Accepted for Use

TEST REPORT

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RENDERED TO

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AREVA	AREVA NP Inc.
	58-9224207-000

PRODUCTS EVALUATED: Unifrax Fiberfax® Durablanket® S, Dow Corning® 732 Silicone Multi-Purpose Sealant, Dow Corning® 790 Silicone Building Sealant and PCI-Promatec SF-150NH High Density Silicone Elastomer

EVALUATION PROPERTY: Fire and Pressure Resistance (Fire-Pressure Test 4)

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. 51-9217624-001, *Detailed Test Plan for Conducting MOX Fire-Pressure Test 4.*

1 Table of Contents

2 Introduction

Intertek Testing Services NA (Intertek) has conducted testing for AREVA NP Inc., on the fire and pressure resistance capabilities of Unifrax Fiberfax® Durablanket® S (Durablanket), Dow Corning® 732 Silicone Multi-Purpose Sealant (DC-732), Dow Corning® 790 Silicone Building Sealant (DC-790) and PCI-Promatec SF-150NH High Density Silicone Elastomer (SF-150NH) through a 12" thick concrete deck for compliance with the applicable requirements of and in accordance with AREVA NP Inc. Document No. 51-9217624-001, *Detailed Test Plan for Conducting MOX Fire-Pressure Test 4.* The test took place on February 20 through February 24, 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 9 without any changes. Refer to AREVA Doc. 58-9223295-001 or Intertek Test Report No. 101276459SAT-018_Rev. 1 for details on Pressure Test 9.

3 Test Samples

3.1. SAMPLE SELECTION

The sealant materials were not independently selected for testing; they were supplied by AREVA NP Inc., and were received in several shipments from June 13, 2013 to January 9, 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
Durablanket® S	33274	NA
DC-732	0007251823	5/29/2015
DC-790	0007643997	11/29/2014
SF-150NH	NH014B01	7/31/2014
SF-150NH	NH083B05	2/28/2014

Information regarding receiving dates and origin of all the materials in the assembly can be found in Appendix F: Quality Documents of Pressure Test 9 (Intertek Test Report 101276459SAT-018_Rev. 1; AREVA Doc. 58-9223295-001). All samples were received in good condition at the Evaluation Center.

3.2. SAMPLE AND ASSEMBLY DESCRIPTION

The test assembly for Fire-Pressure Test 4 was constructed and first tested as Pressure Test 9 before being repurposed for Fire-Pressure Test 4. The only modifications to the assembly from Pressure Test 9 for Fire-Pressure Test 4 was the addition of a simulated fire damper plate inside the HVAC duct penetration test, and the removal of the four rubber pipe caps and

addition of ceramic fiber fill inside the pipes prior to the fire endurance. The rubber caps were re-installed in the pipes following the fire test and prior to the pressure test.

A detailed description and drawings of the concrete deck and penetrations can be found in AREVA NP Inc. Document No. 51-9217624-001, *Detailed Test Plan for Conducting MOX Fire-Pressure Test 4* which is contained in Appendix E. The installation and documentation of penetration seal assemblies contained within the test slab was performed by AREVA under AREVA's Quality Assurance Program (Reference 12.3 in the test plan found in Appendix E).

Within this slab there were two penetrations. The HVAC penetration was 36" x 19" with a 3/4" bevel on three sides of the opening on the top side of the barrier and a 3/4" bevel on all 4 sides of the opening on the bottom side of the barrier. A 1 foot tall "curb" was positioned against the fourth side of the opening on the top side of the barrier to simulate a wall or floor/ceiling slab adjacent to the penetration. The radiation shielding penetration was a 36" x 12" opening without beveled edges. Details for the two penetrations are provided below.

Penetration P1 - Test penetration P1 was a 36" x 19" blockout containing a mechanical duct sealed at one end simulating a duct designed to resist the passage of fire. Specifically, this penetration contained one (1) galvanized steel 14" x 14" duct with a fitted cover plate installed on the bottom side simulating a duct designed to resist the passage of fire. The penetrating duct was located within the opening as shown in Appendix B of the Test Plan in Appendix E. This opening was sealed using a penetration closure design, as laid out in Drawing DCS01-BMF-DS-PLF-A-04509 [Test Plan Reference 12.9], consisting of steel track, steel studs, Structo-Crete concrete panel material, metal retainer angles, Dow Corning® 790 Silicone Building Sealant / Dow Corning® 732 Multi-Purpose Sealant and ceramic fiber blanket material as backing for the silicone sealants.

Penetration P2 - Test penetration P2 was a 36" x 12" blockout containing multiple penetrating items. All sides of the opening were unlined, bare concrete (i.e., no liners, coatings or sleeve materials). The tested conduits included one (1) 2" diameter Rigid Galvanized Steel (RGS) conduit and one (1) 2" diameter Stainless Steel (SS) conduit. The tested pipes included one (1) 2" diameter Schedule 40 Carbon Steel (CS) pipe and one (1) 2" diameter Schedule 10 Stainless Steel (SS) pipe. The conduits and pipes were plugged from the bottom with ceramic fiber during the fire portion of the test and capped on the top with a rubber pipe cap during the pressure portion of the test. (Note: caps and/or plugs are construction aids only and are not being qualified by this fire-pressure test).

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 4. 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 4 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

Six (6) 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

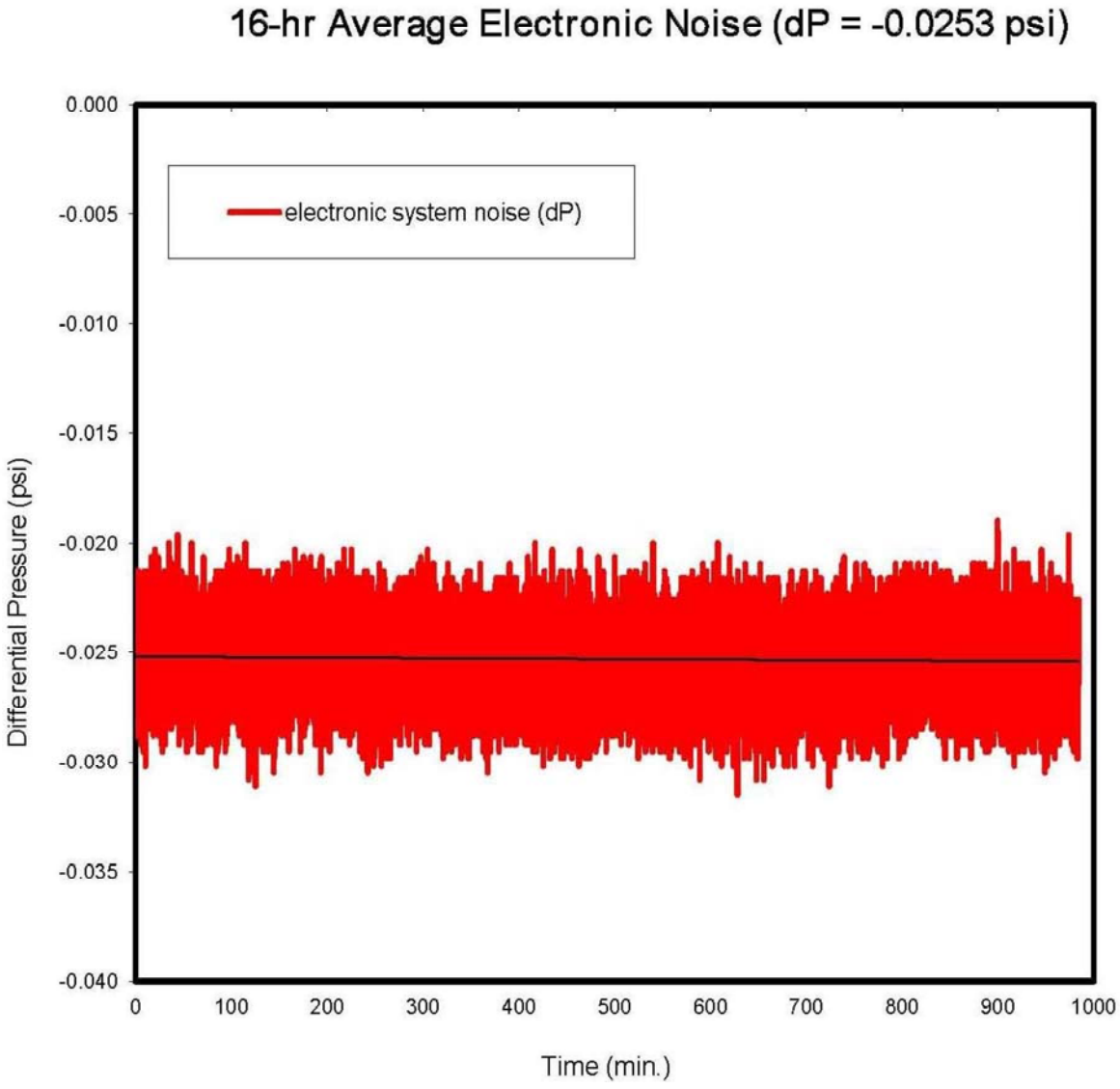
Omega Engineering, Inc., Stamford, CT
Model No. FMA-875A-V-NIST
Serial No. 4270050003001
0-200 lpm

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. 51-9217624-001, *Detailed Test Plan for Conducting MOX Fire-Pressure Test 4*.

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 12.8]), 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, underwent a limited duration fire test (30 minute duration) with the fire tested specimens then subjected to subsequent pressure tests.

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

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

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

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

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

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

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

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

Differential Pressure Test Levels

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

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

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

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

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

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

5 Testing and Evaluation Results

5.1. RESULTS AND OBSERVATIONS

5.1.1. Fire Test

The test assembly was placed on the laboratory's small-scale (7' x 7') horizontal furnace on February 20, 2014. Scott Groesbeck from AREVA was present to witness the test. The ambient temperature at the start of the test was 82°F, with a relative humidity of 39%.

The furnace was fired at 4:07 p.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 test assembly. There was no hose stream test required for this fire-pressure test. However, water was applied with a standard garden hose to extinguish residual flaming as allowed by the test plan. The assembly was allowed to cool for several days prior to conducting the subsequent pressure test.

Following the fire test, it was observed that the Structo-Crete layer on the exposed side of Penetration 1 appeared to have been degraded by the fire exposure. A portion of the first layer of Structo-Crete was sagging. Also, most of the DC-790 material in Penetration 1 was consumed during the fire exposure with only a slight amount of charred material remaining in isolated spots along the perimeter of the retaining angles. All of the DC-732 material between the retaining angles and duct appears to have been consumed by the fire. The exposed surface of the SF-150NH material in Penetration 2 shows signs of slight surface charring. Additionally, the pipes in Penetration 2 are discolored.

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 deck (exposed side) 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 2:35 p.m. on February 24, 2014. Scott Groesbeck representing AREVA NP Inc. was present to witness the test. The ambient temperature at the start of the test was 77°F, with a relative humidity of 57%.

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 and leakage was noted as follows:

Prior to achieving the Stage 1 pressure: The HVAC duct in Penetration 1 started to whistle at

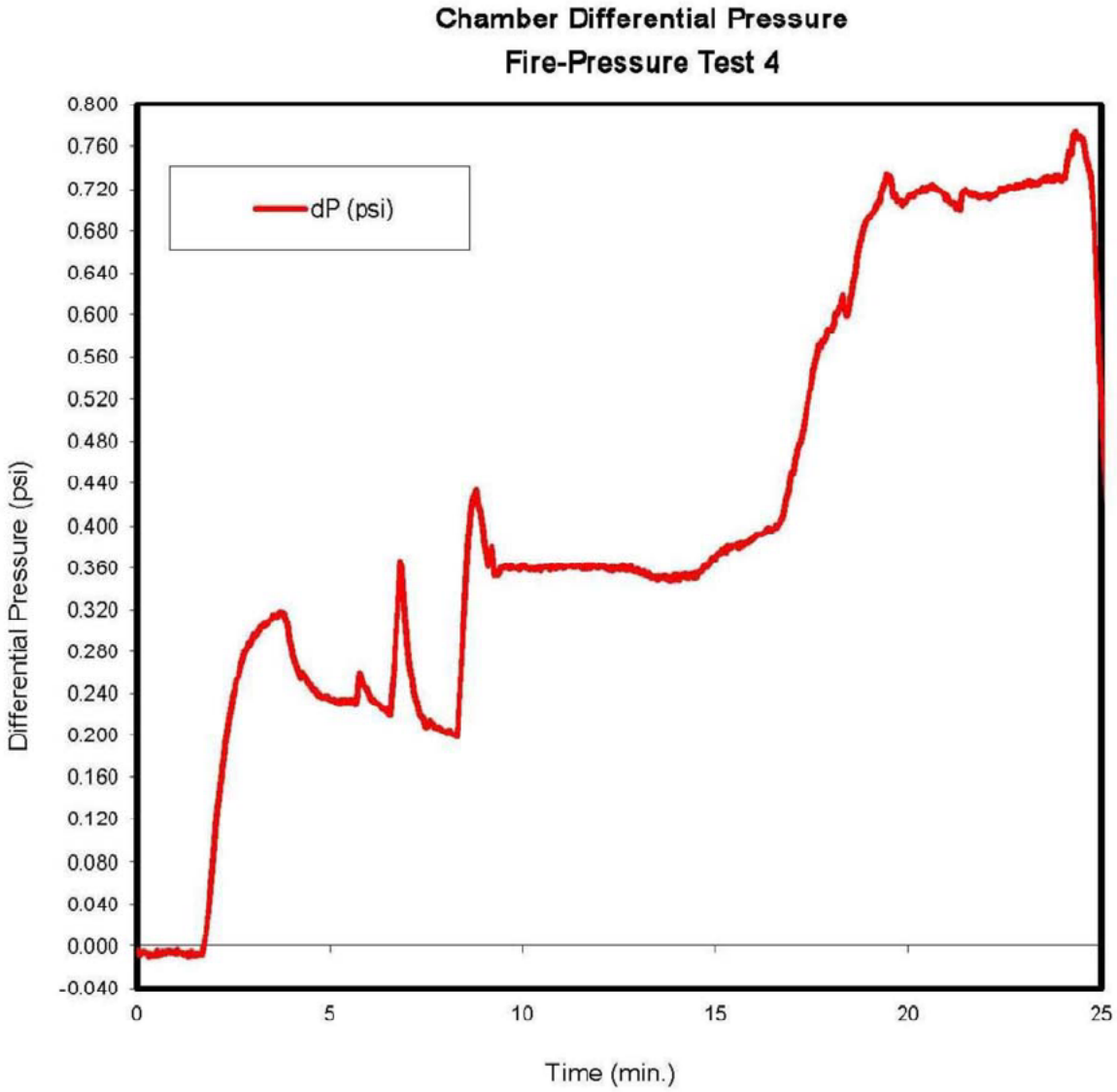
the duct to racked-C retaining angle interface as pressure was introduced into the pressure bonnet. The duct was deflecting inward and pulling away from the DC-732. Since the required pressure could not be achieved with this large leak path, a piece of ethafoam damming material was cut and wedged inside the duct to push the duct back into its original form. This fix allowed the test assembly to build pressure.

Stage 1 (10" WC): The pressure was ramped up to 10" WC and held for the 5 minute hold duration without any leaks noted in Penetration 1. Penetration 2 had four small leaks at various points of interface between the concrete and the SF-150NH seal.

Stage 2 (20" WC): The pressure was increased to 20" WC and held for the 5 minute hold duration. Leakage was noted at the problem area between the duct and the racked-C retaining angle in Penetration 1. The same 4 leakages spots were noted in Penetration 2. All leakage was characterized as "minor", based on the make-up air required to maintain the 5 minute hold period.

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

Listings 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
  - P1 – The majority of the DC 732 and DC 790 is gone from the exposed side and the outer layer of Structo-Crete has fallen away. P2 – Approximately 1/8" of seal degradation. Small gaps are present around all of the pipes and conduits, but the gaps only extend a short distance up into the seal.
- Integrity of seal and conditions on the unexposed side of the penetration
  - P1 – Three sides of the duct were welded to a stiffener angle and no visible changes were observed. The remaining side developed a gap at the interface of the DC 732. The DC 790 and Structocrete remained intact. P2 - No visual changes were observed.
- Location of any penetration seal degradation
  - P2 – uniform degradation on the exposed side of ~1/8 inch
- Condition of seal to barrier interface
  - No visual changes were observed on the unexposed side. A small gap developed on the exposed side of P2 that extended no more than ½" into the seal.
- Condition of seal to penetrating item interfaces
  - P1 – as noted above

6 Conclusion

Intertek Testing Services NA (Intertek) has conducted testing for AREVA NP Inc., on the fire and pressure resistance capabilities of Unifrax Fiberfax® Durablanket® S (Durablanket), Dow Corning® 732 Silicone Multi-Purpose Sealant (DC-732), Dow Corning® 790 Silicone Building Sealant (DC-790) and PCI-Promatec SF-150NH High Density Silicone Elastomer (SF-150NH) through a 12" thick concrete deck for compliance with the applicable requirements of and in accordance with AREVA NP Inc. Document No. 51-9217624-001, *Detailed Test Plan for Conducting MOX Fire-Pressure Test 4.* The evaluation took place on February 20 through February 24, 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: [redacted]
Mike Dey
Staff Engineer

Reviewed by: [redacted]
Project Engineer, Fire Resistance

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

APPENDIX A
Assembly Drawings

APPENDIX A: TEST DECK/TEST SLAB DRAWINGS

The test deck (test slab) for Fire-Pressure Test 4 is depicted on page A-2.

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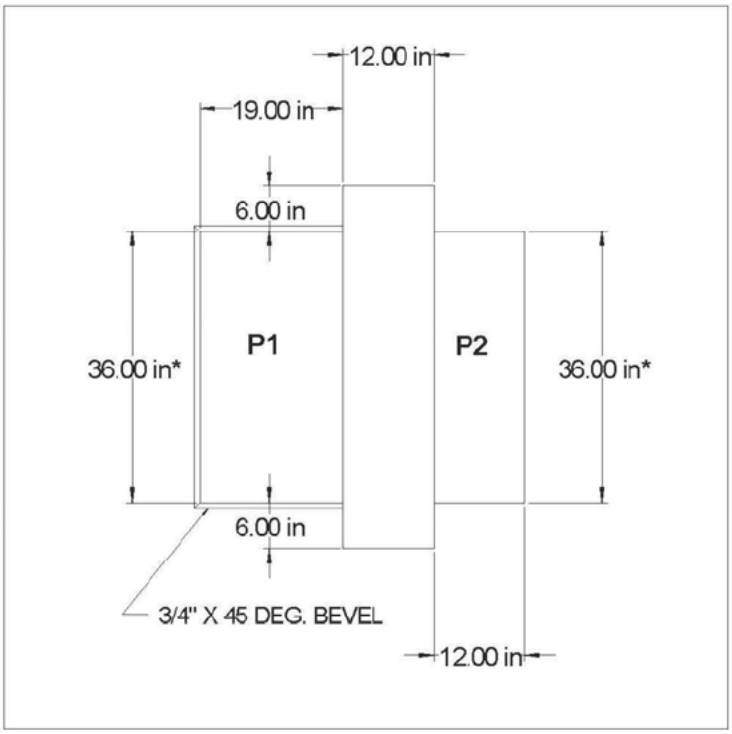
Document No.: 51-9217624-001

Detailed Test Plan for Conducting MOX Fire-Pressure Test 4

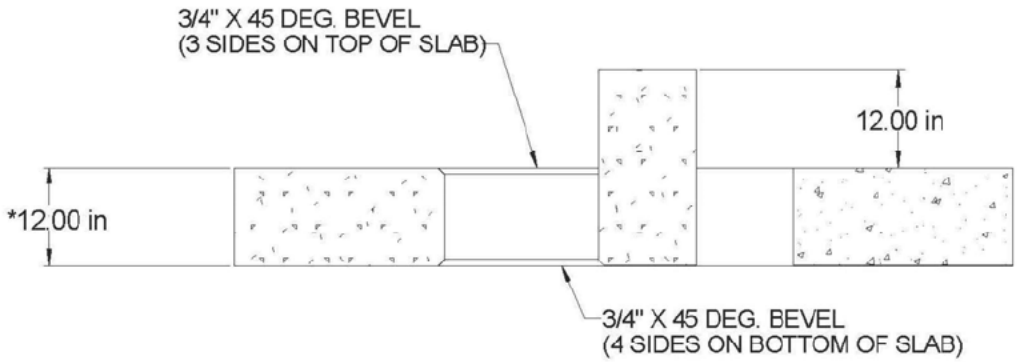
Fire-Pressure Test 4 Test Deck



NOTES:

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

Intertek



Section A - A

NOTES:

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

APPENDIX B: TEST PENETRATION DRAWINGS

This appendix contains Test Penetration drawings. These drawings identify penetrating item locations within the test penetration, as well as, the penetration seal design for each test penetration.

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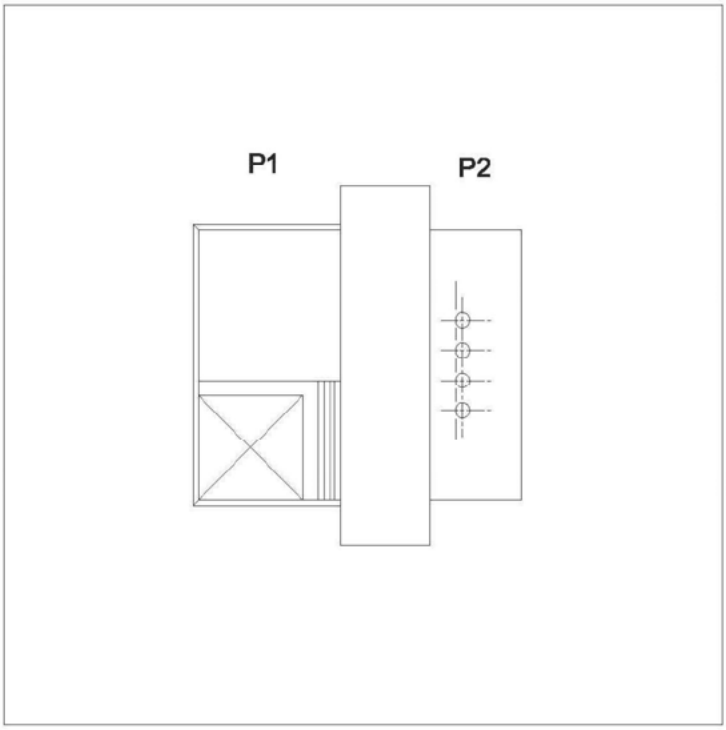
Document No.: 51-9217624-001

Detailed Test Plan for Conducting MOX Fire-Pressure Test 4

Fire-Pressure Test 4 Test Deck



NOTES:

1. TOLERANCE ON ALL SLAB DIMENSIONS IS +/- 1/4"
2. * INDICATES DIMENSIONS TO BE VERIFIED BY AREVA QC.
3. SEE PAGE B-3, B-4, B-5 AND B-6 FOR DETAILS OF PENETRATION P1.
5. SEE PAGE B-7, AND B-8 FOR DETAILS OF PENETRATION P2.

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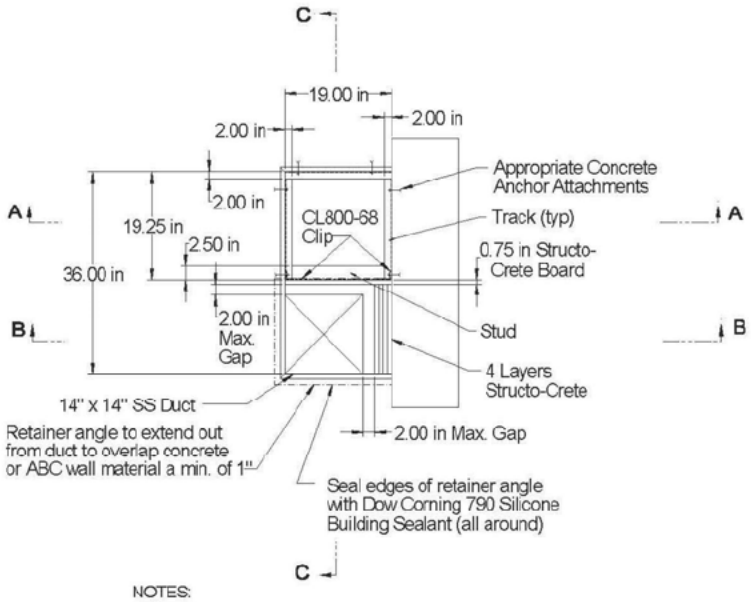
Document No.: 51-9217624-001

Detailed Test Plan for Conducting MOX Fire-Pressure Test 4

Penetration P1



NOTES:

1. TOLERANCE ON ALL SLAB DIMENSIONS IS +/- 1/4"
2. * INDICATES DIMENSIONS TO BE VERIFIED BY AREVA QC.
3. THE STEEL NETWORK STRUCTURAL FRAMING AND STRUCTO-CRETE INSTALLED TO REDUCE OPENING SIZE AROUND DUCT.

   SEE DRAWING DCS01-BMF-DS-PLF-A-04509 FOR DETAILS.
4. ALL CAST CONCRETE SURFACES THAT WILL INTERFACE WITH DOW CORNING 790 SILICONE BUILDING SEALANT SHALL BE PREPARED USING A GRINDER EQUIPPED WITH A HILTI DG-CW AP-SP DIAMOND CUP WHEEL (HILTI ITEM NO. 2066711). THIS INCLUDES THE BEVEL AREA OF THE CONCRETE OPENINGS, AS WELL AS, THE FACE OF THE CONCRETE SLAB ON BOTH SIDES OF THE BARRIER FOR A DISTANCE OF APPROXIMATELY 2" WIDE AROUND THE PERIMETER OF PENETRATION P1.

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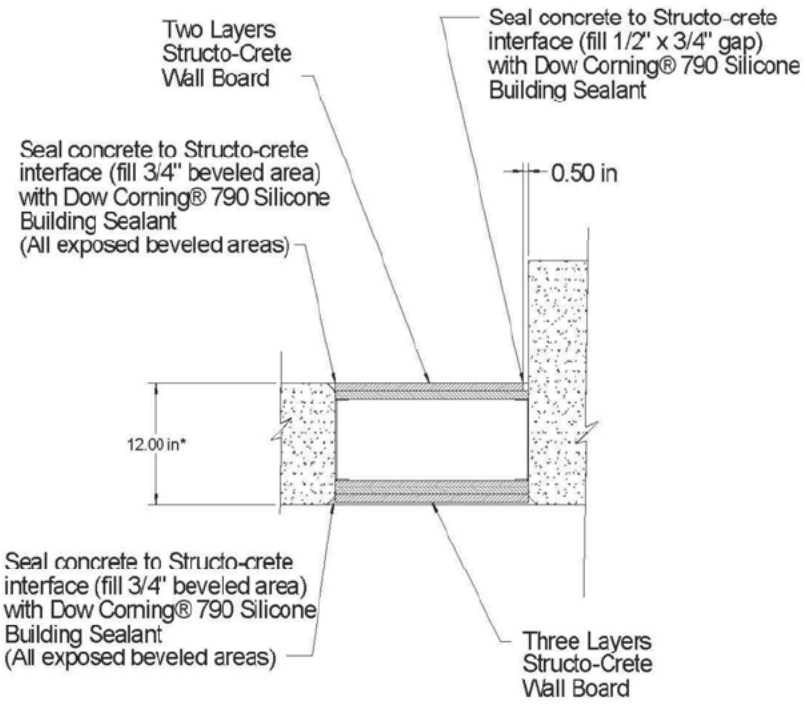
Document No.: 51-9217624-001

Detailed Test Plan for Conducting MOX Fire-Pressure Test 4

Penetration P1



Section A-A

NOTES:

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

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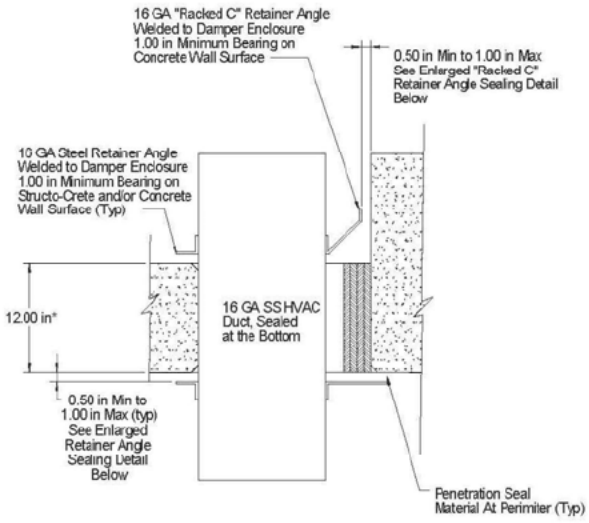
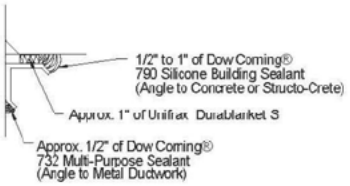
Document No.: 51-9217624-001

Detailed Test Plan for Conducting MOX Fire-Pressure Test 4

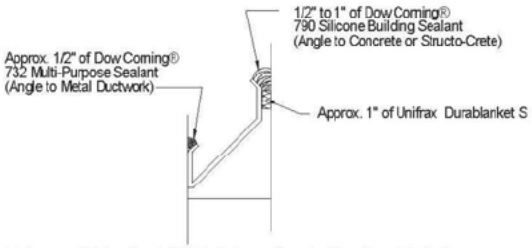
Penetration P1



Section B - B



Enlarged Retainer Angle Sealing Detail



Enlarged "Racked C" Retainer Angle Sealing Detail

NOTES:

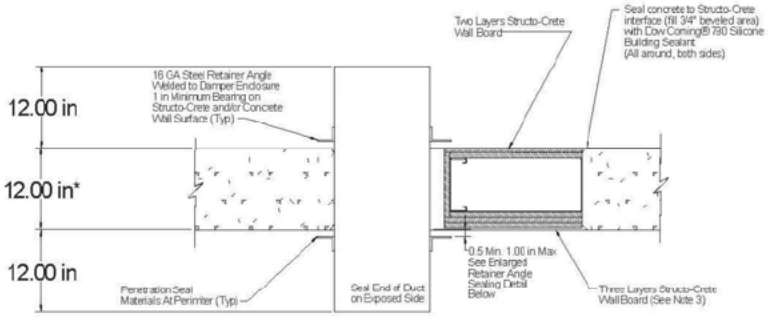
1. TOLERANCE ON ALL SLAB DIMENSIONS IS +/- 1/4"
2. * INDICATES DIMENSIONS TO BE VERIFIED BY AREVA QC.

AREVA

Document No.: 51-9217624-001

Detailed Test Plan for Conducting MOX Fire-Pressure Test 4

Penetration P1



Section C - C

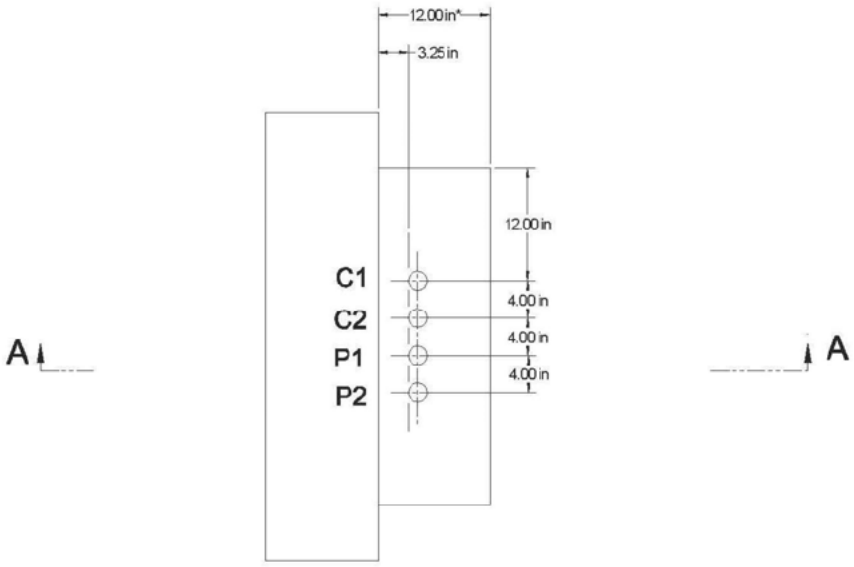
Enlarged Retainer Angle Sealing Detail

NOTES:

1. TOLERANCE ON ALL SLAB DIMENSIONS IS +/- 1/4"
2. * INDICATES DIMENSIONS TO BE VERIFIED BY AREVA QC.
3. HILTI SELF-DRILLING SCREWS – 12-24 X 2-1/2" PFH #4 FIRST LAYER STRUCTO-CRETE TO METAL STUDS.

   HILTI SELF-DRILLING SCREWS – S-MD 12-24 X 3 HWH #5 KWIK-COTE USED FOR SECOND LAYER STRUCTO-CRETE TO METAL STUDS MAY BE USED FOR THE 3RD LAYER STRUCTO-CRETE BY COUNTERSINKING THE 3RD LAYER OF STRUCTO-CRETE UP TO 3/8".

PENETRATION P2



C1 = 2" SS Conduit
C2 = 2" RGS Conduit
P1 = 2" CS Pipe
P2 = 2" SS Pipe

NOTES:

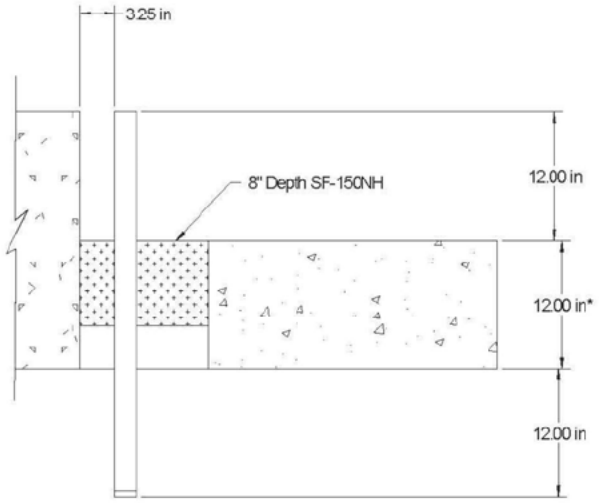
1. TOLERANCE ON ALL SLAB DIMENSIONS IS +/- 1/4"
2. * INDICATES DIMENSIONS TO BE VERIFIED BY AREVA QC.

AREVA

Document No.: 51-9217624-001

Detailed Test Plan for Conducting MOX Fire-Pressure Test 4

PENETRATION P2



Section A - A

NOTES:

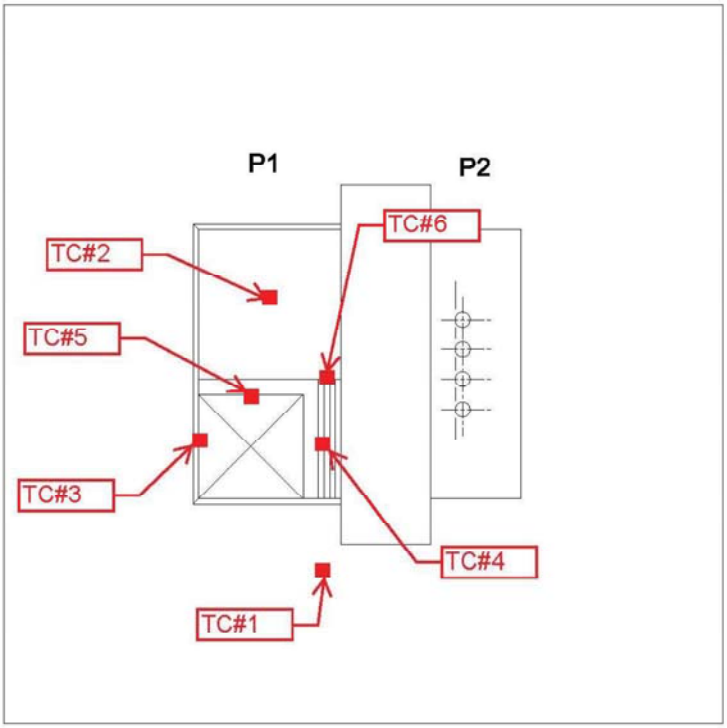
1. TOLERANCE ON ALL SLAB DIMENSIONS IS +/- 1/4"
2. * INDICATES DIMENSIONS TO BE VERIFIED BY AREVA QC.

APPENDIX B
Thermocouple Layout

Thermocouple Layout, Fire-Pressure Test 4

Pen. No.	TC No.	TC Location	Mark No.
SLAB	TC#1	Surface - Test Slab	
Pen 1	TC#2	Surface - Structo-Crete (near center)	
Pen 1	TC#3	Penetrant - 1" above DC-732 on HVAC duct (0" clearance side)	
Pen 1	TC#4	Surface - On racked-C flashing near center	
Pen 1	TC#5	Penetrant - 1" above DC-732 on HVAC duct (HVAC @ Structo-Crete side)	
Pen 1	TC#6	Surface - DC-790 triangle at end of racked-C	
Pen 2	N/A	No TC's were placed on Pen. 2 due to robust seal design and limited duration of fire test (30 minutes). TC's would have provided little useful data for this configuration.	

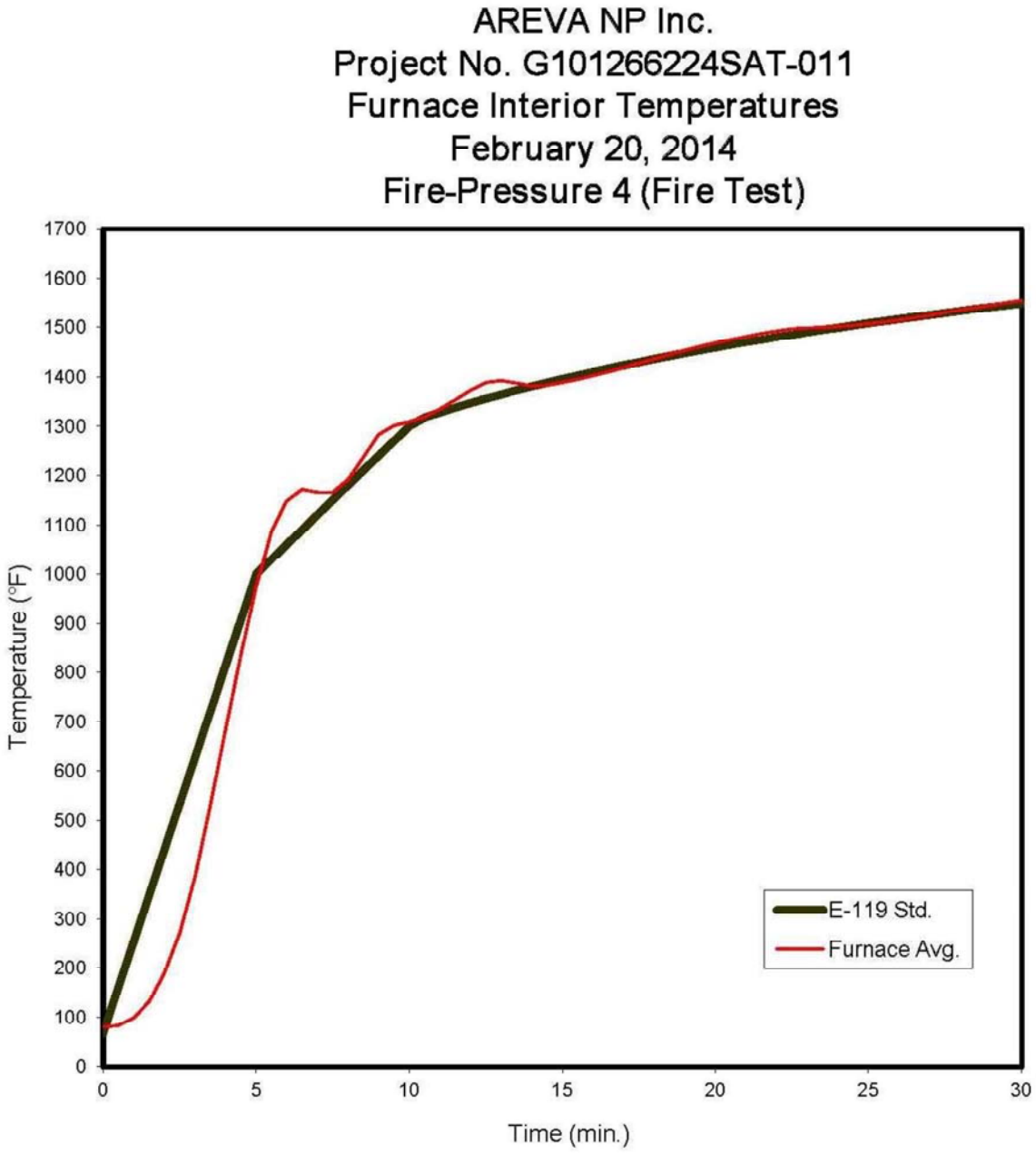
Fire-Pressure Test 4 Test Deck



NOTES:

1. TOLERANCE ON ALL SLAB DIMENSIONS IS +/- 1/4"
2. * INDICATES DIMENSIONS TO BE VERIFIED BY AREVA QC.
3. SEE PAGE B-3, B-4, B-5 AND B-6 FOR DETAILS OF PENETRATION P1.
5. SEE PAGE B-7, AND B-8 FOR DETAILS OF PENETRATION P2.

APPENDIX C1
Temperature Data


AREVA NP Inc.
Project No. G101266224SAT-011
Furnace Interior Temperatures
February 20, 2014
Fire-Pressure 4 (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-011 February 20, 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)
0	68	80	74	91	76	79	0.0074	2.424
0.5	161	83	77	92	79	83	0.0107	2.457
1	254	99	92	104	92	107	0.0116	2.466
1.5	348	131	126	131	118	150	0.0082	2.432
2	441	189	193	181	163	219	0.0124	2.474
2.5	534	271	300	248	229	306	0.0064	2.414
3	627	386	444	356	316	427	0.0174	2.524
3.5	720	529	615	471	419	611	0.0096	2.446
4	814	684	794	600	534	809	0.0058	2.408
4.5	907	837	963	736	663	986	0.0177	2.527
5	1000	974	1107	859	800	1129	0.0226	2.576
5.5	1030	1086	1220	960	934	1231	0.0121	2.471
6	1060	1148	1278	1012	1016	1285	0.0107	2.457
6.5	1090	1171	1285	1055	1052	1292	0.0061	2.411
7	1120	1165	1263	1065	1063	1268	0.0104	2.454
7.5	1150	1165	1253	1080	1076	1252	0.0108	2.458
8	1180	1192	1284	1110	1102	1270	0.0179	2.529
8.5	1210	1237	1338	1146	1153	1312	0.019	2.54
9	1240	1283	1386	1186	1191	1368	0.0124	2.474
9.5	1270	1301	1401	1199	1219	1386	0.0114	2.464
10	1300	1309	1396	1216	1241	1384	0.015	2.5
10.5	1317	1319	1405	1228	1256	1388	0.0152	2.502
11	1328	1335	1425	1243	1269	1402	0.0185	2.535
11.5	1337	1353	1448	1259	1284	1421	0.0129	2.479
12	1347	1373	1471	1278	1301	1441	0.0126	2.476
12.5	1356	1389	1489	1293	1316	1457	0.0131	2.481
13	1364	1393	1483	1303	1327	1458	0.0124	2.474
13.5	1373	1387	1463	1308	1334	1444	0.0111	2.461
14	1381	1382	1449	1310	1337	1431	0.012	2.47
14.5	1388	1383	1450	1315	1340	1427	0.0027	2.377
15	1396	1389	1459	1320	1345	1430	0.0116	2.466
15.5	1403	1395	1468	1326	1350	1437	0.0129	2.479
16	1410	1403	1478	1334	1356	1443	0.0081	2.431
16.5	1417	1410	1487	1341	1362	1451	0.0151	2.501
17	1424	1419	1496	1350	1369	1460	0.0162	2.512
17.5	1430	1428	1507	1358	1376	1469	0.0142	2.492
18	1436	1437	1518	1366	1383	1479	0.0154	2.504
18.5	1442	1445	1526	1375	1392	1488	0.0147	2.497
19	1448	1454	1534	1385	1400	1496	0.0143	2.493
19.5	1454	1461	1540	1393	1408	1503	0.0147	2.497
20	1459	1469	1547	1402	1416	1509	0.0134	2.484
20.5	1465	1475	1552	1410	1424	1515	0.0148	2.498

AREVA NP, Inc. Project No. G101266224SAT-011 February 20, 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)
21	1470	1482	1556	1418	1432	1520	0.0133	2.483
21.5	1475	1488	1561	1426	1441	1523	0.012	2.47
22	1480	1493	1563	1433	1449	1526	0.0101	2.451
22.5	1485	1497	1565	1438	1457	1528	0.0109	2.459
23	1490	1499	1563	1443	1464	1526	0.0129	2.479
23.5	1495	1500	1562	1446	1469	1523	0.0118	2.468
24	1499	1502	1561	1450	1473	1523	0.0133	2.483
24.5	1504	1504	1562	1453	1477	1525	0.0117	2.467
25	1508	1508	1564	1457	1481	1528	0.0122	2.472
25.5	1513	1511	1567	1461	1485	1531	0.0134	2.484
26	1517	1515	1571	1465	1489	1534	0.0125	2.475
26.5	1521	1520	1577	1469	1493	1540	0.0107	2.457
27	1525	1525	1582	1474	1498	1544	0.0153	2.503
27.5	1529	1530	1586	1479	1504	1552	0.0177	2.527
28	1533	1535	1590	1485	1510	1556	0.015	2.5
28.5	1537	1540	1594	1490	1516	1561	0.0128	2.478
29	1541	1545	1598	1496	1521	1566	0.0143	2.493
29.5	1545	1550	1601	1502	1526	1571	0.013	2.48
30	1549	1555	1605	1507	1532	1576	0.0132	2.482

[redacted]

AREVA NP, Inc. Project No. G101266224SAT-011 February 20, 2014

Time (min)	TC #1 (°F)	TC #2 (°F)	TC #3 (°F)	TC #4 (°F)	TC #5 (°F)	TC #6 (°F)
0	73	80	82	80	105	77
0.5	77	80	84	80	106	79
1	77	80	83	80	105	79
1.5	77	80	83	80	105	79
2	77	80	83	80	105	79
2.5	77	80	83	80	105	79
3	77	80	83	80	105	79
3.5	77	80	83	81	105	79
4	77	81	83	81	105	78
4.5	77	80	83	83	105	78
5	77	80	83	84	105	78
5.5	77	79	83	110	105	78
6	77	79	83	110	106	77
6.5	77	79	83	94	106	78
7	77	79	84	99	107	77
7.5	77	79	84	103	107	77
8	77	79	85	111	108	78
8.5	77	79	85	114	108	77
9	77	79	86	117	111	77
9.5	77	79	86	122	112	78
10	77	79	87	127	114	78
10.5	77	79	88	131	115	78
11	77	79	89	135	117	78
11.5	77	79	89	140	119	78
12	77	79	91	144	121	78
12.5	77	79	92	148	123	79
13	77	79	93	154	125	79
13.5	77	79	94	160	128	79
14	77	79	95	167	129	80
14.5	77	79	96	171	131	80
15	77	79	98	176	133	80
15.5	77	79	99	181	135	81
16	77	79	100	184	137	81
16.5	77	79	101	189	139	82
17	77	79	103	196	142	83
17.5	77	79	104	203	144	84
18	77	79	106	210	146	84
18.5	77	79	108	217	148	85
19	77	79	110	224	150	86
19.5	77	79	112	231	152	88
20	77	79	114	232	155	89
20.5	77	79	116	238	156	90

AREVA NP, Inc. Project No. G101266224SAT-011 February 20, 2014

Time (min)	TC #1 (°F)	TC #2 (°F)	TC #3 (°F)	TC #4 (°F)	TC #5 (°F)	TC #6 (°F)
21	77	79	117	243	159	92
21.5	77	79	119	247	161	94
22	77	79	120	249	162	96
22.5	77	79	122	254	164	98
23	77	79	123	255	166	100
23.5	77	79	126	258	167	103
24	77	79	128	262	169	105
24.5	77	79	130	262	171	108
25	77	79	131	267	173	110
25.5	77	79	131	267	175	113
26	77	79	132	274	176	115
26.5	77	79	132	273	177	118
27	77	79	133	276	178	120
27.5	77	79	134	276	179	123
28	77	79	136	277	181	125
28.5	77	79	137	280	182	127
29	77	79	139	286	183	129
29.5	77	79	140	284	184	131
30	77	80	141	282	185	133

APPENDIX C2
Pressure Data

AREVA NP, Inc. Project No. G101266224SAT-011 February 24, 2014

Time (min)	Ch 1 dP (psi)	Ch 2 High Flow (LPM)	Ch 3 Low Flow (LPM)	Total Flow (LPM)
0	-0.0046	0.0044	0	0.0044
0.0333	-0.0046	0.0044	0	0.0044
0.0667	-0.0075	0.0044	0	0.0044
0.1	-0.0075	0	0	0
0.1333	-0.0059	0.0044	0	0.0044
0.1667	-0.0055	0.0044	0	0.0044
0.2	-0.0049	0.0044	0	0.0044
0.2333	-0.0059	0.0044	0	0.0044
0.2667	-0.0062	0.0175	0	0.0175
0.3	-0.0075	0.0044	0	0.0044
0.3333	-0.0098	0	0	0
0.3667	-0.0072	0.0044	0	0.0044
0.4	-0.0085	0.0175	0	0.0175
0.4333	-0.0082	0	0	0
0.4667	-0.0092	0.0044	0	0.0044
0.5	-0.0075	0	0	0
0.5333	-0.0046	0.0044	0	0.0044
0.5667	-0.0085	0.0044	0	0.0044
0.6	-0.0075	0.0044	0.0013	0.0057
0.6333	-0.0075	0	0	0
0.6667	-0.0052	0.0175	0	0.0175
0.7	-0.0072	0.0175	0.0013	0.0188
0.7333	-0.0069	0	0	0
0.7667	-0.0052	0.0044	0	0.0044
0.8	-0.0049	0.0044	0.0013	0.0057
0.8333	-0.0039	0.0044	0	0.0044
0.8667	-0.0059	0	0	0
0.9	-0.0062	0.0175	0.0013	0.0188
0.9333	-0.0049	0	0	0
0.9667	-0.0059	0	0	0
1	-0.0069	0.0044	0	0.0044
1.0333	-0.0072	0	0	0
1.0667	-0.0036	0	0	0
1.1	-0.0065	0	0	0
1.1333	-0.0059	0.0044	0	0.0044
1.1667	-0.0065	0.0044	0	0.0044
1.2	-0.0062	0	0	0
1.2333	-0.0078	0	0	0
1.2667	-0.0072	0.0044	0.0013	0.0057
1.3	-0.0065	0	0	0
1.3333	-0.0095	0.0044	0	0.0044
1.3667	-0.0092	0.0175	0	0.0175
1.4	-0.0055	0.0044	0	0.0044
1.4333	-0.0059	0.0044	0	0.0044

AREVA NP, Inc. Project No. G101266224SAT-011 February 24, 2014

Time (min)	Ch 1 dP (psi)	Ch 2 High Flow (LPM)	Ch 3 Low Flow (LPM)	Total Flow (LPM)
1.4667	-0.0088	0.0044	0	0.0044
1.5	-0.0069	0	0.0013	0.0013
1.5333	-0.0088	0.0175	0	0.0175
1.5667	-0.0069	0.0044	0	0.0044
1.6	-0.0072	0.0044	0	0.0044
1.6333	-0.0075	0.0044	0.0013	0.0057
1.6667	-0.0082	0	0	0
1.7	-0.0046	0.0044	0	0.0044
1.7333	-0.0006	0	0	0
1.7667	0.0043	0.0044	0	0.0044
1.8	0.0119	0.0044	0	0.0044
1.8333	0.0244	0.0044	0	0.0044
1.8667	0.0317	0.0175	0	0.0175
1.9	0.0478	0	0	0
1.9333	0.0606	0.0044	0	0.0044
1.9667	0.0744	0	0.0013	0.0013
2	0.0876	0.0044	0	0.0044
2.0333	0.1031	0.0044	0	0.0044
2.0667	0.1182	0.0044	0.0026	0.007
2.1	0.1304	0.0044	0	0.0044
2.1333	0.139	0	0.0013	0.0013
2.1667	0.1528	0	0	0
2.2	0.1597	0	0	0
2.2333	0.1732	0	0.0013	0.0013
2.2667	0.1808	0	0.0013	0.0013
2.3	0.1933	0.0044	0	0.0044
2.3333	0.2008	0.0044	0	0.0044
2.3667	0.2094	0.0175	0	0.0175
2.4	0.2176	0.0044	0	0.0044
2.4333	0.2232	0	0	0
2.4667	0.2311	0.0044	0	0.0044
2.5	0.24	0	0.0013	0.0013
2.5333	0.2403	0	0	0
2.5667	0.2489	0.0044	0	0.0044
2.6	0.2529	0.0044	0	0.0044
2.6333	0.2561	0	0	0
2.6667	0.2621	0.0175	0	0.0175
2.7	0.2683	0	0.0026	0.0026
2.7333	0.2703	0	0	0
2.7667	0.2733	0.0044	0	0.0044
2.8	0.2795	0.0044	0.0013	0.0057
2.8333	0.2805	0.0044	0	0.0044
2.8667	0.2822	0.0044	0	0.0044
2.9	0.2881	0.0044	0	0.0044

AREVA NP, Inc. Project No. G101266224SAT-011 February 24, 2014

Time (min)	Ch 1 dP (psi)	Ch 2 High Flow (LPM)	Ch 3 Low Flow (LPM)	Total Flow (LPM)
2.9333	0.2861	0.0044	0	0.0044
2.9667	0.2901	0.0044	0.0013	0.0057
3	0.2924	0.0044	0	0.0044
3.0333	0.2963	0.0044	0	0.0044
3.0667	0.2943	0.0044	0	0.0044
3.1	0.2963	0	0	0
3.1333	0.2993	0.0175	0	0.0175
3.1667	0.2999	0.0044	0	0.0044
3.2	0.3029	0.0044	0.0013	0.0057
3.2333	0.3035	0.0044	0	0.0044
3.2667	0.3029	0.0044	0	0.0044
3.3	0.3065	0.0044	0	0.0044
3.3333	0.3045	0	0	0
3.3667	0.3072	0.0175	0	0.0175
3.4	0.3059	0	0	0
3.4333	0.3105	0.0175	0	0.0175
3.4667	0.3111	0.0175	0	0.0175
3.5	0.3101	0.0044	0.0013	0.0057
3.5333	0.3151	0.0175	0	0.0175
3.5667	0.3151	0	0	0
3.6	0.3118	0.0044	0	0.0044
3.6333	0.3124	0	0	0
3.6667	0.3164	0.0044	0	0.0044
3.7	0.3154	0.0044	0.0013	0.0057
3.7333	0.318	0.0044	0.0013	0.0057
3.7667	0.3167	0	0	0
3.8	0.317	0.0044	0	0.0044
3.8333	0.3157	0.0044	0	0.0044
3.8667	0.3088	0.0044	0	0.0044
3.9	0.3072	0.0044	0	0.0044
3.9333	0.298	0.0175	0	0.0175
3.9667	0.2897	0	0	0
4	0.2858	0.0044	0	0.0044
4.0333	0.2769	0.0044	0	0.0044
4.0667	0.2726	0.0044	0	0.0044
4.1	0.2696	0	0	0
4.1333	0.2654	0	0	0
4.1667	0.2621	0.0044	0	0.0044
4.2	0.2588	0.0044	0	0.0044
4.2333	0.2538	0	0	0
4.2667	0.2535	0	0.0013	0.0013
4.3	0.2604	0	0	0
4.3333	0.2568	0.0044	0	0.0044
4.3667	0.2575	0	0	0

AREVA NP, Inc. Project No. G101266224SAT-011 February 24, 2014

Time (min)	Ch 1 dP (psi)	Ch 2 High Flow (LPM)	Ch 3 Low Flow (LPM)	Total Flow (LPM)
4.4	0.2535	0.0044	0	0.0044
4.4333	0.2506	0.0044	0	0.0044
4.4667	0.2489	0.0044	0	0.0044
4.5	0.2486	0.0175	0	0.0175
4.5333	0.2453	0.0044	0.0013	0.0057
4.5667	0.2443	0.0044	0	0.0044
4.6	0.2433	0.0044	0	0.0044
4.6333	0.2427	0.0175	0	0.0175
4.6667	0.2397	0.0044	0	0.0044
4.7	0.238	0	0	0
4.7333	0.2394	0	0	0
4.7667	0.238	0	0.0013	0.0013
4.8	0.2364	0	0	0
4.8333	0.2367	0.0044	0	0.0044
4.8667	0.2361	0.0175	0	0.0175
4.9	0.238	0.0044	0	0.0044
4.9333	0.2371	0.0175	0	0.0175
4.9667	0.2348	0	0.0013	0.0013
5	0.2344	0.0044	0	0.0044
5.0333	0.2344	0.0044	0	0.0044
5.0667	0.2331	0	0	0
5.1	0.2348	0.0044	0	0.0044
5.1333	0.2344	0.0044	0	0.0044
5.1667	0.2315	0.0044	0	0.0044
5.2	0.2311	0.0044	0	0.0044
5.2333	0.2334	0	0	0
5.2667	0.2298	0.0044	0	0.0044
5.3	0.2331	0	0	0
5.3333	0.2344	0.0044	0	0.0044
5.3667	0.2308	0	0	0
5.4	0.2344	0.0044	0	0.0044
5.4333	0.2315	0.0175	0.0013	0.0188
5.4667	0.2308	0	0	0
5.5	0.2338	0.0044	0	0.0044
5.5333	0.2305	0	0	0
5.5667	0.2344	0.0175	0	0.0175
5.6	0.2324	0.0044	0	0.0044
5.6333	0.2308	0.0044	0.0013	0.0057
5.6667	0.2295	0	0	0
5.7	0.2348	0	0	0
5.7333	0.2476	0.0044	0	0.0044
5.7667	0.2594	0.0307	0	0.0307
5.8	0.2578	0.0044	0	0.0044
5.8333	0.2532	0.0044	0.0013	0.0057

AREVA NP, Inc. Project No. G101266224SAT-011 February 24, 2014

Time (min)	Ch 1 dP (psi)	Ch 2 High Flow (LPM)	Ch 3 Low Flow (LPM)	Total Flow (LPM)
5.8667	0.2499	0	0	0
5.9	0.2466	0	0	0
5.9333	0.2443	0.0044	0	0.0044
5.9667	0.245	0.0175	0.0013	0.0188
6	0.2413	0.0175	0	0.0175
6.0333	0.2397	0.0044	0	0.0044
6.0667	0.2361	0.0044	0	0.0044
6.1	0.2338	0.0044	0	0.0044
6.1333	0.2348	0.0044	0	0.0044
6.1667	0.2315	0	0	0
6.2	0.2318	0	0	0
6.2333	0.2301	0.0044	0.0013	0.0057
6.2667	0.2301	0	0	0
6.3	0.2285	0	0	0
6.3333	0.2275	0.0307	0	0.0307
6.3667	0.2249	0	0	0
6.4	0.2262	0	0	0
6.4333	0.2252	0.0044	0	0.0044
6.4667	0.2222	0	0	0
6.5	0.2232	0	0	0
6.5333	0.2196	0.0044	0	0.0044
6.5667	0.219	0	0	0
6.6	0.2357	0	0	0
6.6333	0.2512	0	0	0
6.6667	0.2608	0.0044	0	0.0044
6.7	0.2851	0	0	0
6.7333	0.3052	0.0044	0	0.0044
6.7667	0.3259	0.0044	0	0.0044
6.8	0.3467	0	0	0
6.8333	0.3661	0.0044	0	0.0044
6.8667	0.3625	0	0	0
6.9	0.3427	0	0	0
6.9333	0.3246	0.0044	0.0013	0.0057
6.9667	0.3075	0	0.0013	0.0013
7	0.2943	0.0044	0	0.0044
7.0333	0.2789	0	0	0
7.0667	0.2683	0.0044	0.0013	0.0057
7.1	0.2604	0.0044	0	0.0044
7.1333	0.2542	0.0175	0.0013	0.0188
7.1667	0.243	0.0175	0	0.0175
7.2	0.238	0	0	0
7.2333	0.2334	0.0175	0	0.0175
7.2667	0.2308	0.0175	0	0.0175
7.3	0.2239	0	0	0

AREVA NP, Inc. Project No. G101266224SAT-011 February 24, 2014

Time (min)	Ch 1 dP (psi)	Ch 2 High Flow (LPM)	Ch 3 Low Flow (LPM)	Total Flow (LPM)
7.3333	0.219	0	0	0
7.3667	0.2176	0	0	0
7.4	0.2173	0	0	0
7.4333	0.2143	0.0044	0	0.0044
7.4667	0.2084	0.0044	0	0.0044
7.5	0.2081	0.0044	0	0.0044
7.5333	0.2097	0	0	0
7.5667	0.2087	0.0044	0	0.0044
7.6	0.2137	0	0.0013	0.0013
7.6333	0.2127	0.0044	0.0013	0.0057
7.6667	0.2117	0	0	0
7.7	0.2104	0.0044	0.0013	0.0057
7.7333	0.2074	0	0	0
7.7667	0.2074	0.0044	0	0.0044
7.8	0.2068	0	0	0
7.8333	0.2081	0.0044	0	0.0044
7.8667	0.2061	0	0	0
7.9	0.2058	0.0044	0	0.0044
7.9333	0.2041	0.0044	0	0.0044
7.9667	0.2038	0.0044	0	0.0044
8	0.2041	0.0044	0.0013	0.0057
8.0333	0.2015	0.0175	0	0.0175
8.0667	0.2012	0.0044	0	0.0044
8.1	0.2051	0.0044	0	0.0044
8.1333	0.2012	0	0	0
8.1667	0.2018	0	0	0
8.2	0.2005	0.0175	0	0.0175
8.2333	0.2005	0.0044	0	0.0044
8.2667	0.1992	0	0	0
8.3	0.1985	0	0	0
8.3333	0.2107	0	0.0013	0.0013
8.3667	0.2348	0.0175	0.0013	0.0188
8.4	0.2601	0	0	0
8.4333	0.2815	0.0044	0.0013	0.0057
8.4667	0.3055	0.0044	0	0.0044
8.5	0.3226	0	0	0
8.5333	0.3457	0	0	0
8.5667	0.3671	0.0044	0.0026	0.007
8.6	0.3865	0	0	0
8.6333	0.4013	0.0044	0	0.0044
8.6667	0.4145	0	0	0
8.7	0.4234	0.0044	0.0013	0.0057
8.7333	0.4267	0.0175	0	0.0175
8.7667	0.4293	0	0	0

AREVA NP, Inc. Project No. G101266224SAT-011 February 24, 2014

Time (min)	Ch 1 dP (psi)	Ch 2 High Flow (LPM)	Ch 3 Low Flow (LPM)	Total Flow (LPM)
8.8	0.4326	0.0044	0	0.0044
8.8333	0.424	0.0175	0	0.0175
8.8667	0.4165	0.0044	0	0.0044
8.9	0.4132	0.0044	0	0.0044
8.9333	0.4043	0	0	0
8.9667	0.3974	0.0044	0	0.0044
9	0.3835	0.0044	0.0013	0.0057
9.0333	0.377	0.0044	0	0.0044
9.0667	0.3717	0.0044	0	0.0044
9.1	0.3615	0.0044	0	0.0044
9.1333	0.3651	0	0	0
9.1667	0.373	0	0	0
9.2	0.3799	0	0	0
9.2333	0.37	0.0044	0.0013	0.0057
9.2667	0.3533	0.0044	0	0.0044
9.3	0.3562	0.0175	0	0.0175
9.3333	0.3533	0.0044	0	0.0044
9.3667	0.3529	0.0044	0.0013	0.0057
9.4	0.3546	0.0044	0	0.0044
9.4333	0.3598	0.0044	0	0.0044
9.4667	0.3595	0	0	0
9.5	0.3588	0	0	0
9.5333	0.3598	0	0	0
9.5667	0.3618	0.0044	0.0013	0.0057
9.6	0.3608	0	0	0
9.6333	0.3592	0.0044	0.0013	0.0057
9.6667	0.3585	0.0307	0	0.0307
9.7	0.3621	0.0044	0	0.0044
9.7333	0.3592	0	0	0
9.7667	0.3598	0	0	0
9.8	0.3588	0.0044	0.0013	0.0057
9.8333	0.3598	0.0175	0	0.0175
9.8667	0.3595	0	0.0013	0.0013
9.9	0.3579	0.0175	0	0.0175
9.9333	0.3588	0.0175	0	0.0175
9.9667	0.3628	0	0	0
10	0.3608	0	0	0
10.0333	0.3602	0.0044	0	0.0044
10.0667	0.3625	0.0044	0	0.0044
10.1	0.3595	0.0044	0	0.0044
10.1333	0.3588	0.0044	0	0.0044
10.1667	0.3592	0	0	0
10.2	0.3575	0.0044	0	0.0044
10.2333	0.3598	0	0	0

AREVA NP, Inc. Project No. G101266224SAT-011 February 24, 2014

Time (min)	Ch 1 dP (psi)	Ch 2 High Flow (LPM)	Ch 3 Low Flow (LPM)	Total Flow (LPM)
10.2667	0.3582	0	0	0
10.3	0.3588	0.0175	0.0013	0.0188
10.3333	0.3575	0.0044	0	0.0044
10.3667	0.3585	0.0044	0	0.0044
10.4	0.3592	0.0044	0	0.0044
10.4333	0.3608	0	0	0
10.4667	0.3572	0	0	0
10.5	0.3602	0.0175	0	0.0175
10.5333	0.3598	0.0044	0.0013	0.0057
10.5667	0.3602	0.0044	0	0.0044
10.6	0.3612	0.0044	0	0.0044
10.6333	0.3608	0.0044	0	0.0044
10.6667	0.3612	0.0044	0	0.0044
10.7	0.3575	0	0	0
10.7333	0.3621	0.0044	0.0013	0.0057
10.7667	0.3605	0	0	0
10.8	0.3612	0.0175	0	0.0175
10.8333	0.3588	0	0	0
10.8667	0.3585	0.0044	0	0.0044
10.9	0.3615	0.0044	0	0.0044
10.9333	0.3621	0	0	0
10.9667	0.3602	0	0	0
11	0.3615	0.0044	0.0013	0.0057
11.0333	0.3615	0	0	0
11.0667	0.3588	0.0044	0	0.0044
11.1	0.3602	0	0	0
11.1333	0.3612	0	0	0
11.1667	0.3612	0	0	0
11.2	0.3608	0.0044	0	0.0044
11.2333	0.3612	0.0175	0	0.0175
11.2667	0.3621	0	0	0
11.3	0.3605	0.0175	0	0.0175
11.3333	0.3598	0	0	0
11.3667	0.3608	0	0	0
11.4	0.3618	0	0.0013	0.0013
11.4333	0.3608	0.0044	0	0.0044
11.4667	0.3621	0.0044	0	0.0044
11.5	0.3608	0.0175	0	0.0175
11.5333	0.3595	0.0044	0	0.0044
11.5667	0.3582	0.0044	0	0.0044
11.6	0.3625	0.0175	0	0.0175
11.6333	0.3631	0.0044	0	0.0044
11.6667	0.3585	0	0	0
11.7	0.3628	0.0044	0	0.0044

AREVA NP, Inc. Project No. G101266224SAT-011 February 24, 2014

Time (min)	Ch 1 dP (psi)	Ch 2 High Flow (LPM)	Ch 3 Low Flow (LPM)	Total Flow (LPM)
11.7333	0.3631	0.0044	0	0.0044
11.7667	0.3588	0.0307	0	0.0307
11.8	0.3628	0	0	0
11.8333	0.3621	0.0044	0	0.0044
11.8667	0.3615	0	0	0
11.9	0.3605	0.0044	0	0.0044
11.9333	0.3598	0.0044	0	0.0044
11.9667	0.3595	0.0044	0	0.0044
12	0.3625	0.0044	0	0.0044
12.0333	0.3612	0	0.0013	0.0013
12.0667	0.3602	0.0044	0	0.0044
12.1	0.3618	0.0175	0	0.0175
12.1333	0.3608	0.0044	0.0013	0.0057
12.1667	0.3585	0.0175	0	0.0175
12.2	0.3585	0.0044	0	0.0044
12.2333	0.3572	0.0044	0.0013	0.0057
12.2667	0.3585	0.0044	0	0.0044
12.3	0.3608	0.0044	0	0.0044
12.3333	0.3569	0.0044	0	0.0044
12.3667	0.3608	0	0	0
12.4	0.3585	0.0175	0	0.0175
12.4333	0.3602	0.0175	0.0013	0.0188
12.4667	0.3602	0.0044	0.0013	0.0057
12.5	0.3585	0	0	0
12.5333	0.3579	0	0	0
12.5667	0.3602	0.0175	0.0013	0.0188
12.6	0.3625	0.0044	0	0.0044
12.6333	0.3621	0	0	0
12.6667	0.3588	0	0.0013	0.0013
12.7	0.3572	0.0044	0	0.0044
12.7333	0.3585	0.0044	0.0013	0.0057
12.7667	0.3579	0	0.0013	0.0013
12.8	0.3618	0.0044	0	0.0044
12.8333	0.3582	0	0	0
12.8667	0.3572	0.0044	0	0.0044
12.9	0.3562	0.0044	0	0.0044
12.9333	0.3579	0.0044	0	0.0044
12.9667	0.3582	0	0	0
13	0.3569	0.0175	0.0013	0.0188
13.0333	0.3552	0.0175	0	0.0175
13.0667	0.3542	0	0	0
13.1	0.3556	0	0	0
13.1333	0.3562	0	0	0
13.1667	0.3536	0.0044	0.0013	0.0057

AREVA NP, Inc. Project No. G101266224SAT-011 February 24, 2014

Time (min)	Ch 1 dP (psi)	Ch 2 High Flow (LPM)	Ch 3 Low Flow (LPM)	Total Flow (LPM)
13.2	0.3526	0.0044	0	0.0044
13.2333	0.3529	0	0.0013	0.0013
13.2667	0.3546	0	0	0
13.3	0.3536	0.0044	0	0.0044
13.3333	0.3503	0.0044	0	0.0044
13.3667	0.3503	0	0	0
13.4	0.3506	0	0	0
13.4333	0.3516	0	0	0
13.4667	0.3503	0	0	0
13.5	0.3486	0	0	0
13.5333	0.3519	0.0044	0	0.0044
13.5667	0.3509	0.0044	0	0.0044
13.6	0.35	0	0	0
13.6333	0.3506	0.0175	0	0.0175
13.6667	0.3523	0.0175	0.0013	0.0188
13.7	0.35	0.0044	0	0.0044
13.7333	0.3519	0.0044	0	0.0044
13.7667	0.3486	0.0044	0	0.0044
13.8	0.35	0	0	0
13.8333	0.348	0.0044	0	0.0044
13.8667	0.3513	0	0.0013	0.0013
13.9	0.3486	0.0175	0.0013	0.0188
13.9333	0.3533	0.0044	0	0.0044
13.9667	0.3506	0.0044	0	0.0044
14	0.3529	0	0	0
14.0333	0.349	0.0044	0	0.0044
14.0667	0.349	0.0044	0	0.0044
14.1	0.3529	0.0175	0.0013	0.0188
14.1333	0.3519	0.0175	0	0.0175
14.1667	0.3513	0.0044	0	0.0044
14.2	0.3533	0.0044	0	0.0044
14.2333	0.3542	0.0044	0	0.0044
14.2667	0.3509	0.0044	0	0.0044
14.3	0.35	0.0044	0	0.0044
14.3333	0.3533	0.0044	0	0.0044
14.3667	0.3526	0.0044	0	0.0044
14.4	0.3539	0	0	0
14.4333	0.3506	0	0	0
14.4667	0.3546	0	0	0
14.5	0.3509	0.0044	0.0013	0.0057
14.5333	0.3529	0	0	0
14.5667	0.3556	0	0	0
14.6	0.3556	0.0044	0	0.0044
14.6333	0.3569	0	0	0

AREVA NP, Inc. Project No. G101266224SAT-011 February 24, 2014

Time (min)	Ch 1 dP (psi)	Ch 2 High Flow (LPM)	Ch 3 Low Flow (LPM)	Total Flow (LPM)
14.6667	0.3592	0.0044	0	0.0044
14.7	0.3618	0.0044	0.0013	0.0057
14.7333	0.3635	0.0175	0	0.0175
14.7667	0.3605	0	0	0
14.8	0.3638	0.0175	0	0.0175
14.8333	0.3631	0.0175	0	0.0175
14.8667	0.3674	0.0175	0	0.0175
14.9	0.37	0	0	0
14.9333	0.3691	0.0175	0	0.0175
14.9667	0.3707	0.0175	0	0.0175
15	0.3681	0	0	0
15.0333	0.372	0.0044	0	0.0044
15.0667	0.3727	0	0	0
15.1	0.3746	0.0044	0.0013	0.0057
15.1333	0.3733	0.0044	0	0.0044
15.1667	0.377	0.0044	0	0.0044
15.2	0.3753	0.0044	0	0.0044
15.2333	0.3776	0	0	0
15.2667	0.3746	0.0044	0.0013	0.0057
15.3	0.3793	0.0044	0.0013	0.0057
15.3333	0.3809	0.0044	0.0026	0.007
15.3667	0.3783	0	0	0
15.4	0.3799	0.0044	0	0.0044
15.4333	0.3806	0.0044	0	0.0044
15.4667	0.3812	0	0.0013	0.0013
15.5	0.3806	0	0.0013	0.0013
15.5333	0.3812	0	0	0
15.5667	0.3825	0.0044	0	0.0044
15.6	0.3789	0.0175	0.0013	0.0188
15.6333	0.3835	0	0	0
15.6667	0.3806	0.0044	0	0.0044
15.7	0.3835	0	0	0
15.7333	0.3812	0.0175	0	0.0175
15.7667	0.3819	0.0044	0.0013	0.0057
15.8	0.3845	0	0	0
15.8333	0.3832	0.0044	0.0026	0.007
15.8667	0.3845	0	0	0
15.9	0.3862	0.0175	0.0013	0.0188
15.9333	0.3852	0	0	0
15.9667	0.3875	0	0	0
16	0.3878	0.0044	0	0.0044
16.0333	0.3895	0.0044	0	0.0044
16.0667	0.3918	0.0044	0	0.0044
16.1	0.3924	0.0307	0	0.0307

AREVA NP, Inc. Project No. G101266224SAT-011 February 24, 2014

Time (min)	Ch 1 dP (psi)	Ch 2 High Flow (LPM)	Ch 3 Low Flow (LPM)	Total Flow (LPM)
16.1333	0.3918	0.0175	0	0.0175
16.1667	0.3908	0.0044	0	0.0044
16.2	0.3918	0.0044	0	0.0044
16.2333	0.3928	0	0.0013	0.0013
16.2667	0.3934	0.0044	0	0.0044
16.3	0.3951	0.0175	0	0.0175
16.3333	0.397	0.0044	0	0.0044
16.3667	0.3983	0.0044	0	0.0044
16.4	0.3967	0.0044	0	0.0044
16.4333	0.3954	0.0044	0	0.0044
16.4667	0.397	0.0044	0.0013	0.0057
16.5	0.3977	0.0175	0	0.0175
16.5333	0.3983	0.0175	0	0.0175
16.5667	0.4013	0.0044	0	0.0044
16.6	0.3983	0	0	0
16.6333	0.4013	0.0175	0	0.0175
16.6667	0.4026	0.0044	0	0.0044
16.7	0.4053	0	0	0
16.7333	0.4069	0.0044	0	0.0044
16.7667	0.4102	0.0044	0	0.0044
16.8	0.4168	0	0	0
16.8333	0.4244	0.0044	0	0.0044
16.8667	0.428	0.0044	0	0.0044
16.9	0.4329	0.0044	0.0013	0.0057
16.9333	0.4421	0	0	0
16.9667	0.45	0.0044	0	0.0044
17	0.4484	0.0044	0	0.0044
17.0333	0.4527	0	0	0
17.0667	0.4619	0	0	0
17.1	0.4648	0.0044	0.0013	0.0057
17.1333	0.4744	0.0044	0	0.0044
17.1667	0.478	0.0044	0	0.0044
17.2	0.4793	0.0175	0	0.0175
17.2333	0.4852	0	0	0
17.2667	0.4892	0.0175	0.0013	0.0188
17.3	0.4961	0.0044	0	0.0044
17.3333	0.5037	0.0044	0	0.0044
17.3667	0.5116	0.0044	0	0.0044
17.4	0.5185	0.0044	0	0.0044
17.4333	0.5267	0.0044	0	0.0044
17.4667	0.531	0.0044	0	0.0044
17.5	0.5386	0.0044	0	0.0044
17.5333	0.5468	0.0044	0.0013	0.0057
17.5667	0.5494	0.0175	0	0.0175

AREVA NP, Inc. Project No. G101266224SAT-011 February 24, 2014

Time (min)	Ch 1 dP (psi)	Ch 2 High Flow (LPM)	Ch 3 Low Flow (LPM)	Total Flow (LPM)
17.6	0.5577	0.0044	0	0.0044
17.6333	0.5623	0	0	0
17.6667	0.5705	0.0175	0	0.0175
17.7	0.5715	0.0044	0	0.0044
17.7333	0.5698	0	0	0
17.7667	0.5748	0.0044	0	0.0044
17.8	0.5731	0.0044	0	0.0044
17.8333	0.5761	0.0044	0	0.0044
17.8667	0.5781	0.0044	0	0.0044
17.9	0.5863	0.0175	0.0013	0.0188
17.9333	0.5863	0.0175	0	0.0175
17.9667	0.5866	0	0	0
18	0.5853	0.0175	0	0.0175
18.0333	0.5899	0	0	0
18.0667	0.5922	0	0.0013	0.0013
18.1	0.6011	0	0.0013	0.0013
18.1333	0.6005	0.0044	0	0.0044
18.1667	0.6024	0.0044	0	0.0044
18.2	0.6077	0.0044	0	0.0044
18.2333	0.6097	0	0	0
18.2667	0.6172	0.0307	0	0.0307
18.3	0.6195	0.0044	0	0.0044
18.3333	0.6051	0	0	0
18.3667	0.6057	0.0044	0	0.0044
18.4	0.5988	0	0	0
18.4333	0.6005	0.0044	0	0.0044
18.4667	0.6077	0.0175	0	0.0175
18.5	0.6172	0.0044	0	0.0044
18.5333	0.6209	0.0175	0	0.0175
18.5667	0.6304	0	0	0
18.6	0.635	0	0	0
18.6333	0.6446	0	0	0
18.6667	0.6554	0.0044	0.0013	0.0057
18.7	0.661	0.0044	0	0.0044
18.7333	0.6696	0.0044	0.0013	0.0057
18.7667	0.6722	0	0	0
18.8	0.6775	0.0044	0	0.0044
18.8333	0.6831	0.0175	0.0013	0.0188
18.8667	0.6854	0	0	0
18.9	0.6913	0.0044	0	0.0044
18.9333	0.6916	0.0044	0.0013	0.0057
18.9667	0.6946	0.0044	0	0.0044
19	0.6936	0.0175	0	0.0175
19.0333	0.6966	0	0	0

AREVA NP, Inc. Project No. G101266224SAT-011 February 24, 2014

Time (min)	Ch 1 dP (psi)	Ch 2 High Flow (LPM)	Ch 3 Low Flow (LPM)	Total Flow (LPM)
19.0667	0.6982	0.0044	0	0.0044
19.1	0.6982	0.0175	0	0.0175
19.1333	0.7025	0.0175	0	0.0175
19.1667	0.7018	0.0044	0	0.0044
19.2	0.7055	0.0044	0	0.0044
19.2333	0.7074	0	0	0
19.2667	0.7074	0.0044	0	0.0044
19.3	0.717	0	0	0
19.3333	0.7203	0.0175	0	0.0175
19.3667	0.7246	0	0	0
19.4	0.7272	0.0044	0	0.0044
19.4333	0.7338	0.0175	0	0.0175
19.4667	0.7318	0.0044	0	0.0044
19.5	0.7325	0.0175	0.0013	0.0188
19.5333	0.7305	0	0	0
19.5667	0.7246	0.0044	0.0013	0.0057
19.6	0.7127	0	0	0
19.6333	0.715	0.0044	0	0.0044
19.6667	0.712	0.0044	0	0.0044
19.7	0.7078	0.0175	0	0.0175
19.7333	0.7091	0	0	0
19.7667	0.7088	0	0.0013	0.0013
19.8	0.7088	0.0044	0	0.0044
19.8333	0.7048	0.0044	0	0.0044
19.8667	0.7084	0.0044	0	0.0044
19.9	0.7078	0	0	0
19.9333	0.7071	0	0	0
19.9667	0.7094	0	0.0013	0.0013
20	0.7114	0.0044	0.0013	0.0057
20.0333	0.7137	0.0044	0	0.0044
20.0667	0.7137	0.0044	0	0.0044
20.1	0.714	0.0175	0.0013	0.0188
20.1333	0.7124	0	0	0
20.1667	0.7167	0.0044	0	0.0044
20.2	0.7173	0.0044	0	0.0044
20.2333	0.7186	0.0307	0	0.0307
20.2667	0.7176	0.0044	0	0.0044
20.3	0.717	0.0044	0.0013	0.0057
20.3333	0.7183	0.0044	0	0.0044
20.3667	0.7219	0.0044	0	0.0044
20.4	0.7176	0.0044	0	0.0044
20.4333	0.7176	0.0044	0	0.0044
20.4667	0.7219	0.0175	0	0.0175
20.5	0.7219	0.0175	0	0.0175

AREVA NP, Inc. Project No. G101266224SAT-011 February 24, 2014

Time (min)	Ch 1 dP (psi)	Ch 2 High Flow (LPM)	Ch 3 Low Flow (LPM)	Total Flow (LPM)
20.5333	0.7203	0.0175	0	0.0175
20.5667	0.7236	0.0044	0.0013	0.0057
20.6	0.7246	0	0	0
20.6333	0.7209	0.0044	0	0.0044
20.6667	0.7196	0	0	0
20.7	0.7226	0.0044	0.0013	0.0057
20.7333	0.7206	0.0175	0	0.0175
20.7667	0.719	0.0044	0	0.0044
20.8	0.7199	0.0175	0	0.0175
20.8333	0.7183	0	0	0
20.8667	0.7176	0.0044	0	0.0044
20.9	0.717	0.0044	0	0.0044
20.9333	0.7144	0	0	0
20.9667	0.7097	0.0044	0.0013	0.0057
21	0.7137	0	0.0013	0.0013
21.0333	0.7101	0.0307	0	0.0307
21.0667	0.7074	0.0044	0	0.0044
21.1	0.7065	0.0044	0	0.0044
21.1333	0.7065	0.0175	0	0.0175
21.1667	0.7065	0	0	0
21.2	0.7061	0.0044	0	0.0044
21.2333	0.7018	0.0044	0.0013	0.0057
21.2667	0.7035	0.0175	0.0013	0.0188
21.3	0.7045	0	0	0
21.3333	0.7009	0.0044	0	0.0044
21.3667	0.7127	0.0044	0	0.0044
21.4	0.7183	0.0044	0	0.0044
21.4333	0.7167	0.0044	0	0.0044
21.4667	0.7199	0.0044	0	0.0044
21.5	0.7176	0	0	0
21.5333	0.7163	0	0	0
21.5667	0.7176	0.0044	0	0.0044
21.6	0.714	0.0044	0	0.0044
21.6333	0.7173	0.0044	0	0.0044
21.6667	0.7137	0.0044	0.0013	0.0057
21.7	0.717	0.0175	0	0.0175
21.7333	0.7147	0.0175	0	0.0175
21.7667	0.7137	0	0	0
21.8	0.7137	0.0044	0	0.0044
21.8333	0.7114	0.0044	0.0013	0.0057
21.8667	0.7124	0.0044	0	0.0044
21.9	0.7134	0	0	0
21.9333	0.7124	0.0044	0	0.0044
21.9667	0.7124	0.0044	0	0.0044

AREVA NP, Inc. Project No. G101266224SAT-011 February 24, 2014

Time (min)	Ch 1 dP (psi)	Ch 2 High Flow (LPM)	Ch 3 Low Flow (LPM)	Total Flow (LPM)
22	0.713	0	0	0
22.0333	0.715	0.0175	0	0.0175
22.0667	0.7117	0.0044	0	0.0044
22.1	0.7104	0.0175	0.0013	0.0188
22.1333	0.7134	0.0044	0	0.0044
22.1667	0.714	0	0	0
22.2	0.714	0	0	0
22.2333	0.7137	0	0	0
22.2667	0.7167	0.0044	0	0.0044
22.3	0.7173	0.0044	0	0.0044
22.3333	0.717	0.0175	0	0.0175
22.3667	0.7209	0.0044	0	0.0044
22.4	0.7186	0.0175	0.0013	0.0188
22.4333	0.7176	0	0	0
22.4667	0.7213	0.0175	0.0013	0.0188
22.5	0.718	0	0	0
22.5333	0.7196	0.0175	0.0013	0.0188
22.5667	0.7199	0.0044	0	0.0044
22.6	0.7229	0.0175	0.0013	0.0188
22.6333	0.7223	0.0044	0	0.0044
22.6667	0.7229	0.0307	0	0.0307
22.7	0.7219	0.0044	0	0.0044
22.7333	0.7206	0.0175	0	0.0175
22.7667	0.7229	0	0	0
22.8	0.7249	0	0	0
22.8333	0.7219	0.0044	0.0013	0.0057
22.8667	0.7239	0	0.0013	0.0013
22.9	0.7246	0	0	0
22.9333	0.7239	0.0044	0	0.0044
22.9667	0.7229	0	0	0
23	0.7269	0.0044	0	0.0044
23.0333	0.7259	0.0044	0	0.0044
23.0667	0.7252	0.0044	0.0013	0.0057
23.1	0.7285	0	0	0
23.1333	0.7282	0	0	0
23.1667	0.7239	0.0044	0	0.0044
23.2	0.7259	0	0	0
23.2333	0.7272	0.0175	0.0013	0.0188
23.2667	0.7265	0.0044	0	0.0044
23.3	0.7252	0	0	0
23.3333	0.7259	0.0044	0.0013	0.0057
23.3667	0.7249	0.0044	0	0.0044
23.4	0.7275	0.0044	0	0.0044
23.4333	0.7288	0.0044	0	0.0044

AREVA NP, Inc. Project No. G101266224SAT-011 February 24, 2014

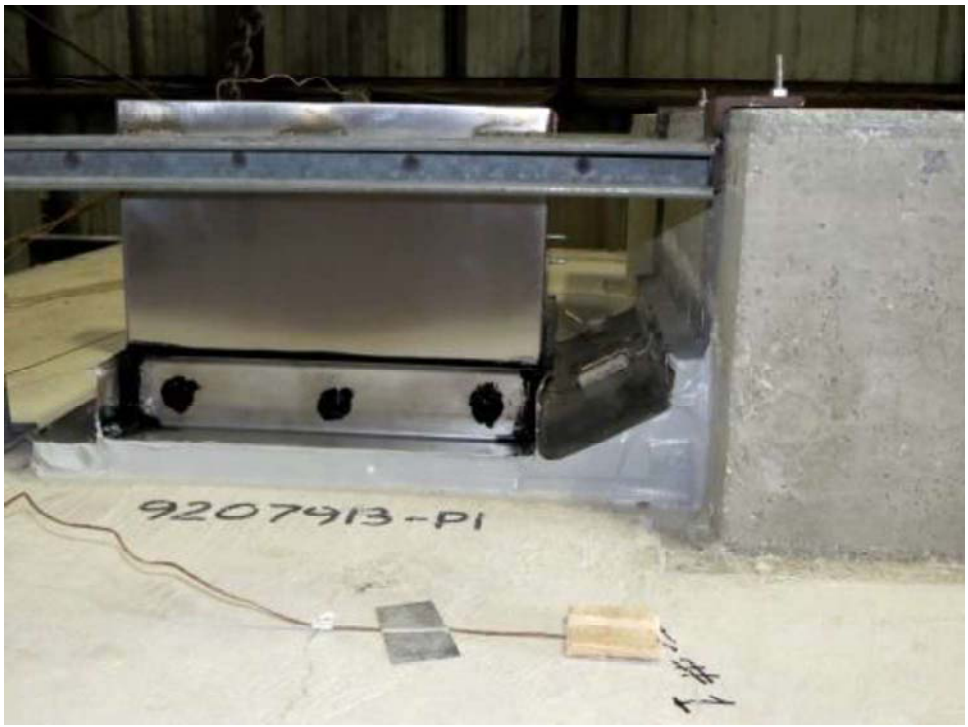
Time (min)	Ch 1 dP (psi)	Ch 2 High Flow (LPM)	Ch 3 Low Flow (LPM)	Total Flow (LPM)
23.4667	0.7288	0.0044	0	0.0044
23.5	0.7292	0.0044	0	0.0044
23.5333	0.7311	0.0307	0	0.0307
23.5667	0.7288	0.0175	0	0.0175
23.6	0.7318	0.0044	0	0.0044
23.6333	0.7308	0	0	0
23.6667	0.7311	0.0044	0	0.0044
23.7	0.7282	0	0	0
23.7333	0.7311	0.0175	0	0.0175
23.7667	0.7288	0.0044	0.0013	0.0057
23.8	0.7328	0	0	0
23.8333	0.7305	0.0044	0	0.0044
23.8667	0.7328	0	0	0
23.9	0.7295	0.0044	0	0.0044
23.9333	0.7308	0.0044	0.0013	0.0057
23.9667	0.7285	0.0044	0	0.0044
24	0.7318	0.0044	0	0.0044
24.0333	0.7321	0	0	0
24.0667	0.7308	0.0175	0	0.0175
24.1	0.7387	0.0044	0	0.0044
24.1333	0.7479	0.0044	0	0.0044
24.1667	0.7552	0.0044	0.0013	0.0057
24.2	0.7515	0	0	0
24.2333	0.7532	0	0	0
24.2667	0.7677	0.0044	0	0.0044
24.3	0.7723	0.0044	0	0.0044
24.3333	0.7743	0.0175	0	0.0175
24.3667	0.7687	0	0	0
24.4	0.7664	0	0.0013	0.0013
24.4333	0.7693	0.0044	0	0.0044
24.4667	0.7657	0.0175	0	0.0175
24.5	0.767	0.0175	0	0.0175
24.5333	0.7631	0	0	0
24.5667	0.7552	0	0	0
24.6	0.7486	0	0	0
24.6333	0.7433	0.0175	0	0.0175
24.6667	0.7367	0.0044	0	0.0044
24.7	0.7354	0.0044	0.0013	0.0057
24.7333	0.7239	0	0	0
24.7667	0.7107	0	0.0013	0.0013
24.8	0.6953	0.0044	0.0013	0.0057
24.8333	0.6663	0	0	0
24.8667	0.633	0.0044	0	0.0044
24.9	0.6041	0.0044	0.0013	0.0057

AREVA NP, Inc. Project No. G101266224SAT-011 February 24, 2014

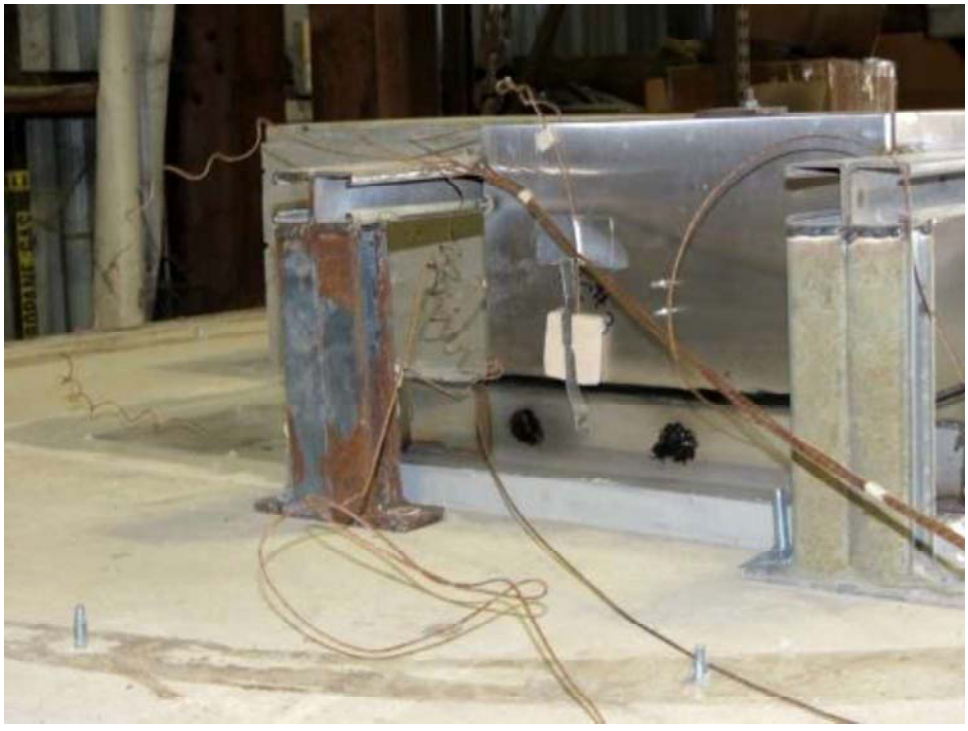
Time (min)	Ch 1 dP (psi)	Ch 2 High Flow (LPM)	Ch 3 Low Flow (LPM)	Total Flow (LPM)
24.9333	0.5702	0.0175	0	0.0175
24.9667	0.5465	0.0044	0.0013	0.0057
25	0.5215	0	0	0

APPENDIX D1
Photographs: Fire Test

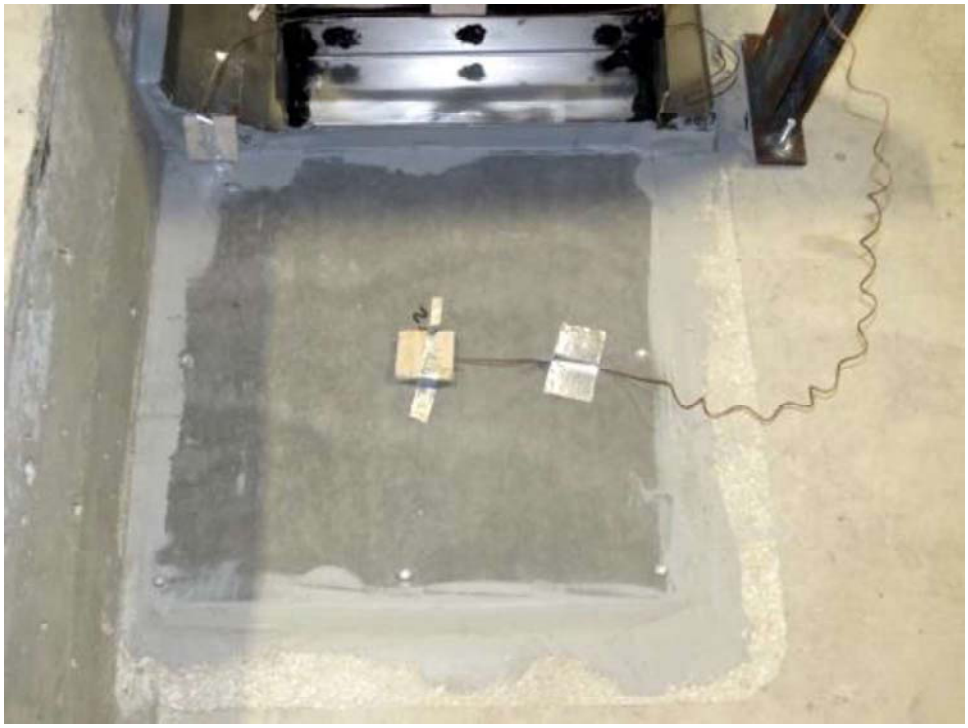

9207913-P1
9207913-P2


9207913-P1

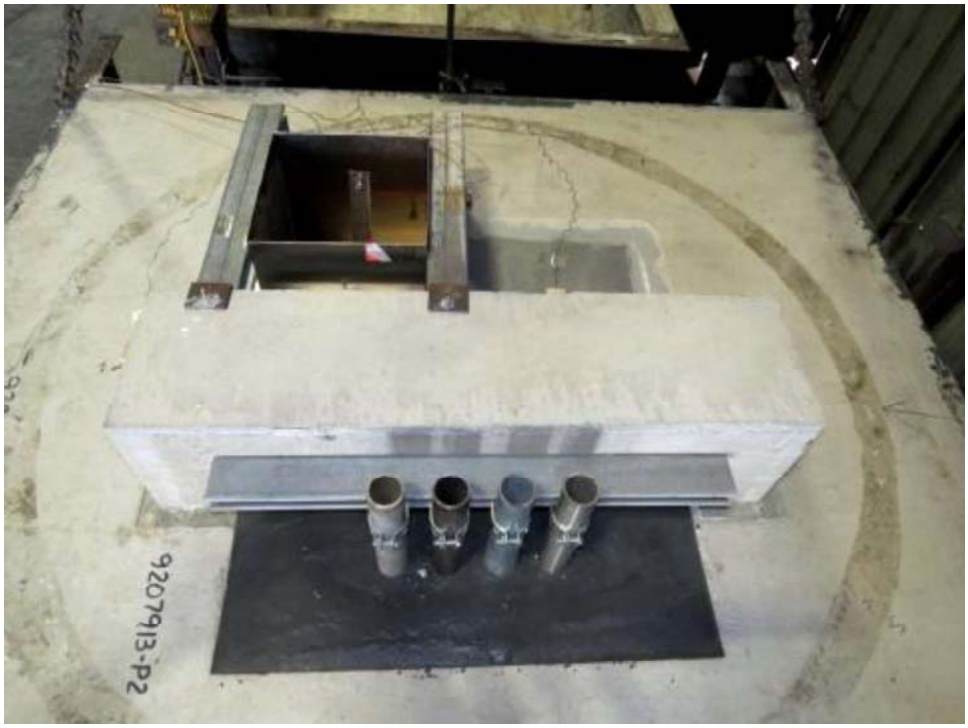

9207913-P2




FIRE-PRESSURE
#4
SIMULATED
FIRE DAMPER
2014/02/20




9207913-P1
9207913-P2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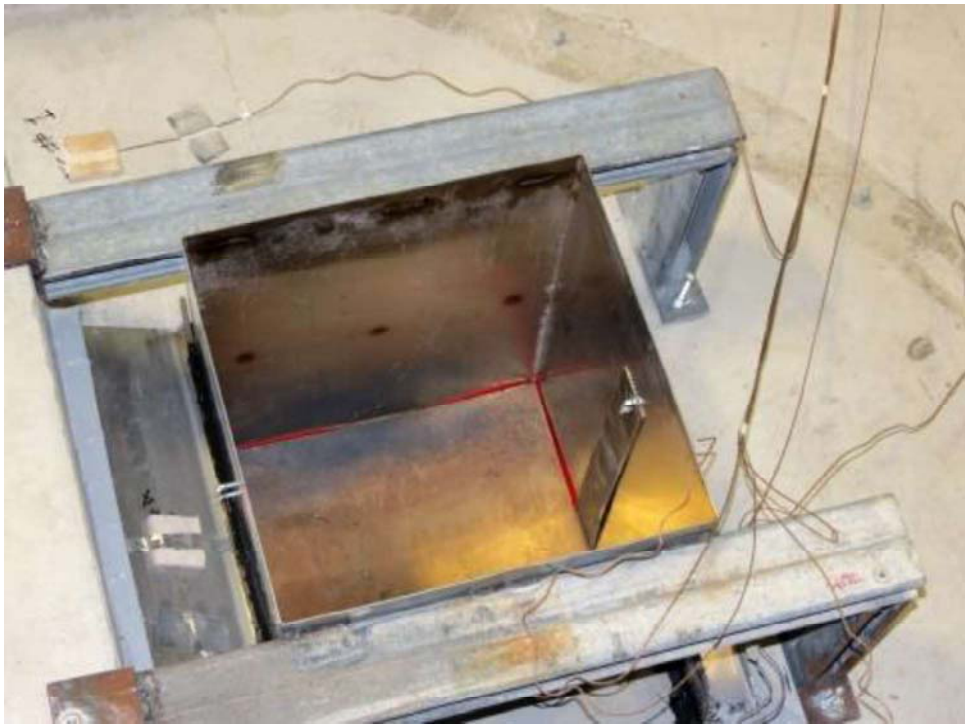


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2014/02/21

APPENDIX D2
Photographs: Pressure Test


2014/02/24


2014/02/24


2014/02/28


2014/02/24


2014/02/24


2014/02/24


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2014/02/24


7913-P1
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9207913-P1
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2014/02/26


9207913-P2


2014/02/26


2014/02/27

APPENDIX E
Test Plan

Controlled Document

20004-020 (10/21/2013)

AREVA NP Inc.

Engineering Information Record

Document No.: 51 - 9217624 - 001

Detailed Test Plan for Conducting MOX Fire-Pressure Test 4

[redacted]

Mike Dey
Staff Engineer

[redacted]

Michael A. Brown
Quality Supervisor

Page 1 of 37

AREVA

20004-020 (10/21/2013)
Document No.: 51-9217624-001

Detailed Test Plan for Conducting MOX Fire-Pressure Test 4

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	2-14-14	All
Derrick Risner Eng I / PEYF1-A	[redacted]	R	2-14-14	All
Scott Groesbeck Manager Tech Ops / PEYF1-A	[redacted]	A	2/14/14	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]	2/17/14

MOX Services concurrence: [redacted] 17Feb14

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 1-19), Appendix A (3 pages), Appendix B (8 pages), Appendix C (5 pages), and Appendix D (2 pages) for a total of 37 pages.
001	Page 7	Added CS and HVAC acronyms.
001	Section 2.2	Changed penetrating commodities to material available on site.
001	Appendix B	Changed penetrating commodities to material available on site.
001	Appendix B, Page B-3	Changed track size to material available on site and added Note 4 concerning required concrete surface preparation prior to DC-790 application.
001	Appendix B, Page B-6	Added Note 3 for Screw installation.
001	Appendix C, Page C-4	Changed pipe, conduit and track sizes to material available on site.
001	Appendix C, Page C-5	Corrected screw description and added double asterisk note.
001	General	This document contains the main body of the report (pages 1-19), Appendix A (3 pages), Appendix B (8 pages), Appendix C (5 pages), Appendix D (2 pages), for a total of 37 pages.

Table of Contents

Table of Contents
(continued)

List of Tables

Page

ACRONYMS

CGD	Commercial Grade Dedication
CGI	Commercial Grade Item
CS	Carbon Steel
HVAC	Heating Ventilation and Air Conditioning
IROFS	Items Relied On For Safety
MOX	Mixed Oxide
MFFF	Mixed Oxide Fuel Fabrication Facility
QA	Quality Assurance
QC	Quality Control
QL	Quality Level
SSC	Structures, Systems and Components
w.g.	Water Gauge

Penetration Seal Materials

SF-150NH	Prematec SF-150NH High-Density Silicone Elastomer
DC-732	Dow Corning® 732 Multi-Purpose Sealant
DC-790	Dow Corning® 790 Silicone Building Sealant

AREVA

Document No.: 51-9217624-001

Detailed Test Plan for Conducting MOX Fire-Pressure Test 4

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 4. 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 4 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 4 is to be the same test assembly that was constructed and used for MOX Pressure Test 9 [Reference 12.7]. If the slab from 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 penetrations. The HVAC penetration will be 36" x 19" with a ¾" bevel on three sides of the opening on the top side of the barrier and a ¾" bevel on all 4 sides of the opening on the bottom side of the barrier. A 1 foot tall "curb" will be positioned against the fourth side of the opening on the top side of the barrier to simulate a wall or floor/ceiling slab adjacent to the penetration. The radiation shielding penetration will be a 36" x 12" opening without beveled edges. Details for the two penetrations are provided in Section 2.2. All of the penetrations will be unlined (bare concrete). The test deck will be

horizontally oriented with a hemispherical 72" diameter steel pressure vessel mounted on the exposed side of the precast opening in the slab.

Additionally, most of the openings (penetrations) in the MOX facility have been cast with a 3/4" 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 pressure seals, the bevel may provide a benefit over non-beveled openings. Therefore, for the purposes of the penetration seal test program, the bevel feature will only be included on penetrations where it is deemed to have a potential negative impact on the penetration seal performance.

For the HVAC penetrations being evaluated in this test, the seal configurations result in penetration closure/seal materials abutting and overlapping the 3/4" bevel such that the bevel could impact the closure/seal performance. As a result, for the HVAC penetration in this test plan, the 3/4" bevel feature will be utilized.

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

2.2 Test Description

There are two openings to be sealed and tested in MOX Fire-Pressure Test 4.

Penetration P1 - Test penetration P1 is a 36" x 19" blockout containing a mechanical duct sealed at one end simulating a duct designed to resist the passage of fire. Specifically, this penetration will contain one (1) galvanized steel 14" x 14" duct with a fitted cover plate installed on the bottom side simulating a duct designed to resist the passage of fire. The penetrating duct will be located within the opening as shown in Appendix B. This opening will be sealed using a penetration closure design, as laid out in Drawing DCS01-BMF-DS-PLF-A-04509 [Reference 12.9], consisting of steel track, steel studs, structo-crete concrete panel material, metal retainer angles, Dow Corning® 790 Silicone Building Sealant / Dow Corning® 732 Multi-Purpose Sealant and ceramic fiber blanket material as backing for the silicone sealants.

Penetration P2 - Test penetration P2 is a 36" x 12" blockout containing multiple penetrating items. All sides of the opening will be unlined, bare concrete (i.e., no liners, coatings or sleeve materials). The tested conduits will include one (1) 2" diameter Rigid Galvanized Steel (RGS) conduit and one (1) 2" diameter Stainless Steel (SS) conduit. The tested pipes will include one (1) 2" diameter Schedule 40 Carbon Steel (CS) pipe and one (1) 2" diameter Schedule 10 Stainless Steel (SS) pipe. The conduits and pipes will be capped on at least one side or fitted with a welded cover plate (Note: caps and/or cover plates are construction aids only and are not being qualified by this pressure test). The cap/welded cover plate shall be made air tight, so that any leakage during the test must pass though the seal assembly and not internal to the pipe or conduit (this may be assisted by the installation of an internal elastomer seal inside the conduit/pipe or with a rubber pipe cap).

Note:	During the fire test portion, pipes and conduits may be sealed with a non-combustible material, with a separate air tight seal installed for the pressure test portion. Pressure tightness through the pipes and conduits are not within the scope of this fire pressure test plan.

The opening will be sealed using an eight (8) inch thick seal of Promatec SF-150NH High-Density Silicone Elastomer (SF-150NH) with no permanent damming installed around the various penetrating commodities. The penetration seal material will be located within the opening as shown in Appendix B.

The penetrating items 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 4 is being conducted to demonstrate that typical HVAC and radiation barrier seal designs can withstand anticipated fire-induced pressures. HVAC and radiation barrier openings at MOX may be beveled or non-beveled. Where the openings are beveled, the bevel provides a greater surface area for sealant bonding, and therefore, is expected to result in a more robust seal design than non-beveled openings. For the HVAC penetrations being evaluated in this test, the seal configurations result in penetration closure/seal materials abutting and overlapping the 3/4" bevel such that the bevel could impact the closure/seal performance. As a result, for the HVAC penetration in this test plan, the 3/4" bevel feature will be utilized. The radiation barrier seal will not utilize the bevel design.

This test will evaluate fire-pressure resistance capabilities of penetration closure designs installed to reduce opening size around ducts with the use of steel studs, steel track, and/or layers of Structo-Crete panels with several designs of sheet metal retainer angles. Joints sealed using Dow Corning® 790 Silicone Building Sealant and Dow Corning® 732 Multi-Purpose Sealant. A successful test will substantiate the acceptability of this seal configuration to withstand anticipated fire-induced pressures when installed in and around HVAC commodities, regardless of commodity size and orientation. Specifically, the fire-pressure resistance of:

- Track, stud and Structo-Crete panel construction.
- Stacked layers of Structo-Crete panels installed through the penetration using HILTI fasteners and threaded rod with coupler.
- Joint between sheet metal retainer angles and concrete wall or Structo-Crete panel sealed using Dow Corning® 790 Silicone Building Sealant and ceramic fiber blanket material as backing for the silicone sealant.
- Joint between sheet metal retainer angle and metal ductwork sealed using Dow Corning® 732 Multi-Purpose Sealant.
- Sheet metal retainer angle spanning a maximum 2" gap from duct to Structo-Crete panel closure.
- Sheet metal retainer angle spanning a maximum 5" gap from duct to parallel concrete barrier resulting in a "Racked C" retainer angle design.
- Sheet metal retainer angle at a Structo-Crete interface maximum 1" gap sealed with Dow Corning® 790 Silicone Building Sealant and ceramic fiber blanket material as backing for the silicone sealant.
- Sheet metal retainer angle at a concrete interface maximum 1" gap sealed with Dow Corning® 790 Silicone Building Sealant and ceramic fiber blanket material as backing for the silicone sealant.
- Structo-Crete to concrete interface (beveled area and gaps) sealed with Dow Corning® 790 Silicone Building Sealant.

Additionally, this test will evaluate fire-pressure resistance capabilities of an eight (8) inch thick Promatec SF-150NH High-Density Silicone Elastomer (SF-150NH) seal with no permanent damming installed in an unlined (bare concrete) penetration. SF-150NH will be used in this test around RGS and SS conduits, and Carbon Steel (CS) and Stainless Steel (SS) pipes. A successful test will substantiate the acceptability of this seal configuration to withstand anticipated fire-induced pressures when installed in and around the following types of commodities, regardless of commodity size:

- RGS conduits
- SS conduits
- CS pipe
- SS pipe

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® 790 Silicone Building Sealant.
2. Dow Corning® 732 Multi-Purpose Sealant.
3. Unifrax Fiberfrax® Durablanket® S – 6 pcf density
4. Promatec SF-150NH High-Density Silicone Elastomer

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

Penetrating items (e.g., pipes, conduits and HVAC) will be used in this fire pressure test to simulate MOX-specific plant commodities during the fire pressure test but are not considered an integral part of the penetration seal assemblies being tested. Therefore, the quality level of the penetrating items is **Non-safety**.

Penetrating items for this fire pressure test will come from one of two sources: MOX Services or the testing laboratory. MOX Services supplied items are identified on the MOX Services Bill of Materials in Section C.2 of Appendix C. Items provided by the testing laboratory are identified on the Testing Laboratory Bill of Materials in Section C.3 of Appendix C.

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 and placement of penetrating items, 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 Test Plan and in accordance with AREVA NP Inc. Document 01-9198306, *Installation Instruction Manual for MOX Penetration Seal Test Program* [Reference 12.4].

QA/QC verification of penetration seal installations shall be documented as required by AREVA NP Inc. Document 01-9198306, Installation Instruction Manual for MOX Penetration Seal Test Program [Reference 12.4]. 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® 790 and 732 sealants and Durablanket S installed as a backing material in conjunction with these sealants, and the SF-150NH elastomer.

8.3 Pre-Test Verifications

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

9.0 PROCEDURE

9.1 Fire Endurance Test

The fire endurance test portion of the fire-pressure test shall comply with the pertinent requirements of *ASTM E 814-94b* [Reference 12.8]. 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 pressure test.

10.0 DATA SYSTEMS

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

11.0 TEST REPORT

The testing laboratory shall submit a report on the results of both the fire and pressure test portions of this fire-pressure test. The test report shall contain the collected data and required quality control documentation. The

final test report shall be prepared in sufficient detail to summarize the total testing activity. The final report shall include as a minimum:

- Date of tests (fire and pressure)
- Location of tests
- Description of test apparatus and test articles
- Calibration documentation for all data systems connected to the test apparatus
- Test procedures used
- Acceptance criteria
- Provide quality control records
- Results of the fire and pressure tests, 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 51-9207913-000, *Detailed Test Plan for Conducting MOX Pressure Test 9*

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 *Shaw AREVA MOX Services Drawing DCS01-BMF-DS-PLF-A-04509, Sheet 1, Revision 0, Sheet 2, Revision 0; and Sheet 3, Revision 2

APPENDIX A: TEST DECK/TEST SLAB DRAWINGS

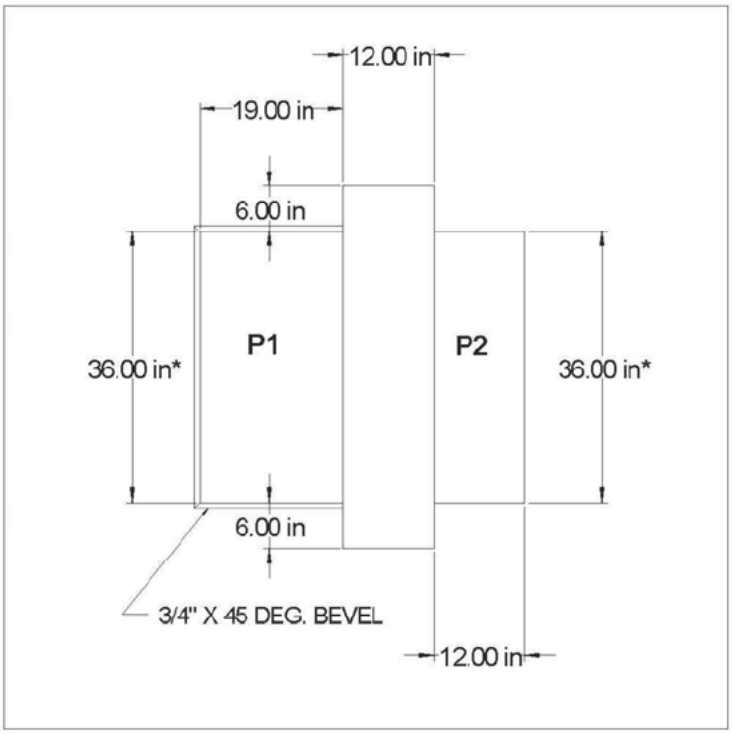
The test deck (test slab) for Fire-Pressure Test 4 is depicted on page A-2.

AREVA

Document No.: 51-9217624-001

Detailed Test Plan for Conducting MOX Fire-Pressure Test 4

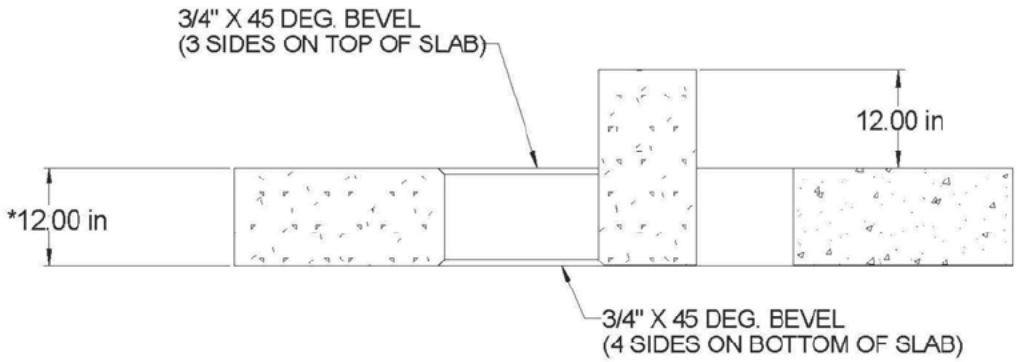
Fire-Pressure Test 4 Test Deck



NOTES:

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

Intertek



Section A - A

NOTES:

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

APPENDIX B: TEST PENETRATION DRAWINGS

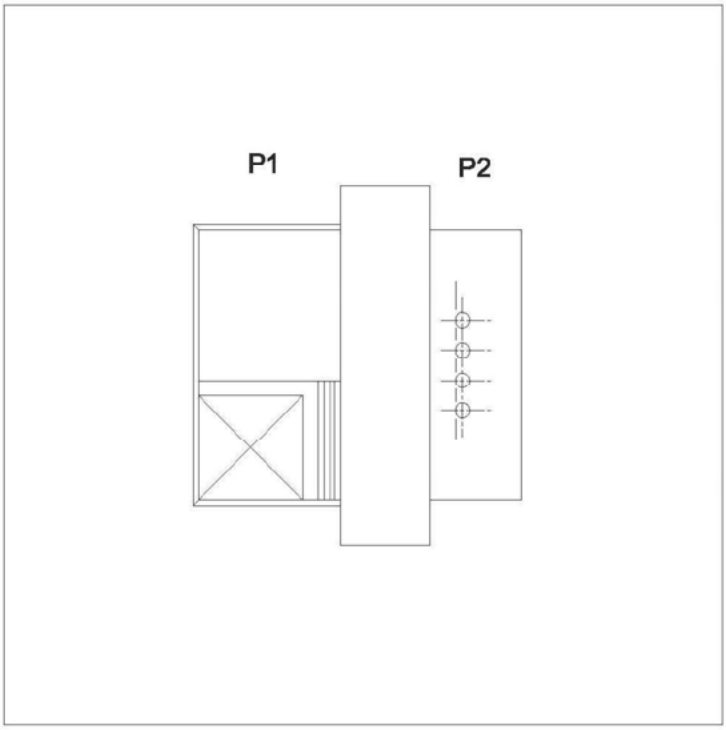
This appendix contains Test Penetration drawings. These drawings identify penetrating item locations within the test penetration, as well as, the penetration seal design for each test penetration.

AREVA

Document No.: 51-9217624-001

Detailed Test Plan for Conducting MOX Fire-Pressure Test 4

Fire-Pressure Test 4 Test Deck



NOTES:

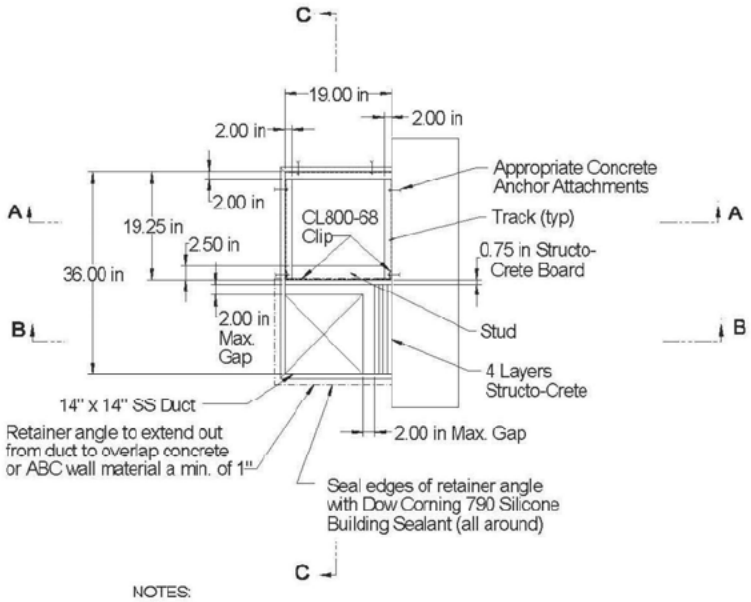
1. TOLERANCE ON ALL SLAB DIMENSIONS IS +/- 1/4"
2. * INDICATES DIMENSIONS TO BE VERIFIED BY AREVA QC.
3. SEE PAGE B-3, B-4, B-5 AND B-6 FOR DETAILS OF PENETRATION P1.
5. SEE PAGE B-7, AND B-8 FOR DETAILS OF PENETRATION P2.

AREVA

Document No.: 51-9217624-001

Detailed Test Plan for Conducting MOX Fire-Pressure Test 4

Penetration P1



NOTES:

1. TOLERANCE ON ALL SLAB DIMENSIONS IS +/- 1/4"
2. * INDICATES DIMENSIONS TO BE VERIFIED BY AREVA QC.
3. THE STEEL NETWORK STRUCTURAL FRAMING AND STRUCTO-CRETE INSTALLED TO REDUCE OPENING SIZE AROUND DUCT.

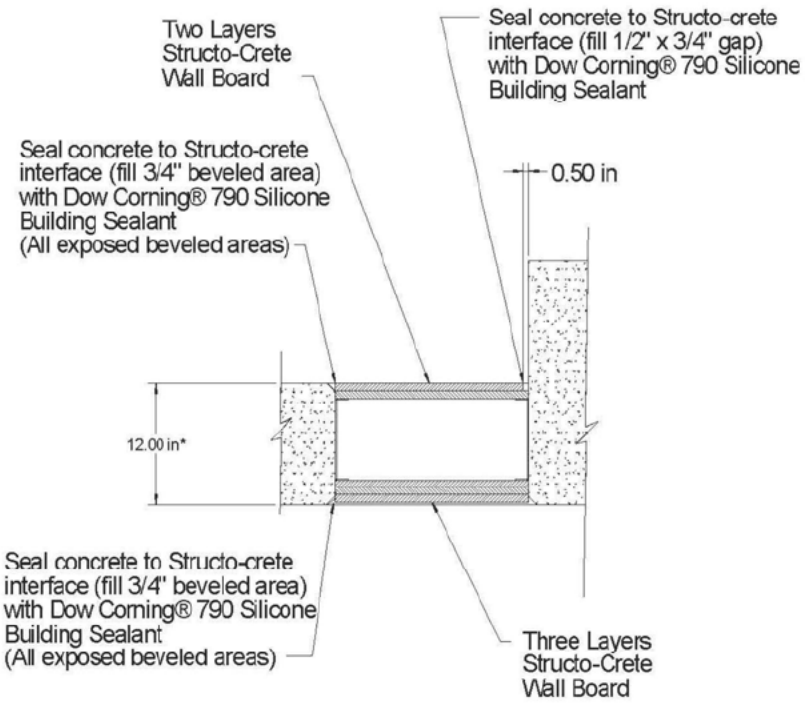
   SEE DRAWING DCS01-BMF-DS-PLF-A-04509 FOR DETAILS.
4. ALL CAST CONCRETE SURFACES THAT WILL INTERFACE WITH DOW CORNING 790 SILICONE BUILDING SEALANT SHALL BE PREPARED USING A GRINDER EQUIPPED WITH A HILTI DG-CW AP-SP DIAMOND CUP WHEEL (HILTI ITEM NO. 2066711). THIS INCLUDES THE BEVEL AREA OF THE CONCRETE OPENINGS, AS WELL AS, THE FACE OF THE CONCRETE SLAB ON BOTH SIDES OF THE BARRIER FOR A DISTANCE OF APPROXIMATELY 2" WIDE AROUND THE PERIMETER OF PENETRATION P1.

AREVA

Document No.: 51-9217624-001

Detailed Test Plan for Conducting MOX Fire-Pressure Test 4

Penetration P1



Section A-A

NOTES:

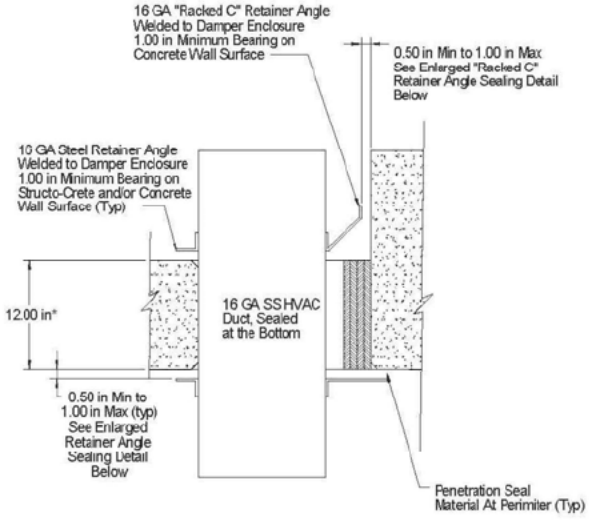
1. TOLERANCE ON ALL SLAB DIMENSIONS IS +/- 1/4"
2. * INDICATES DIMENSIONS TO BE VERIFIED BY AREVA QC.

AREVA

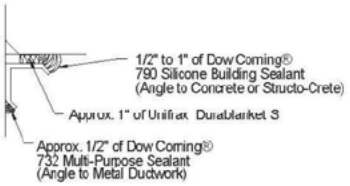
Document No.: 51-9217624-001

Detailed Test Plan for Conducting MOX Fire-Pressure Test 4

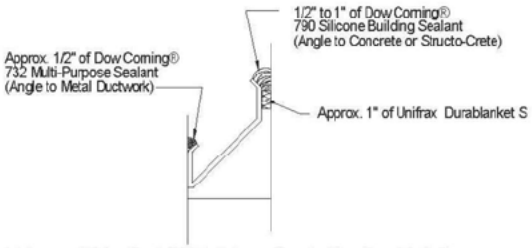
Penetration P1



Section B - B



Enlarged Retainer Angle Sealing Detail



Enlarged "Racked C" Retainer Angle Sealing Detail

NOTES:

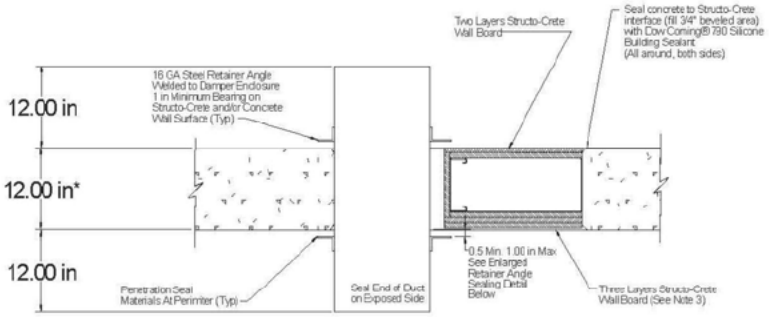
1. TOLERANCE ON ALL SLAB DIMENSIONS IS +/- 1/4"
2. * INDICATES DIMENSIONS TO BE VERIFIED BY AREVA QC.

AREVA

Document No.: 51-9217624-001

Detailed Test Plan for Conducting MOX Fire-Pressure Test 4

Penetration P1



Section C - C

Enlarged Retainer Angle Sealing Detail

NOTES:

1. TOLERANCE ON ALL SLAB DIMENSIONS IS +/- 1/4"
2. * INDICATES DIMENSIONS TO BE VERIFIED BY AREVA QC.
3. HILTI SELF-DRILLING SCREWS – 12-24 X 2-1/2" PFH #4 FIRST LAYER STRUCTO-CRETE TO METAL STUDS.

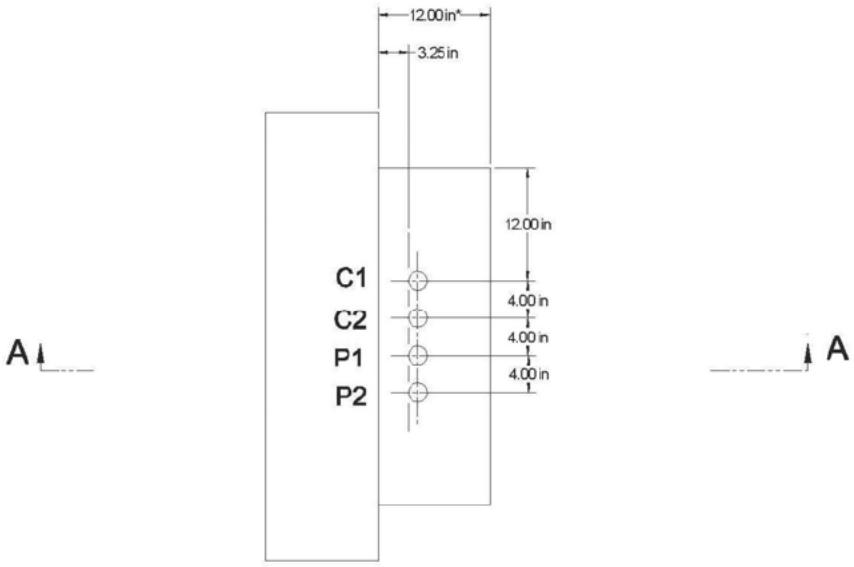
   HILTI SELF-DRILLING SCREWS – S-MD 12-24 X 3 HWH #5 KWIK-COTE USED FOR SECOND LAYER STRUCTO-CRETE TO METAL STUDS MAY BE USED FOR THE 3RD LAYER STRUCTO-CRETE BY COUNTERSINKING THE 3RD LAYER OF STRUCTO-CRETE UP TO 3/8".

AREVA

Document No.: 51-9217624-001

Detailed Test Plan for Conducting MOX Fire-Pressure Test 4

PENETRATION P2

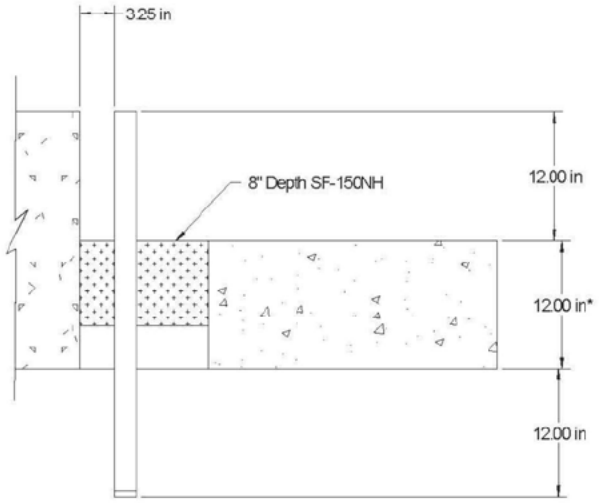


C1 = 2" SS Conduit
C2 = 2" RGS Conduit
P1 = 2" CS Pipe
P2 = 2" SS Pipe

NOTES:

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

PENETRATION P2



Section A - A

NOTES:

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

AREVA

Document No.: 51-9217624-001

Detailed Test Plan for Conducting MOX Fire-Pressure Test 4

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® 790 Silicone Building Sealant	N/A	1	Case	1 Case
2	Dow Corning® 732 Silicone Building Sealant	N/A	1	Case	1 Case
3	Promatec SF-150NH High-Density Silicone Elastomer (50lb part A, 50lb part B, 100lb set)	N/A	2	Set	2 Set
4	Unifrax Fiberfrax® Durablanket® S – 6 lbs/cu. ft., 1" thick, 48" wide, 25 linear feet	764522000	1	Roll	1 Roll
5*	Hilti Self-Drilling Screws – 12-24 x 2-1/2" PFH #4 (1-1/2" thread length) (1st Layer Structocrete to Metal Studs)	311637	1	Box (1500 Screws)	1 Box
6*	Threaded Coupler, M8-1.25, 38 mm Long (Need 2)	N/A	10	Couplers	10 Couplers
7*	Threaded Rod, M8-1.25 (1 @ 1 meter length each, field cut to lengths needed – need 2 @ 6 in.)	N/A	1	Rod	1 Rod

*Use surplus from previous MOX testing at Intertek Lab.

AREVA

Document No.: 51-9217624-001

Detailed Test Plan for Conducting MOX Fire-Pressure Test 4

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*	Hilti HSL-3-G M8/20 Heavy Duty Expansion Anchor for anchoring steel stud systems to the concrete test deck (Need 8 anchors)	HSL-3-G M 8/20	1	Box	1 Box

*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
2**	2" Diameter Galvanized Conduit – Calconduit or Equal with Cap (Need 1 @ 3 LF w/Cap)	N/A	10	Ft.	10 Ft.
3**	2" Diameter Schedule 40 Carbon Steel Pipe with Caps (Need 1 @ 3 LF w/Cap)	N/A	10	Ft.	10 Ft.
4**	2" Diameter Stainless Steel Conduit –Calbrite Stainless Steel Conduit Systems, Type 304, or Equal with Cap (Need 1 @ 3 LF w/Cap)	N/A	10	Ft.	10 Ft.
5**	2" Diameter Schedule 40 Stainless Steel Pipe with Cap (Need 1 @ 3 LF w/Cap)	N/A	10	Ft.	10 Ft.
6*	The Steel Network, 8" Steel Stud (Need approximately 2 feet)	800C/STW250-97	10	Feet	10 Feet
7*	The Steel Network, 8" Track (Need approximately 6 feet)	800T200-97	20	Feet	20 Feet
8*	The Steel Network, Stiff Clip CL (Need 2)	CL800-68	1	Box	1 Box
9	16 Gauge 14" x 14" Stainless Sheet Metal Duct with End Welded Closed using 16 Gage Stainless Sheet Steel	N/A	3	Ft.	3 Ft.
10	Retainer Angle Iron 2-1/2" x 1-3/4", 2' Long	N/A	4	Pcs.	4 Pieces

AREVA

Document No.: 51-9217624-001

Detailed Test Plan for Conducting MOX Fire-Pressure Test 4

Bill of Material for Intertek Supplied Items*					
Item	**Description**	**Part Number**	**Quantity**	**Units**	**Total**
11	Retainer Angle Iron 2-1/2" x 3", 2' Long	N/A	2	Pcs.	4 Pieces
12	Retainer Angle Iron 2-1/2" x 6-3/4", 2' Long	N/A	1	Pc.	1 Piece
13	Racked "C" Retainer Angle Iron 2-1/2" x r=4" @ ~30-45 deg.	N/A	1	Pc.	1 piece
14*	Hilti Self-Drilling Screws – Heavy Gauge Metal (2-1/4" thread length) (2nd Layer of Structo-Crete to Metal Studs – may be used for the 3rd layer Structo-Crete by countersinking the 3rd layer of Structo-Crete up to 3/8")	S-MD 12-24x3 HWH #5 Kwik-Cote	1	Box (1000 Screws)	1 Box
15*	Hilti Self-Drilling Screws – Light-Medium Gauge Metal (1/2" thread length) (Metal Clips)	S-MD 12-14 x ¾" HWH #3	1	Box (5000 Screws)	1 Box

*Use surplus from previous MOX testing at Intertek Lab.

** Reclaim from MOX Seismic Pressure Test 7

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.

Page C-5

AREVA

Document No.: 51-9217624-001

Detailed Test Plan for Conducting MOX Fire-Pressure Test 4

APPENDIX D: DESIGN VERIFICATION CHECKLIST

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

AREVA

DESIGN VERIFICATION CHECKLIST

Document Identifier 51 - 9217624 - 001

Title Detailed Test Plan for Conducting MOX Fire-Pressure Test 4

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.: 51-9217624-001

Detailed Test Plan for Conducting MOX Fire-Pressure Test 4

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

AREVA

DESIGN VERIFICATION CHECKLIST

Document Identifier 51 - 9217624 - 001

Comments on the preceding responses:

Verified By: (First, MI, Last)	Derrick V Risner Printed / Typed Name	[redacted] Signature	2/11/2014 Date

APPENDIX F
Commercial Grade Dedication-Related Documents

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

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

- AREVA Document 51-9212666-000, "Dow Corning 732 Multi-Purpose Sealant Critical Characteristics"
- AREVA Document 51-9212668-000, "Dow Corning 790 Silicone Building Sealant Critical Characteristics"
- AREVA Document 51-9212670-000, "Unifrax Durablanket S Critical Characteristics"

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

The SF-150NH High Density Silicone Elastomer seal material used in this test was not base-lined to establish critical characteristics because this material is proprietary to PCI Promatec; is only available from PCI Promatec; and can be procured Nuclear Safety Related (i.e., MOX QL-1) from PCI Promatec. Therefore, future procurements of this product can be handled such that no Commercial Grade Dedication is required.

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

APPENDIX G
Quality Documents

The test assembly for Fire-Pressure Test 4 was the same assembly constructed and tested first as Pressure Test 9. 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 9 (Intertek Report No. 101276459SAT-018_Rev. 1; AREVA Doc. 58-9223295-001).

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]

Aaron Jubbs, Technical Manager

Maintaining Accuracy:

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

Recalibration:

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

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

Intertek

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

Certificate of Verification

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

Verification Performed By:

[redacted]

Verification Approved By:

[redacted]

Project Engineer

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

CERTIFICATE NO: 54676-0009

Page 1 of 1

SYSTEM SCALE CORPORATION
SSC LAB DIVISION

CERTIFICATE OF CALIBRATION

ACLASS ACCREDITED CALIBRATION
Certificate # AC-1756

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

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

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

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

Calibration Accuracy± 1% FS

Note:A=Reading plus Uncertainty exceeds tolerance limits.

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

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

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

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

[redacted]
Cindy Glover
Production Supervisor

Comments:

CERTIFICATE NO: 55020-0001

Page 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] 3/14/13

ilac-MRA ACCREDITED Calibration Certificate No. 1750.01

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

Cert. No.: 1045-5005294

Traceable® Certificate of Calibration for Watr/Shock Res Stpwch

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

Instrument Identification:

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

Standards/Equipment:

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

Certificate Information:

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

Test Conditions: 22.5°C 42.0 %RH 1020 mBar

Calibration Data: (New Instrument)

Unit(s)	Nominal	As Found	In Tol	Nominal	As Left	In Tol	Min	Max	±U	TUR
Sec/24hr		N.A.		0.000	-0.300	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.

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

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REPORT OF CALIBRATION

To: INTERTEK TESTING SERVICES

16015 SHADY FALLS ROAD
ELMENDORF, TX
78112

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

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

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

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

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

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

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

Calibrated by: AM

REFERENCE STANDARD THERMOCOUPLE TYPE K

NIST TRACEABILITY AVAILABLE UPON REQUEST
TEST # 279113

[redacted]

Approved By: Dante Bediones 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 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	199.9	0.1	199.9	0.1	0.1	2.0
400.0	400.1	-0.1	400.0	0.0	-0.1	2.0
600.0	599.6	0.4	599.7	0.3	0.4	2.4
800.0	800.3	-0.3	800.3	-0.3	-0.3	3.2
1000.0	1000.8	-0.8	1000.9	-0.9	-0.9	4.0

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

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

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

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

Calibrated by: AM

REFERENCE STANDARD THERMOCOUPLE TYPE K

NIST TRACEABILITY AVAILABLE UPON REQUEST
TEST # 279113

[redacted]

Approved By: Dante Bedlones Cal. Lab. Manager

Page 11 of 22

LIST OF CALIBRATED EQUIPMENT: PRESSURE TEST

Description	Serial No.	Calibration Due Date
Thermo-Hygrometer	130548237	9/19/2015
Data Acquisition System	18041FE	8/11/2014
Pressure Transducer	406707	1/30/2015
Mass Flowmeter	4270050001001	1/30/2015
Mass Flowmeter	4270050003001	1/30/2015
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

Control Company is an ISO 17025:2005 Calibration Laboratory Accredited by (A2LA) American Association for Laboratory Accreditation, Certificate No. 1750.01.
Control Company is ISO 9001:2008 Quality Certified by (DNV) Det Norske Veritas, Certificate No. CERT-01805-2006-AQ-HOU-RvA.
International Laboratory Accreditation Cooperation (ILAC) - Mutilateral Recognition Arrangement (MRA).

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

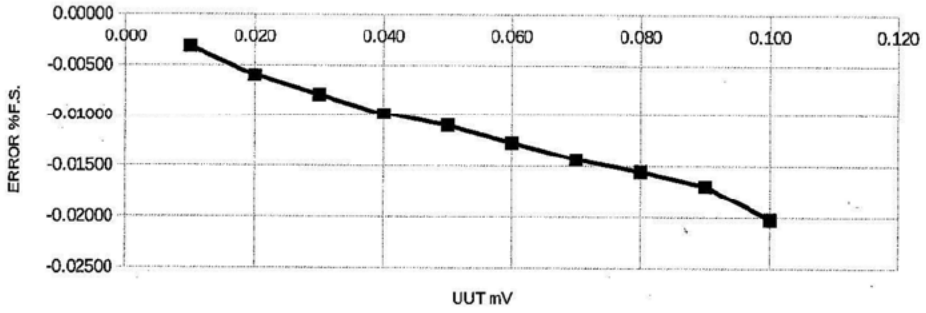
This Data Acquisition System was verified following the Draft "Work Instruction for Verifying Yokogawa Darwin Data Acquisition Systems" dated 8/28/2013

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.

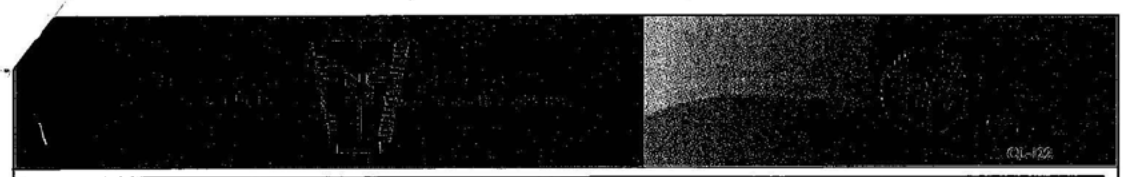
Dick Munns Company • 10572 Calle Lee #138 • Los Alamitos, CA 90720
[redacted]5 • Fax (714) 827-0823

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

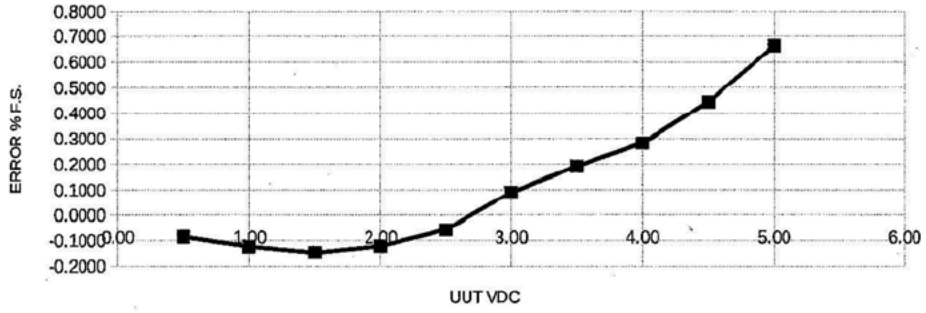


CERTIFICATE OF CALIBRATION

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.

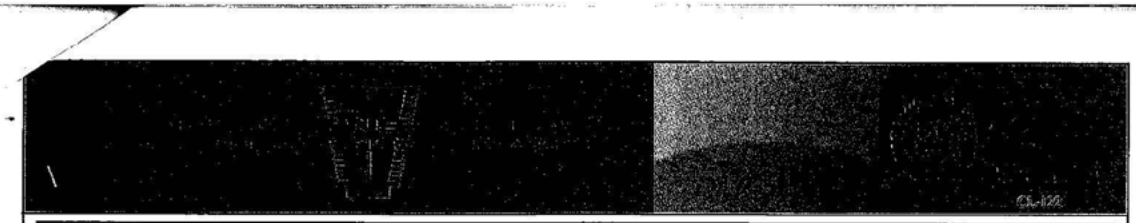
Dick Munns Company • 10572 Calle Lee #138 • Los Alamitos, CA 90720
[redacted] • Fax (714) 827-0823

This Calibration Certificate s[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

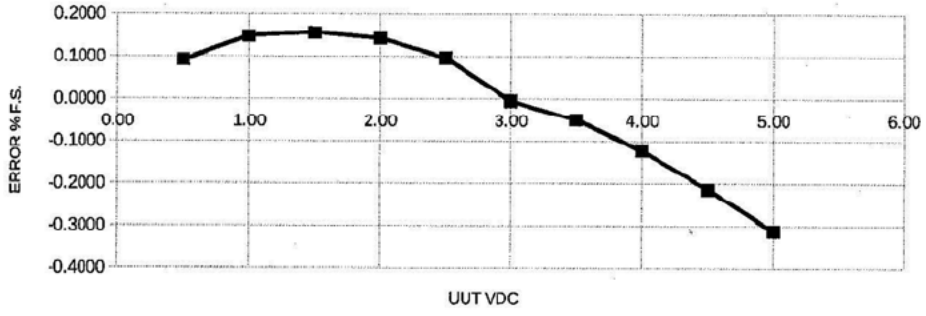


CERTIFICATE OF CALIBRATION

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-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.

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

This Calibration Certificate shall [redacted] NY. 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

[redacted] 3/4/13

ilac-MRA ACCREDITED Calibration Certificate No. 1750.01

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

Cert. No.: 1045-5005294

Traceable® Certificate of Calibration for Watr/Shock Res Stpwch

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

Instrument Identification:

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

Standards/Equipment:

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

Certificate Information:

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

Test Conditions: 22.5°C 42.0 %RH 1020 mBar

Calibration Data: (New Instrument)

Unit(s)	Nominal	As Found	In Tol	Nominal	As Left	In Tol	Min	Max	±U	TUR
Sec/24hr		N.A.		0.000	-0.300	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.

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[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: 101266224SAT-011 **CLIENT :** AREVA

Project Description FIRE PRESSURE #4

	SAT	UNSAT

I. ASSEMBLY

Proper materials used .....
Material documentation complete.....
Configuration/dimensions in accordance w/ approved drawings....
Description of assembly: MX AREVA FIRE PRESSURE #4

II. ELECTRICAL CABLE

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

III. THERMOCOUPLES

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

IV. FIRE BARRIER

Name or type of material SF150NH, DC732/790, STRUCTURAL
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

V. FINAL PREBURN VERIFICATION

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

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

Temperature 82 Humidity 39 Date 2/20/14 Time of Test start 4:07P

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-011 for AREVA NP, Inc.

Page 1 of 1

ITEM	DATE	INIT'L
Concrete poured by Alamo Concrete	1/10/14	MD
Concrete conditioned	1/17/14	MD
Critical attributes of test slab verified	2/4/14	MD
Seals poured	2/12/14	MD
Completed seal assembly verified against the test plan	2/12/14	MD
Pressure Test #9 conducted	2/19/14	MD
Assembly re-purposed for Fire-Pressure Test #4	2/19/14	MD
Thermocouples installed in accordance with the test plan	2/19/14	MD
Fire-Pressure Test #4 (Fire Test) conducted	2/20/14	MD
Fire-Pressure Test #4 (Pressure Test) conducted	2/24/14	MD

9/12 NQAP-007.7.3

Certificate of Conformance

Client Name: AREVA NP Inc. Date: September 10, 2014

Project No: G101266224SAT-011

Intertek Testing Services NA (Intertek) has conducted testing for AREVA NP Inc., on the fire and pressure resistance capabilities of Uniprix Fiber fax® Dura blanket® S (Dura blanket), Dow Corning® 732 Silicone Multi-Purpose Sealant (DC-732), Dow Corning® 790 Silicone Building Sealant (DC-790) and PCI-Primate SF-150NH High Density Silicone Elastomer (SF-150NH) through a 12" thick concrete deck for compliance with the applicable requirements of and in accordance with AREVA NP Inc. Document No. 51-9217624-001, *Detailed Test Plan for Conducting MOX Fire-Pressure Test 4.* The test took place on February 20 through February 24, 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 10, 2014
Date

Intertek Testing Laboratory
16015 Shady Falls Road, Elmendorf TX 78112
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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 10, 2014	Original Issue Date