

PERFORMANCE OF FLOOD RATED PENETRATION SEALS

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Flood Penetration Seal Performance Evaluation

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NRC PROJECT TITLE: Flood Penetration Seal Performance at NPPs

Project Team: Fire Risk Management, Inc.
Nuvia US

Project Overview:

Project Objective: *To establish Testing Standards and Protocols to evaluate the effectiveness and performance of seals for penetrations in flood rated barriers at NPPs.*

Project Tasks:

Task 1: Development of Testing Standards, Acceptance Criteria, and Protocols

Task 1.1: Identify and describe the various typical seal materials for FPSs used at NPPs

Task 1.2: Develop standard testing procedures, acceptance criteria and protocols for testing effectiveness and performance of FPSs.

Task 2: Testing of Selected Flood Penetration Seal Types and Designs

Task 3: Final Technical Report



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TASK 1.1 OVERVIEW

- Researched publicly-available information regarding installed Flood-rated Penetration Seals
 - ADAMS database
 - NPP responses to NRC 50.54 Letter (54)
 - NRC Audit Reports
 - LERs, NUREGs, INs. IRs (relevant info noted in 28/-/15/13)
- Wide variety of seal assemblies and materials noted
 - Concrete, Mortar, Grout
 - Mechanical seals (such as boot or link)
 - Silicone foams (high & low densities)
 - Epoxies & Elastomers
 - Urethane
 - Caulking
- Combination of “fill” materials with exterior “damming” materials applied (waterproofing)



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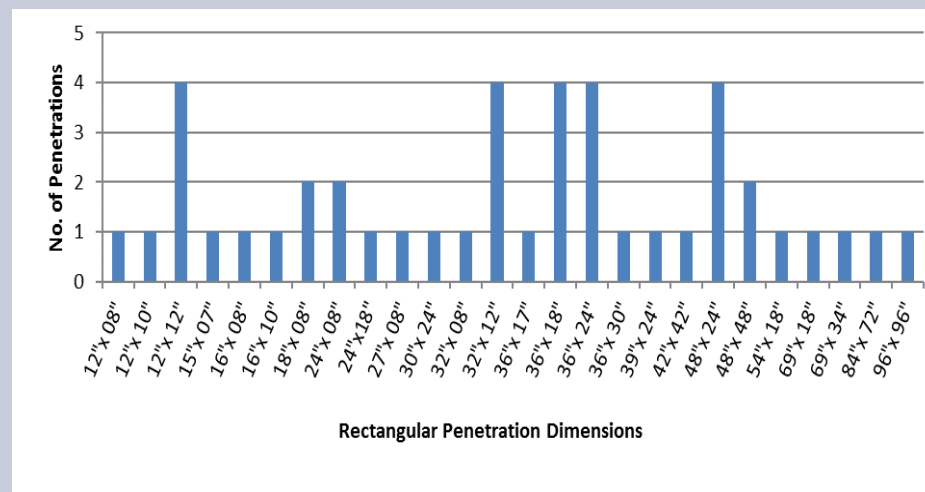
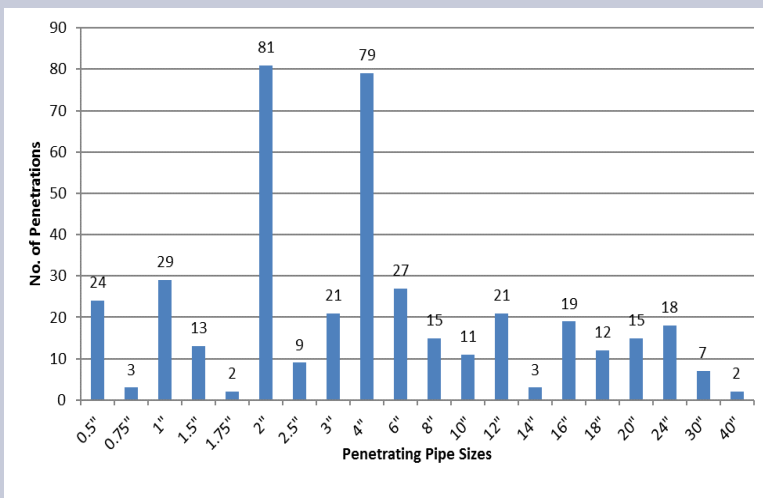
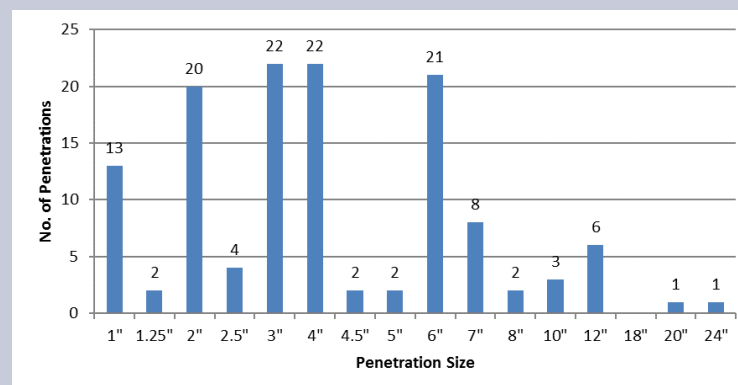
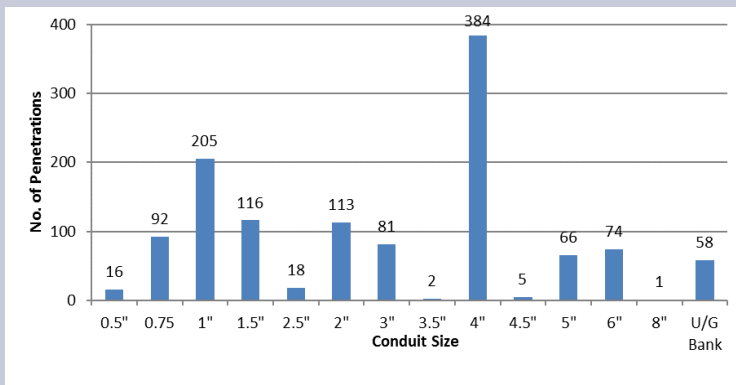
TASK 1.1 OVERVIEW (Cont'd)

- Wide range of penetration configurations and types of penetrants
 - Rectangular & Circular
 - Sleeved and Core Bore
 - Single & Multiple Penetrants and “Blanks”
 - Pipes, Cables, Conduit, etc.
 - Varying sizes / diameters
- Both interior and exterior applications
- FPS Assessments
 - “Formed in place” seals (foams, elastomers) appear to exhibit greatest variability in performance
 - Materials / Products (formulations) vary between Manufacturers
- Summary Report Developed: “*Flood Penetration Seal Assemblies at Existing Nuclear Power Plants*”

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TASK 1.1 OVERVIEW (Cont'd)





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TASK 1.2 OVERVIEW

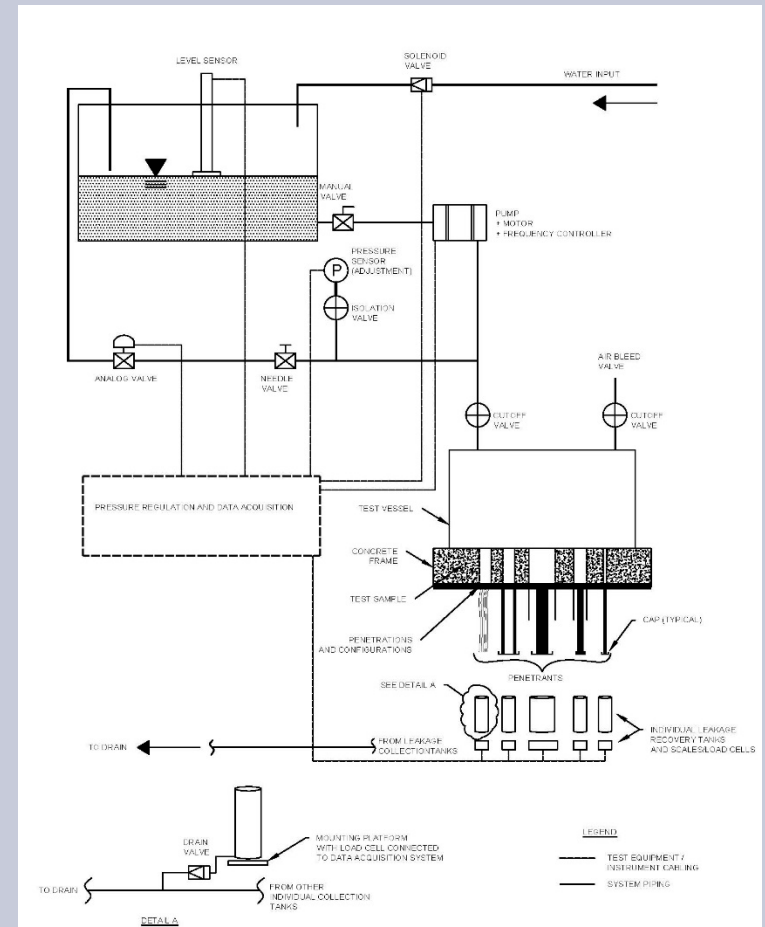
- Review of NUVIA Flood Test Apparatus & Procedures
 - NUVIA is only entity currently testing FPSs; using standard procedures/protocols
- Review of UL 1479 – Fire Tests of Through-Penetration Firestops
 - Section 6A – Water Leakage Test (W rating)
- Review of FM Approval Standard for Flood Abatement Equipment
 - Does not address “penetrations” in flood barriers; primarily the barriers themselves, including dikes
 - Does provide some input regarding “impact” resistance
- Review of ASTM E814 – Standard Test Method for Fire Tests of Penetration Firestop Systems
 - Used as a primary “template” for formatting Flood Test Procedure
 - Industry familiarity with formatting

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TASK 1.2 OVERVIEW (Cont'd)

- Development of draft Procedure complete – ready for use in Phase II
 - Provides “guidance” and standardized methodology for testing flood-rated penetration seals
 - Test apparatus design; including data acquisition
 - Performance-based approach to metrics (no specific pass/fail criteria)
 - Manufacturers will need to specify limitations of their products
 - Phase II testing may identify potential short-comings with the p-based approach





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TASK 2 OVERVIEW

- Development of Test Plan
 - Selection of candidate FPSs; types and numbers to be tested
 - Final design for Test Apparatus (*completed*)
 - Location for testing (*completed*)
- Test Objective(s)
 - Exercise & evaluate Flood Test Procedure (“test the test”)
 - Research/Evaluation of specific FPS assemblies/materials noted as installed at NPPs
- Test Matrix
 - Include all types of seal assemblies & materials
 - Greater emphasis on “formed in place” seals
 - Some evaluation of existing (non-standard) seal configurations noted during Task 1 document research
- Scheduled Test Results/Report due mid-2018
 - Test results used to modify Test Procedure as/if needed
 - Final Test Procedure submitted



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TASK 3 OVERVIEW

- Development of Final Technical Report
 - Summation of Task 1 & 2 results
 - Suitable for NUREG/CR
- Scheduled Project Completion; 3rd Qtr 2018

GOING FORWARD

- NUREG
 - Provide guidance to Industry for standardized process for evaluating/quantifying FPS performance
 - Support NRC oversight requirements
 - FPS pass/fail criteria will be function of Flood PRA requirements; NPP-specific
- Possible future development of commercial (industry) Test Standard



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Presenter Info

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