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Draft Flood Penetration Seal Performance at Nuclear Power Plants Literature Review (Task 1.1) and Test Methodology (Task 1.2)

Comment On: NRC-2018-0028-0001
Draft Flood Penetration Seal Performance at Nuclear Power Plants; Literature Review (Task 1.1) and Test Methodology (Task 1.2)

Document: NRC-2018-0028-DRAFT-0004
Comment on FR Doc # 2018-03340

Submitter Information

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Organization: Nuclear Energy Institute

General Comment

See attached file(s)

Attachments

(2)

03-22-18 NRC_NEI_Draft 4 Flood Seal Testing Comments Letter

03-22-18_NRC Industry Comments on Flood Seals_Attachment

83 FR 7239
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NUCLEAR ENERGY INSTITUTE

March 22, 2018

Ms. May Ma
Office of Administration
Mail Stop: TWFN-7-A60M
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001
Submitted via Regulations.gov

Subject: NEI Comments on Task 1.1 and Task 1.2 of the project entitled, "Flood Penetration Seal Performance at Nuclear Power Plants," (Docket ID NRC-2018-0028).

Project Number: 689

Dear Ms. Ma:

The Nuclear Energy Institute (NEI)[1], on behalf of our members, appreciates the opportunity to provide comments on the subject Task 1.1 and Task 1.2 of the project entitled, "Flood Penetration Seal Performance at Nuclear Power Plants." The purpose of this letter is to provide the attached comments which recommend changes that would improve clarity and ensure quality data from experiments is being obtained.

We understand the purpose of this project is to perform a research task to "develop a flood penetration and testing methodology that could be used to assess the performance and reliability of those seals"[2] that are credited for flood protection at nuclear power stations. The industry's position is aligned with the Task 1.1 Summary, which states that "... the data provided in the various documents reviewed indicate that the majority of reported "failures" in flood barriers were the result of either unsealed penetrations or where a penetration seal assembly was either broken, degraded, or not properly installed."[3] As the testing project is focused on installed seal configurations, the industry strongly suggests that the project as proposed will be of limited value and should incorporate walkdown and visual inspection methodology.

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[1] The Nuclear Energy Institute (NEI) is the organization responsible for establishing unified policy on matters affecting the nuclear energy industry, including the regulatory aspects of generic operational and technical issues. NEI's members include entities licensed to operate commercial nuclear power plants in the United States, nuclear plant designers, major architect/engineering firms, fuel cycle facilities, nuclear materials licensees, and other organizations and entities involved in the nuclear energy industry.

[2] ML18043B094, Flood Penetration Seal Performance at Nuclear Power Plants, Task 1.1, Draft for Comment dated 2/13/2018, page 2

[3] Ibid, page 10

While we provided comments on both the draft Task 1.1 and Task 1.2 documents, we recommend that the subject of Task 1.1 include a review of seal testing already performed by the industry, and that this review be completed prior to further developing the draft test methodology discussed in Task 1.2.

We appreciate the NRC staff's consideration of the attached comments. If you have any questions concerning this letter and the attached table, please contact Jon Kapitz (202.739.8077; jkk@nei.org) or me (202.739.8132; fap@nei.org).

Sincerely,

Frances Pimentel

Frances A. Pimentel

Attachment

c: Mr. Thomas Aird, RES/DRA/FXHAB, NRC
Mr. Joseph Sebrosky, NRR/DLP/PBMB, NRC
Mr. Juan F. Uribe, NRR/DLP/PBMB, NRC
NRC Document Control Desk

Attachment

Comments on Flood Penetration Seal Assemblies at Operating Nuclear Power Plants, Task 1.1 (ML18043B094):

	Affected Section	Comment/Basis	Recommendation
1.	Page 1	Task identifies ". . . NRC Staff noted that there did not appear to be any form of regimented test methodologies being used by the Licensees to verify or quantify the level of performance associated with specific flood seal assemblies."	Consider adding to review, documentation from pressure tests that were performed to qualify existing pressure barrier (flood) penetrations seals as an extension to this task. While requirements were not promulgated resulting in standardized test methodologies and establishing parameters for qualifying pressure resistant penetration seals, test strategies were established and tests were performed by industry for the design and qualification of these seals. Available test data can provide insights. Outcome should align with industry testing if done appropriately; albeit resulting bounding parameters may not be consistent.
2.	Page 1. "Without a set of methodologies that can be used to test and evaluate the performance of specific flood seal configurations, it is not possible to verify whether or not a specific penetration seal assembly can adequately support the flood mitigation requirements for the various NPPs."	The statement predetermines that the flood barriers were not designed and assumes that visual inspections of the design are inadequate to assess whether the barrier is installed correctly or effectively.	At the heart of the data analysis is to establish a test that can support the design basis, but does not necessarily preclude that the testing methodology proposed by one vendor is supported by the manufacturer. The data analysis should have an element of working with the original vendors to support whether active testing is recommended along with the quality assurance requirements of installation.

Attachment

	Affected Section	Comment/Basis	Recommendation
3.	Page 2	Task identifies "the primary objective for this initial review is to develop a series of candidate flood penetration seal assemblies that will then be included as representative example seal configurations in the subsequent testing phase."	As noted above, recommend review of existing pressure test documentation in conjunction with established seal designs. The task identified the types of seals being used and could include a review of test documentation for these penetration seal configurations. Testing was often performed with QA oversight while some testing was performed and documented by independent test laboratories. It may be beneficial to consider existing seal designs with available test/acceptance documentation to identify open issues or concerns requiring further research and/or validation.
4.	Page 3. "The majority of the assemblies contained in this database were provided by a sampling of four (4) of the responding NPPs that provided significant installation details and are expected to be representative of typical plants."	The statement assumes that an applicable data spread can be assessed from a sample of 4 plants that provided a lot of information. This may be significantly misleading if the data spread doesn't contain minimum targets of barrier types or design basis. Additional NPPs have augmented inspections programs for barriers and seal.	Ensure that data includes both pre-and post-General Design Criteria plants. While substantial submittal information from 4 sites provides a complete data set of those designs, even partial data from another site that represents different design basis eras would more appropriately represent an industry cross section, and actual seal conditions might be significantly better than portrayed in this data, due to continuing inspections covered by structural monitoring programs that are typically driven by Maintenance Rule condition monitoring and License Renewal aging management.

Attachment

	Affected Section	Comment/Basis	Recommendation
5.	Page 7	Identifies and discusses "parameters that must be considered for each candidate penetration seal assembly; the size and configuration of the penetration and the material selection for the seal assembly."	Understanding of the scope is to identify seal design parameters that will impact the pressure resistance of a penetration seal to support evaluation and qualification testing. Some bounding parameters are intuitive and most have been identified by previous industry testing. From these, tests can be performed to validate these bounding parameters. In general, the parameters will be generic and not material dependent (demonstrated testing a few materials and varying these parameters in lieu of testing a large number of materials). For example; size of the seal in important regardless of material type because as the area of the seal increases the force acting on seal also increases while the perimeter of the seal works to resist this pressure and keep the seal in place.

Attachment

	Affected Section	Comment/Basis	Recommendation
6.	Page 7. "Silicone foam is recommended for inclusion as a candidate material in seal assemblies during the testing.... due to its extensive use and operating history"	The statement is only partially correct and the material has been used in some NPPs, but not all NPPs.	The testing methodology proposed should include most of materials used and not be developed specifically toward Silicone foam material. Seal materials used to protect safety related systems should have the greatest priority for new testing methodologies. Silicone foam was extensively used for sealing fire barrier penetration seals within the Nuclear Industry – not certain that it has been extensively used and credited for flood barrier penetration seals. The original "... objective for this research project is to develop a test methodology to be used to evaluate the effectiveness and performance of the various types of seal assemblies that are installed in barriers designed to prevent the intrusion of water." This seems to be moving to the testing of specific seal materials and away from the objective.
7.	Page 8	Task recommends "testing of some of the "repaired" configurations that have been applied to silicone foam seals may also be considered for inclusion in the research test plan to assess any potential improvements in the seal's ability to support specific flood mitigation requirements."	This inclusion does not seem to be consistent with the original objective of this project as noted in the previous comment. The overall objective for this research project is to develop a test methodology that could be used to evaluate the effectiveness and performance of the various types of seal assemblies that are installed in barriers designed to prevent the intrusion of water

Attachment

	Affected Section	Comment/Basis	Recommendation
8.	Page 8	The task notes the ". . . inclusion of seal assemblies that have been specifically (commercially) marketed for flood mitigation will also be included in the testing program, regardless of whether or not they have been previously identified as being installed at existing NPPs. The proposed test procedures must be demonstrated as being appropriated to support the testing of all types of flood penetration seal assemblies. It is anticipated that the research program will include testing of the above listed penetration / seal configurations using a wide range of materials, including elastomers and epoxies, caulking materials, along with mechanical type seals (boot, link, etc.)	Recommend identifying the test methodologies that are important to pressure resistance of a penetration seal. These parameters should be generic and not specific or different for each type of seal material.
9.	Page 9. "An important standard to consider in the development of the draft flood test methodology is ASTM E814 – Standard Test Method for Fire Tests of Penetration Firestop Systems"	Reference to the ASTM and similar guidance documents of fire barrier testing is being used in the context as if they were current "inservice" inspection methodologies whereas many and most are actually vendor testing methodologies used to qualify an installation configuration generically before it is installed with no field test other than the appropriate Quality Assurance assigned by the original manufacturer. Inappropriate referencing of factory testing where comparing to field testing is misleading.	Ensure where referencing any fire barrier testing methodology comparison to the flood barrier testing to distinguish if the comparative testing is "field" or "inservice" testing as opposed to "factory" testing.

Attachment

	Affected Section	Comment/Basis	Recommendation
10.	Page A-2, Information Notice Data	The Relevant Information shown in the table for IN 2002-12 appears to be a duplication of the Relevant Information listed for IN 2007-01. The events documented in the Table for IN 2002-12 are not the same as contained in the published version of IN 2002-12.	Correct the table as indicated with the published version of IN 2002-12.

Attachment

Comments on Draft Methodology for Testing and Evaluating the Performance of Flood Penetration Seals, Task 1.2 (ML18043B093):

	Affected Section	Comment/Basis	Recommendation
1.	General	It is unclear of the testing goals if the methodology is trying to establish a set of generically tested and accepted configurations similar to what was done by the Joint Owners Group (JOG) for Motor Operated Valves or if is to establish at test to be implemented in the field. The test apparatus development appears to be more aligned with the JOG project as it is grouping testing development based on "common" penetrations as opposed to "most difficult to test." Similar to comments from Task 1.1, this supports a "factory testing" plan as opposed to a "field testing" methodology. Similarly, data analysis provided does not include information on accessibility that would be important to field testing.	Do not develop testing acceptance criteria like the 10CFR50 appendix J program which will tend to be labor intensive and costly.

Attachment

	Affected Section	Comment/Basis	Recommendation
2.	General	The test methodology is reasonable. However, the depicted test chamber seems to be overly engineered for simple penetration seal configurations. For example, a single pipe or conduit configuration does not need or warrant the test chamber when the same required data can be obtained by capping the exposed side of the seal and then applying a controlled water head to the seal. This draft methodology is being developed in support of the Phase 2 activity to "test the test methodology" followed by an update to the test methodology prior to the end of the research program. The risk from only including the highly engineered test chamber in this draft methodology is that the option for a simpler test configuration will not be included in the subsequent phases of the research program.	Add additional information to the last paragraph on page 5 in Flood Seal Testing Methodology Development section to acknowledge that the test chamber described and shown in Enclosure 1 is intended to permit testing of "all types of seal assemblies/materials" and that a simplified test configuration for simple seal penetration configurations should not be excluded from the final edition of the test methodology. An example is in Enclosure 1, Section 3.5 implies the required use of a data logging system, when in many cases a manual log may be realistic and practical.
3.	Page 6. "5.1 Flood tests should be performed within an environmentally controlled area to minimize variables...."	Guidance for testing methodologies needs to replicate actual NPP's service conditions to allow for accurate prediction of seal performance".	Ensure testing conditions including EQ, dose, and other parameters typical of NPPs applications, and particularly safety related systems are developed in the new methodologies.

Attachment

	Affected Section	Comment/Basis	Recommendation
4.	Page 9. "An important standard to consider in the development of the draft flood test methodology is ASTM E814 – Standard Test Method for Fire Tests of Penetration Firestop Systems"	Reference to the ASTM and similar guidance documents of fire barrier testing is being used in the context as if they were current "inservice" inspection methodologies whereas many and most are actually vendor testing methodologies used to qualify an installation configuration generically before it is installed with no field test other than the appropriate Quality Assurance assigned by the original manufacturer. Inappropriate referencing of factory testing where comparing to field testing is misleading.	Ensure where referencing any fire barrier testing methodology comparison to the flood barrier testing to distinguish if the comparative testing is "field" or "inservice" testing as opposed to "factory" testing.
5.	Enclosure 1, Section 1	The scope of the testing methodology is limited to the laboratory setting.	Was any attempt made to develop a method to test actual flood penetration seals in situ? The results of such a test would be useful to demonstrate the capability of actual installed and aged flood penetrations. One possibility would be to pressurize a control volume on the upstream side of the penetration with nitrogen, and correlate the measured leakage to equivalent water leakage. The problem to overcome, of course, is how to build the control volume and seal it around all the various penetrants in very tight spaces. It would be difficult, but if we could do it, we'd have a much more informative and useful method than a laboratory test.
6.	Enclosure 1 – Section 1.4.3	Section identifies that . . . evaluation of each through-penetration flood seal assembly will be based on; Compatibility of assembly to the proposed environment, which can include aging characteristics of assembly materials.	Pressure test methodology presented does not evaluate proposed environment or provide specific provisions. Recommend removal from this section ("Scope of Test Methodology") and identify aging as a consideration. This would be an alternate evaluation.

Attachment

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7.	Enclosure 1 – Section 1.5	Section identifies that testing is a stated pressure for "duration to mimic flooding conditions to which the assembly may be exposed."	For events postulated to be of significantly long duration or testing of seals that may have constant and continuous exposure (below grade), consider establishment of a maximum exposure duration representative of continuous.
8.	Enclosure 1, Section 1.8	Section identifies the standard units for volumetric flow (leakage) to be stated in gallons per minute (gpm).	Gallons per minute is a considerable volume and most existing seal tests have reported leakage in much smaller units (ounces and drips per minute). Reduce prescriptive requirement or provide alternatives for reporting leakage of test results.
9.	Enclosure 1, Section 1.11	Section identifies that penetration seal assemblies and penetrants are to be reflective of their intended as-built (or planned) configuration.	Revise to acknowledge and allow consideration and use of bounding configurations.
10.	Enclosure 1, Section 2.2.3.2	Section discusses membrane penetration as a "penetration that passes through part of the barrier."	Suggest providing an example or examples as this can be confusing (if barrier is not breeched there is no penetration to test).
11.	Enclosure 1, Section 3.2	Section note identifies; "Note: For consistency and ease of (head) pressure measurement at the level of each penetration, the horizontal mounting is typically preferred."	Provide caution noting that while horizontal mounting provides conservative results that these may not be representative of results that would be achieved by the same seal if installed and tested in a vertical plane.
12.	Enclosure 1, Section 3.3	Section requires test assembly to have "a water fill connection."	Require means of providing for make-up water and eliminate the prescriptive requirement for a water fill connection. Makeup water can be provided manually, particularly when acceptance criteria is determined to be leaktight.

Attachment

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13.	Enclosure 1, Section 3.3 and 3.5	Section requires water level indicator to be included in the pressure chamber design.	In the case of testing a horizontal seal on a horizontal plan, pressure can be determined (and often more accurately) based on the level of water above the plane of the barrier/seal.
14.	Enclosure 1, Section 3.4	As written, this implies the test conditions must be held at a specified, constant pressure without allowance for a control band or range which maintains the "minimum test condition". Under zero seal leakage test conditions this may be adequate, however for conditions which allow a specific seal leakage rate a control band is more appropriate.	Add clarification that the 'specified water pressure' is a specified pressure band/range.
15.	Enclosure 1, Section 3.7	As written states that leakage must be collected from the unexposed side. This collected requirement may not always be practical.	Allowance to monitor the exposed side for loss of water volume, which should be conservative for a single simple penetration seal configuration, should be included.
16.	Enclosure 1, Section 3.8	The test chamber could be designed with sufficient water inventory to alleviate the need to provide a hard-piped make-up source. Water inventory loss during the duration of the test sequence could be compensated by increasing the overpressure in the test chamber, providing the required test pressure at the seal itself is maintained.	Provide clarification in Section 3.8 description or on Appendix A Schematic that the water input supply piping does not require hard piping.

Attachment

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17.	Enclosure 1, Section 4	This section lacks additional useful detail on how the test sample is to be configured.	Provide additional detail on how to configure the test sample. For example, the placement of the penetrants is important. If the penetrants are close to the center of the penetration, it creates an unsupported span between the penetrant and the wall for the sealing material to bear the load. This would be a bounding case for penetrations where the unsupported span is shorter.
18.	Enclosure 1, Section 4.4	Section requires penetrating items containing hollow spaces, such as pipes and conduit, to be sealed on both "the exposed and unexposed sides to prevent any water leakage . . ."	Revise to allow for sealing of one side. Sealing on a single side should be sufficient to prevent leakage through the penetrating item and is typical of some testing performed previously.
19.	Enclosure 1, Section 4.5	Section requires testing representative of an as-built configuration, including all pipes, conduits, cables (percent fill), required supports, etc...	Revise to allow consideration of bounding configuration parameters. For example, a larger percent of cable fill may be bounding and an acceptable representation of a smaller percentage of cable fill and less pipes may be bounding and may acceptably represent a test configuration with less pipes, etc.
20.	Enclosure 1, Section 4.6	Section requires that through-penetrating items extend a minimum of 12 inches (305 mm) on both the exposed and unexposed sides of the test sample.	Revise to require sufficient support but eliminating the requirement for 12 inch extension, particularly on the exposed side of the assembly. Requirement for extending may impact testing, field representation and require more tests. Particularly when testing on a horizontal plan. For example, a conduit sealed with a flood barrier penetration seal could be tested in and with the larger seal but extension on the exposed side of the conduit would impact the test pressure (exposure).

Attachment

	Affected Section	Comment/Basis	Recommendation
21.	Enclosure 1, Section 4.8	Section requires conditioning of the test sample, including all installed penetration seal assemblies/materials, to provide a moisture content that is representative of that which is anticipated for field construction.	Revise to eliminate this requirement for penetration seal assemblies/materials. Conditioning parameters appear appropriate for cementitious materials but not materials such as elastomers, silicone caulks, epoxies, etc.
22.	Enclosure 1, Section 4.8	This discusses conditioning of the test sample for moisture content, but not for aging.	Aging could be very important, especially for silicone foam seals. Consider aging the test samples – perhaps using a method similar to the aging of instruments for Environmental Qualification testing.
23.	Enclosure 1, Section 5.2	Section identifies requirements for documenting the test assembly.	Consider adding the following considerations from previous test protocols; • Documentation regarding substrate to which the seal is in contact or installed. Identify if opening is Concrete or a Liner. If liner the material (steel, galvanized steel) and if coated what coating is applied. • Penetrating items should not only be documented by type and number but size and the location of these within the seal as well. These provide support to the seal and the location can impact pressure resistance. • Cable fill (important when cable is bundled as the intricacies between cables are difficult to close) • Cable type - some cable types impact the cure of some (elastomeric) materials. • Clarify use of the term fill density to limit fill to penetrating items that are rigidly supported that penetrate the seal (typically not inclusive of cable).

Attachment

	Affected Section	Comment/Basis	Recommendation
24.	Enclosure 1, page 7 Note 1	Note example of determining fill density indicates that a 2 in pipe in a 4 in sleeve has a fill density of approximately 50%.	Definition defines fill density as the "percentage of the available penetration opening area that is occupied by a penetrating item." Area of 4 in pipe is approx. 12.5 sq. in., area of 2 in pipe is approx. 3.14 sq. in so it seems that the fill density would be approximately 25%.
25.	Enclosure 1 Appendix B, Section B-3	As written states that the test methodology is not intended to address other potential leakage mechanisms other than the static head of water for a specified duration. The section then goes on to define other mechanisms such as impact loading from debris. Associated effects from flooding as defined in other NRC documents include debris considerations other than impact loading from debris.	For consistency and clarity in wording consider inclusion of the "associated effects term" as captured below "This test methodology is not intended to address any other potential leakage mechanisms for penetration seal assemblies beyond exposure to specified water pressures for a specified duration. This includes mechanisms such as impact from float debris, vibration due to seismic activity or attached machinery, or aging. Although it is anticipated that some seal assemblies could be exposed *to additional loading as a result of the flooding associated effects including* ~~to~~ "impact" damage from floating debris and seismic activity, there are too many variables associated with such an event to develop a realistic simulation for inclusion in a "standardized" testing methodology. Where such events need to be evaluated, those evaluations should be separate from this test methodology ...."
26.	General Editorial Comments	Inconsistency in use of Attachment, & Enclosure Page 5 includes "A draft of the test methodology is provided as Attachment 1 to this report." Page E-1 labels it as "Enclosure 1" for the Draft Test Methodology	

Attachment

	Affected Section	Comment/Basis	Recommendation
27.	None		Materials installed as test specimens should be installed by installers qualified to perform installation as required by manufacture/procedures (as in plant).