

Motivations, Plans, and Status for the Development of PFM Regulatory Guidance

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Public Meeting

Development of Guidance for Probabilistic Fracture Mechanics (PFM)

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Outline



- PFM Background
- Need for PFM Regulatory Guidance
- PFM Regulatory Guidance Development Project
- Current Progress and Schedule

PFM Background (1/2)

- Different way of looking at engineering problems
 - Probabilistic and deterministic fracture mechanics both address uncertainty, but differently
 - No longer single deterministic conservative analysis
 - Many deterministic analyses with randomly sampled inputs
 - Statistics performed on collection of outputs to determine probability of an event
- Probabilistic fracture mechanics (PFM) has potential to address technical and regulatory issues in the U.S.
 - Pressurized thermal shock
 - Leak-before-break
 - Alternative nondestructive examination frequencies

PFM Background (2/2)

- PFM software in the U.S.
 - FAVOR
 - xLPR v2
 - Proprietary industry codes
- Regulatory challenges: difficult for NRC staff to reproduce or verify PFM calculations
 - Complex regulatory review
 - ‘Black Box’ codes with insufficient vetting of inputs and code: low confidence in output
 - Examples where the documents could not be accepted as regulatory basis for long term inspection programs under NRC rulemaking
 - MRP-105, “Materials Reliability Program Probabilistic Fracture Mechanics Analysis of Pressure-Water Reactor [PWR] Reactor Pressure Vessel Top Head Nozzle Cracking,” dated April 2004
 - MRP-113, “Materials Reliability Program Probabilistic Fracture Mechanics Analysis of PWR Reactor Pressure Vessel Top Head Nozzle Cracking,” dated July 2004
 - xLPR in part a result of these unsuccessful PFM efforts
- Latest developments at U.S. NRC regarding PFM
 - Improvements to the FAVOR code
 - Release and application of xLPR v2
 - PFM Regulatory Guide development

Need for PFM Guidance

- With FAVOR v16.1 and xLPR v2.0, NRC expects increase in number of industry PFM submittals
 - PFM calculations with new or modified PFM codes
 - Proposed alternatives to ASME BPVC and ASME Code Cases
 - Relief requests and topical reports
- Need to develop a regulatory guide to better inform applicants using PFM as a technical basis to support relief requests, license amendment requests, and topical reports
- The Regulatory Guide will promote acceptable path for PFM regulatory analyses
 - Technical correctness and rigor
 - Quality Assurance
 - Documentation
 - Transparency
- Objectives of PFM guidance development project:
 - Clearly outline NRC expectations for PFM regulatory applications
 - Increased confidence in PFM analysis results
 - More predictable regulatory outcomes

PFM Regulatory Guidance Development Project Overview and Schedule



- Project driven by User Need NRR-2016-004
- Phase 1: Technical Letter Report (TLR): now
 - High level document
 - Goal: highlight some important PFM concepts
 - Final Draft available: ADAMS [ML17335A048](#)
- Phase 2: Draft Guide (DG) and supporting NUREG technical basis: late 2018 target
 - Version 0 of DG under review and revisions (internal to NRC)
 - NUREG technical basis under development (internal to NRC)
 - To be informed by pilot study lessons-learned, NRR review, and feedback from public meetings
- Phase 3: Pilot study: late 2018 target
 - GOAL: test and correct guidance being developed, as needed
 - Initial definition of pilot study underway
 - xLPR: collection of fictitious piping failure analysis problems
 - Subsequent pilot studies TBD

Summary

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- Increased role of probabilistic methods and PFM for nuclear regulatory applications in U.S.
 - PFM regulatory guidance being developed by NRC: acceptable path for PFM regulatory analyses
 - Project started in 2016, DG target is late 2018
 - 3 phases:
 - TLR
 - DG + NUREG Technical Basis
 - Pilot Study
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