test 11 and Seismic Pressure Test 9 will not be damaged during Pressure Test 11 and Seismic Pressure Test 9 and will be available for reuse in this fire pressure test. For the purpose of Fire Pressure Test 5, no changes will be made to the seal assemblies installed for Pressure Test 11 and Seismic Pressure Test 9. For test slab drawings see Pressure Test 11 drawings in Appendix A of Document 51-9215844, "*Detailed Test Plan for Conducting MOX Pressure Test 11*" [Reference 12.7].

APPENDIX B: TEST PENETRATION DRAWINGS

It is anticipated that the slab with the silicone elastomer seal material used for Pressure Test 11 and Seismic Pressure Test 9 will not be damaged during Pressure Test 11 and Seismic Pressure Test 9 and will be available for reuse in this fire pressure test. For the purpose of Fire Pressure Test 5, no changes will be made to the seal assemblies installed for Pressure Test 11 and Seismic Pressure Test 9. For penetration drawings see Pressure Test 11 drawings in Appendix B of Document 51-9215844, "*Detailed Test Plan for Conducting MOX Pressure Test 11*" [Reference 12.7].

APPENDIX C: BILL OF MATERIALS

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

C.1 Table Bill of Materials for AREVA Supplied Items

Bill of Material for AREVA Supplied Items					
Item	**Description**	**Part Number**	**Quantity**	**Units**	**Total**
1	Dow Corning Sylgard® 170 Silicone Elastomer (50lb part A, 50lb part B, 100lb Set)	N/A	1	Sets	2 Sets
2	Quantum Silicones QSil 5558MC (50lb part A, 50lb part B, 100lb set)	N/A	1	Sets	2 Sets

C.2 Bill of Materials for MOX Services Supplied Items

Bill of Material for MOX Services Supplied Items					
Item	**Description**	**Part Number**	**Quantity**	**Units**	**Total**
1	N/A				
2					
3					

*Use surplus from previous MOX testing at Intertek Lab.

C.3 Bill of Materials for Intertek Supplied Items

Bill of Material for Intertek Supplied Items*					
Item	**Description**	**Part Number**	**Quantity**	**Units**	**Total**
1*	Structo-Crete Structural Concrete Panel (Need approximately 1 full sheet)	N/A	1	Pallet (20 Sheets)	1 Pallet

*Use surplus from previous MOX testing at Intertek Lab.

Note: 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.: 51-9218186-000

Detailed Test Plan for Conducting MOX Fire-Pressure Test 5

APPENDIX D: DESIGN VERIFICATION CHECKLIST

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AREVA

DESIGN VERIFICATION CHECKLIST

Document Identifier 51 - 9218186 - 000

Title Detailed Test Plan for Conducting Fire- Pressure Test 5

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

AREVA

Document No.: 51-9218186-000

Detailed Test Plan for Conducting MOX Fire-Pressure Test 5

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

AREVA

DESIGN VERIFICATION CHECKLIST

Document Identifier 51 - 9218186 - 000

Comments on the preceding responses:

Verified By: (First, MI, Last)	Derrick V Risner (Printed / Typed Name)	[redacted] (Signature)	2/4/2014 (Date)

Intertek

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 51-9212668-000, "Dow Corning 790 Silicone Building Sealant Critical Characteristics"

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

Note: Even though the DC-790 material used in this test was only intended as a construction aid to reduce the chance of leakage occurring through the Structo-Crete to concrete interfaces, the DC-790 material used in this test was conservatively included in the MOX Penetration Seal Test Program's material baseline process.

The Structo-Crete (procured by Intertek) used in this test was not base-lined by AREVA because MOX Services is responsible for determining critical characteristics of Structo-Crete, as well as, any associated Commercial Grade Dedication of similar components.

APPENDIX G
Quality Documents

The test assembly for Fire-Pressure Test 5 was the same assembly constructed and first tested as Pressure Test 11. 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 11 (Intertek Report No. 101276459SAT-019; AREVA Doc. 58-9224202-000.

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] [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:

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]

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
INSPECTION
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 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]

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	-0.300	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]

[redacted]

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.

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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
C[redacted]

Approved By: [redacted] Cal. Lab. Manager

Page 8 of 22

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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

[redacted]

Approved By: Dante Bedolfes 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	8/11/2014
Pressure Transducer	406707	1/30/2015
Mass Flowmeter	4270050001001	1/30/2015
Mass Flowmeter	4270050003001	1/30/2015
Stop watch	130177254	4/1/2015

Build B
HORIZONTAL

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] [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:

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:	02/11/2014
Re-verification Date:	08/11/2014
Manufacturer:	National Insturments
Model No.:	USB-6210 (Only use 3 channels)
Serial No.:	18041FE
Equipment Description:	Data Acquisition System
Calibration Sources:	Ronan SN: 11380 due 4/6/2014
Performance:	See the attached sheet

Verification Performed By:

[redacted]

Staff Engineer

Verification Approved By:

[redacted]

Test Engineer

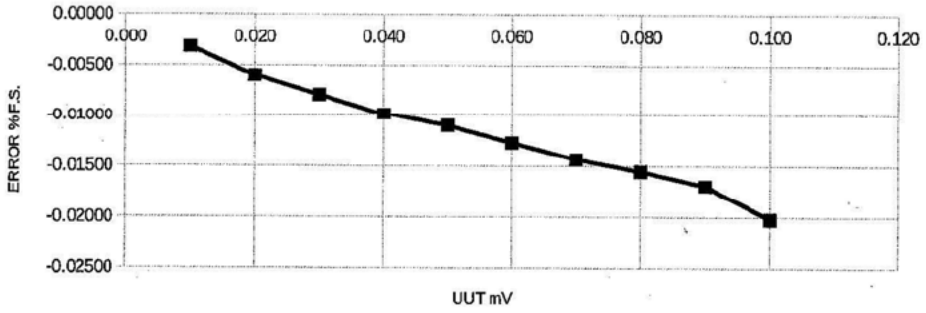
This Data Acquisition System was verified following the Draft "Work Instruction for Verifying Yokogawa Darwin Data Acquisition Systems" dated 8/28/2013

CERTIFICATE OF CALIBRATION

CUSTOMER:	**INTERTEK** ELMENDORF TX	**CALIBRATION DATE:**	01/30/14
PO NUMBER:	REF.# 01292014	**CALIBRATION DUE:**	01/30/15
INST. MANUFACTURER:	OMEGADYNE	**PROCEDURE:**	NAVAIR17-20MG-20
INST. DESCRIPTION:	PRESSURE TRANSDUCER	**CALIBRATION FLUID:**	70 F
MODEL NUMBER:	PX409-005DWUV	**STANDARD(S) USED:**	A49A. A24. A321 DUE 8-14
SERIAL NUMBER:	406707	**NIST TRACE #' S:**	1361269184, 1360578741, 1360586185, 1236086968
RATED UNCERTAINTY:	+/- 0.05 % FS	**AMBIENT CONDITIONS:**	759 mm HGA 55 % RH 70 F
UNCERTAINTY GIVEN:	FLOW measurement uncertainty: +/- .011 % F.S. K=2	**CERTIFICATE FILE #:**	456353.14

NOTES: AS RECEIVED/ AS LEFT WITHIN SPECS. NO ADJUSTMENTS MADE . REFERENCE CONDITIONS ARE: 760 mm HGA 70 F

TEST POINT NUMBER	UUT INDICATED mV OUT	DM.STD. ACTUAL PSID	ERROR % F.S.	
1	0.010	0.49984	-0.00318	
2	0.020	0.99970	-0.00602	
3	0.030	1.49960	-0.00792	
4	0.040	1.99951	-0.00984	
5	0.050	2.49945	-0.01105	
6	0.060	2.99936	-0.01272	
7	0.070	3.49928	-0.01435	
8	0.080	3.99922	-0.01552	
9	0.090	4.49915	-0.01692	
10	0.100	4.99899	-0.02020	



All instruments used in the performance of the shown calibration have traceability to the National Institute of Standards and Technology (NIST). The uncertainty ratio between the calibration standards (DM.STD.) used and the unit under test (UUT) is a minimum of 4:1, unless otherwise noted. Calibration has been performed per the shown procedure number, in accordance with ISO 10012:2003, ISO 17025:2005, ANSI/NCSL-Z-540.3, and/or MIL-STD-45662A. Test methods: API2530-92 & ASME MFC-3M-1989.

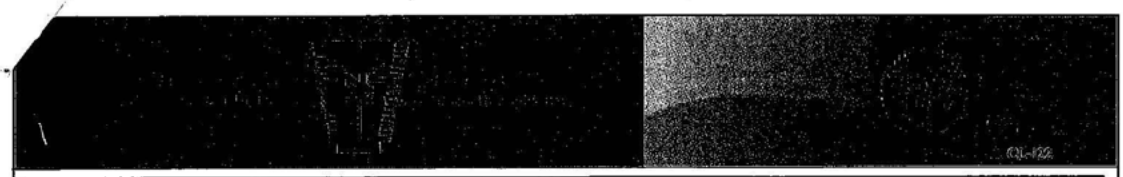
Dick Munns Company • 10572 Calle Lee #138 • Los Alamitos, CA 90720
[redacted]5 • Fax (714) 827-0823

This Calibration Certificate sha[redacted]PANY. The data shown applies only to the instrument being calibrated and under the stated conditions of calibration.

Date: 1/30/2014

Calibration Technician: [redacted]

Page 1 of 1

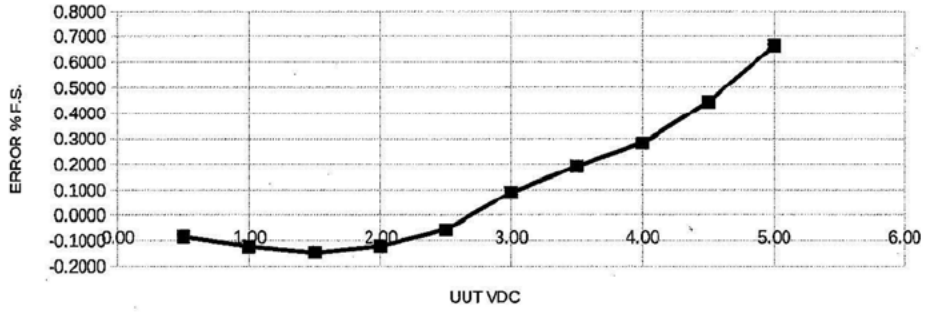


CERTIFICATE OF CALIBRATION

CUSTOMER:	**INTERTEK** ELMENDORF TX	**CALIBRATION DATE:**	01/30/14
PO NUMBER:	REF.# 01292014	**CALIBRATION DUE:**	01/30/15
INST. MANUFACTURER:	OMEGA	**PROCEDURE:**	NAVAIR17-20MG-20
INST. DESCRIPTION:	MASS FLOWMETER	**CALIBRATION FLUID:**	GN2 @ 70 F
MODEL NUMBER:	FMA-872A-V-NIST	**STANDARD(S) USED:**	A1-A4, A24, A321 DUE 8-14
SERIAL NUMBER:	4270050001001	**NIST TRACE #' S:**	1361259184, 1360578741, 1360586185
RATED UNCERTAINTY:	+/- 1 % FS	**AMBIENT CONDITIONS:**	759 mm HGA 55 % RH 70 F
UNCERTAINTY GIVEN:	FLOW measurement uncertainty: +/- .204 % F.S. K=2	**CERTIFICATE FILE #:**	456355.14

NOTES: AS RECEIVED/ AS LEFT WITHIN SPECS. NO ADJUSTMENTS MADE . REFERENCE CONDITIONS ARE: 760 mm HGA 70 F

TEST POINT NUMBER	UUT INDICATED VDC OUT	DM.STD. ACTUAL SLPM	ERROR % F.S.	
1	0.50	1.983	-0.0855	
2	1.00	3.975	-0.1231	
3	1.50	5.971	-0.1460	
4	2.00	7.976	-0.1217	
5	2.50	9.988	-0.0579	
6	3.00	12.018	0.0889	
7	3.50	14.038	0.1908	
8	4.00	16.056	0.2817	
9	4.50	18.089	0.4444	
10	5.00	20.133	0.6634	



All instruments used in the performance of the shown calibration have traceability to the National Institute of Standards and Technology (NIST). The uncertainty ratio between the calibration standards (DM.STD.) used and the unit under test (UUT) is a minimum of 4:1, unless otherwise noted. Calibration has been performed per the shown procedure number, in accordance with ISO 10012:2003, ISO 17025:2005, ANSI/NCSL-Z-540.3, and/or MIL-STD-45662A. Test methods: API2530-92 & ASME MFC-3M-1989.

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5 • Fax (714) 827-0823

This Calibration Certificate [redacted] PANY. The data shown applies only to the instrument being calibrated and under the stated conditions of calibration.

Date: 1/30/2014

Calibration Technician: [redacted]

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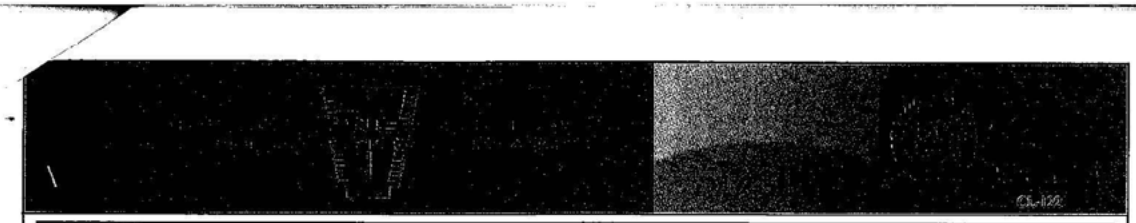
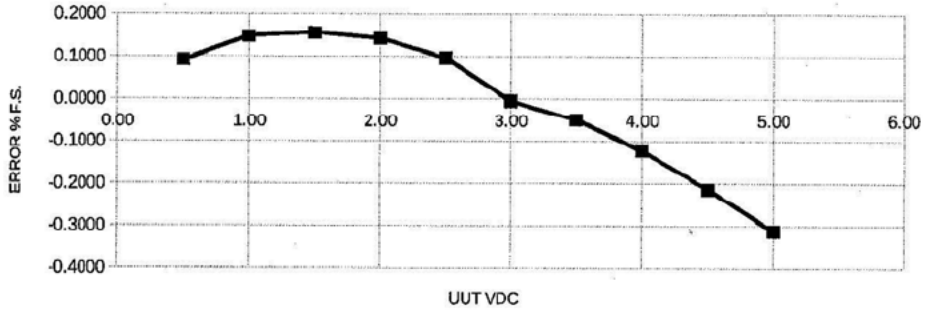


CERTIFICATE OF CALIBRATION

CUSTOMER:	**INTERTEK** ELMENDORF TX	**CALIBRATION DATE:**	01/30/14
PO NUMBER:	REF.# 01292014	**CALIBRATION DUE:**	01/30/15
INST. MANUFACTURER:	OMEGA	**PROCEDURE:**	NAVAIR17-20MG-20
INST. DESCRIPTION:	MASS FLOWMETER	**CALIBRATION FLUID:**	GN2 @ 70 F
MODEL NUMBER:	FMA-875A-V-NIST	**STANDARD(S) USED:**	A1-A4, A24, A321 DUE 8-14
SERIAL NUMBER:	4270050003001	**NIST TRACE #' S:**	1361269184, 1360578741, 1360586185
RATED UNCERTAINTY:	+/- 1 % FS	**AMBIENT CONDITIONS:**	759 mm HGA 55 % RH 70 F
UNCERTAINTY GIVEN:	FLOW measurement uncertainty: +/- .204 % F.S. K=2	**CERTIFICATE FILE #:**	456354.14

NOTES: AS RECEIVED/ AS LEFT WITHIN SPECS. NO ADJUSTMENTS MADE . REFERENCE CONDITIONS ARE: 760 mm HGA 70 F

TEST POINT NUMBER	UUT INDICATED VDC OUT	DM.STD. ACTUAL SLPM	ERROR % F.S.	
1	0.50	20.183	0.0913	
2	1.00	40.294	0.1471	
3	1.50	60.311	0.1553	
4	2.00	80.282	0.1411	
5	2.50	100.191	0.0957	
6	3.00	119.988	-0.0059	
7	3.50	139.899	-0.0505	
8	4.00	159.754	-0.1230	
9	4.50	179.573	-0.2138	
10	5.00	199.373	-0.3133	



All instruments used in the performance of the shown calibration have traceability to the National Institute of Standards and Technology (NIST). The uncertainty ratio between the calibration standards (DM.STD.) used and the unit under test (UUT) is a minimum of 4:1, unless otherwise noted. Calibration has been performed per the shown procedure number, in accordance with ISO 10012:2003, ISO 17025:2005, ANSI/NCSL-Z-540.3, and/or MIL-STD-45662A. Test methods: API2530-92 & ASME MFC-3M-1989.

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Fax (714) 827-0823

This Calibration Certificate sh[redacted] The data shown applies only to the instrument being calibrated and under the stated conditions of calibration.

Date: 1/30/2014

[redacted] ibration Technician:

Page 1 of 1

[redacted] 9/7/14

ilac-MRA ACCREDITED Calibration Certificate No. 1750.01

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

Cert. No.: 1045-5005572

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: 130177254 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: 4/01/13 **Cal Due: 4/01/15**

Test Conditions: 23.5°C 50.0 %RH 1017 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	-0.400	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] [redacted]

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

TEST ARTICLE ATTRIBUTE CHECKLIST

PROJECT NO: G101266224-012 **CLIENT :** AREVA

Project Description FIRE PRESSURE #5

	SAT	UNSAT

I. ASSEMBLY

Proper materials used .....
Material documentation complete.....
Configuration/dimensions in accordance w/ approved drawings....
Description of assembly: FIRE PRESSURE #5

[redacted]

II. ELECTRICAL CABLE

Correct material used .....
Material documentation complete .....
Correct cable lay-in and fill requirements .....
Description of electrical cable:

N/A

III. THERMOCOUPLES

Correct thermocouple type, certs received .....
Thermocouples positioned in accordance with test plan .....
Adequately labeled and secured .....
Quality Assurance verification done .....
Description of thermocouples: 24 GA TYPE K

[redacted]

IV. FIRE BARRIER

Name or type of material DC 170 + QSIL + STRUCTOCHEM
INTERTEK received material documentation provided by Client.....
Materials provided by INTERTEK properly documented .....
Materials installed by INTERTEK in accordance with test plan .....
INTERTEK Quality Assurance responsibilities determined .....
QA responsibilities of Client installation determined .....
Moisture check required ..... Yes ___ No X
Special requirements

[redacted]

V. FINAL PREBURN VERIFICATION

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

CALIBRATION DOCUMENTATION (S/N and calibration due date)
Data Acquisition Equipment:
Other Measurement Devices: SEE TEST DATA PACKAGE

Temperature 57 Humidity 49 Date 2-13-14 Time of Test start 11:10 A

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-012 for AREVA NP, Inc.

Page 1 of 1

ITEM	DATE	INIT'L
Concrete poured by Alamo Concrete	1/10/14	MD
Concrete conditioned	1/13/14	MD
Critical attributes of test slab verified	1/29/14	MD
Completed seal assemblies verified against the test plan	2/10/14	MD
Pressure Test #11 conducted	2/12/14	MD
Seismic Test #9 conducted using the same assembly	2/12/14	MD
Test Assembly re-purposed for Fire-Pressure #5	2/12/14	MD
Thermocouples installed in accordance with the test plan	2/12/14	MD
Fire-Pressure #5 (Fire Test) conducted	2/13/14	MD
Fire-Pressure #5 (Pressure Test) conducted	2/18/14	MD

9/12 NQAP-007.7.3

Certificate of Conformance

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

Project No: G101266224SAT-012

Intertek Testing Services NA (Intertek) has conducted testing for AREVA NP Inc., on the fire and pressure resistance capabilities of Dow Corning® Sylgard 170 Silicone Elastomer (DC-170), Quantum Silicones QSil 5558MC Silicone Elastomer (QSil 5558MC) 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. 51-9218186-000, *Detailed Test Plan for Conducting MOX Fire-Pressure Test 5*. This test took place February 13 through February 18, 2014.

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