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External Flooding PRA Activities

5th Annual Probabilistic Flood hazard Assessment
Workshop
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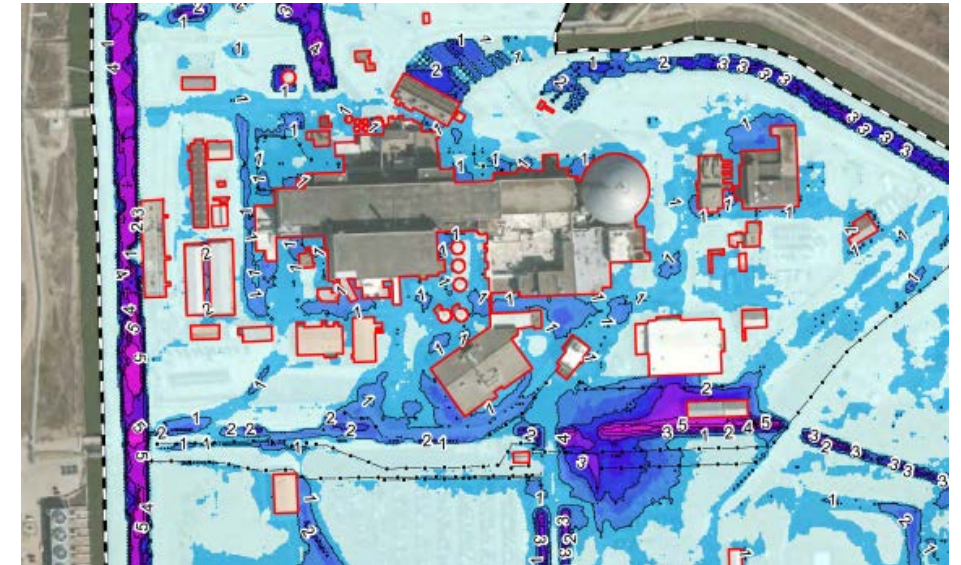
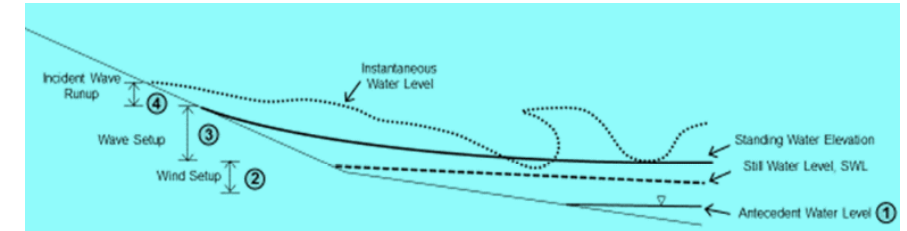
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External Flooding PRA Walkdown Guidance

External Flooding Walkdown Guidance ([3002015989](#))

- EPRI developed a guidance for performing an external flooding PRA walkdown in support of developing an external flooding PRA model
- The guidance is flexible enough to support any level of risk assessment or external flooding analysis
- Report provides a framework on how to Prepare and Conduct Ext. Flooding walkdown to collect the necessary information to support Ext. Flooding Analysis/PRA
- Topics covered:
 - Key flooding characteristics and flood causing mechanisms
 - Pre-walk down preparation:
 - External flooding equipment list
 - External flood operator actions list
 - External flood protection features
 - Initial walkdown
 - Focused scope walkdown
 - Documentation
 - Team composition



External Flooding PRA Guidance

Project Objective

- Develop External Flood Guidance Document
 - Tie guidance to Part 8 of ASME/ANS Standard (XFLD)
 - Specifically integrate:
 - Hazard characterization
 - Human performance assessment of pre-flood, “adverse environment” actions and organizational performance
 - Treatment of portable equipment (FLEX)
 - Model quantification and treatment of uncertainties

Overview of External Flood PRA Process

Elements of an External Flood Hazard Risk Assessment

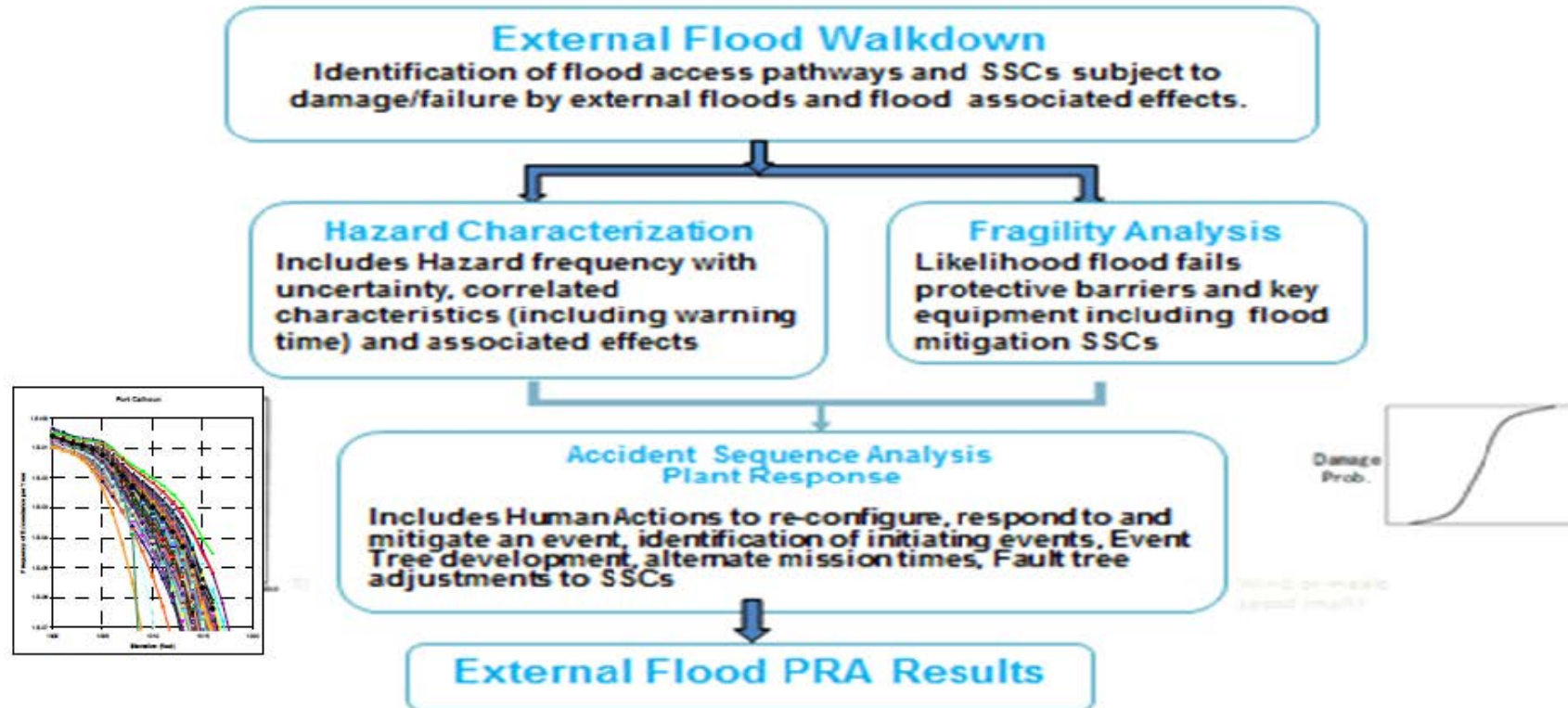
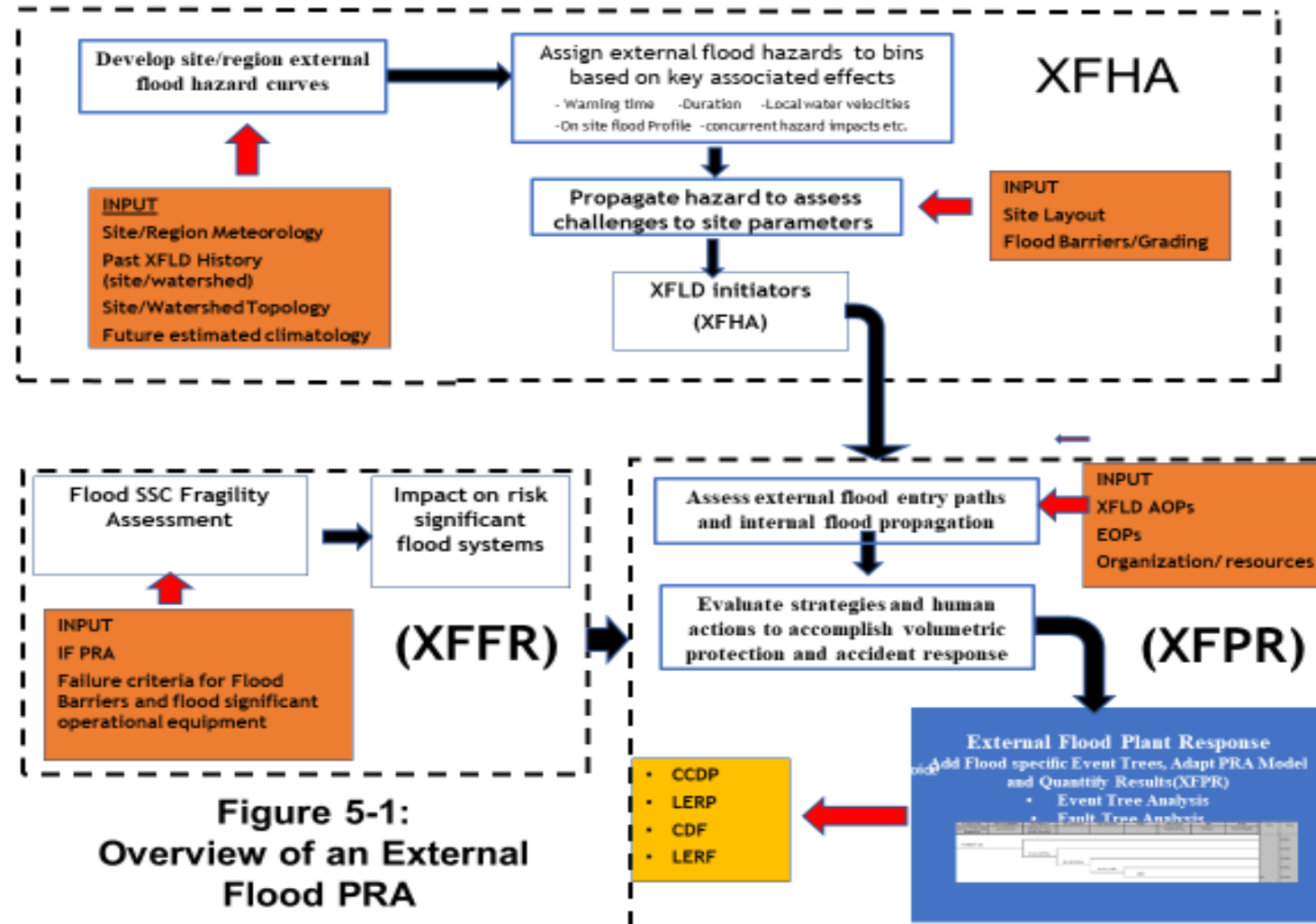


Figure 2-1: Elements of an External Flood PRA

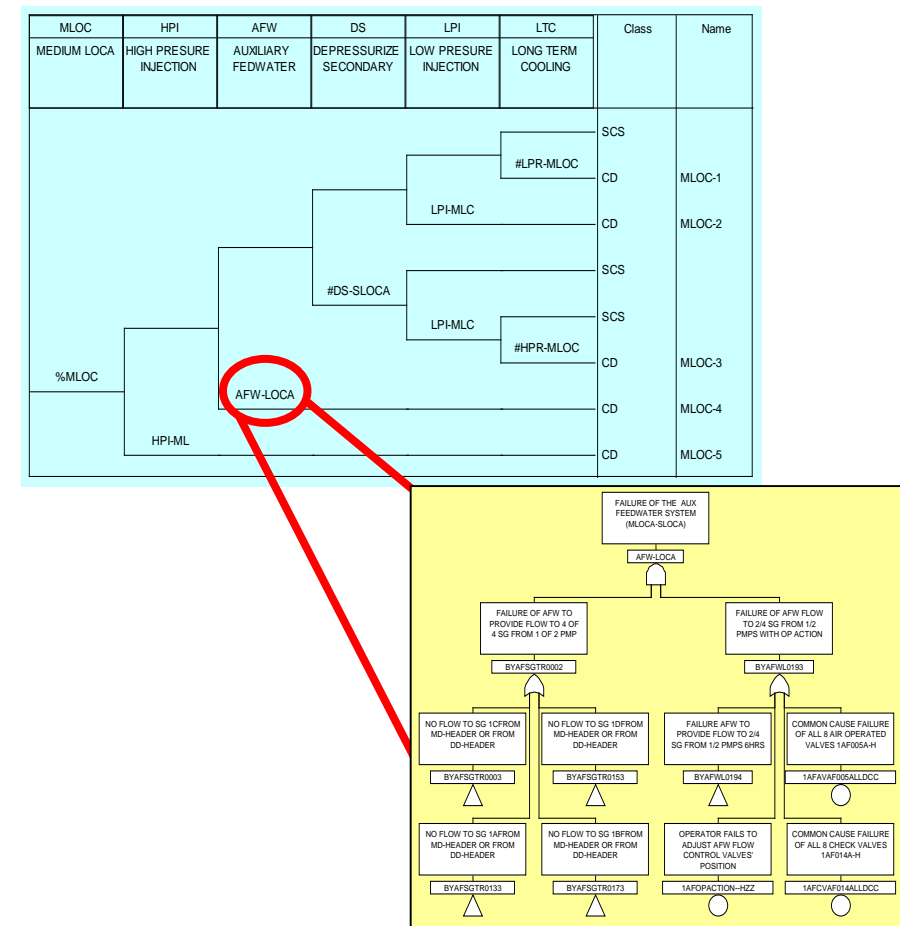
Structure of External Flood PRA Guidance



**Figure 5-1:
Overview of an External
Flood PRA**

External Flood Guidance Document

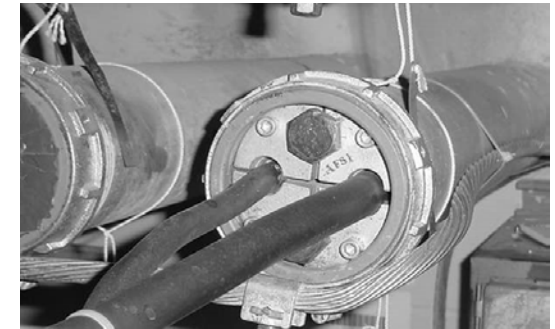
- Document follows structure of ASME/ANS PRA Standard for External Flood PRA (Part 8)
- Guidance Document to includes:
 - Hazard Characterization (XHFA)
 - Fragility Assessment (XFFR)
 - Plant Response and Quantification (XFPR)
 - Example Applications
 - Local Intense Precipitation
 - Storm Surge
 - Riverine Flood



Qualitative Risk Ranking Process of External Flood Penetration Seals

Project Objective

- Develop Risk Informed Strategy to Rank Plant Penetrations based on In-Leakage Potential and Potential contribution to Plant Risk
- Integrates insights from:
 - [3002005423](#) – Flood Protection Systems Guide
 - [3002010620](#) - External Flood Protection Design/License Basis Management Best Practices Guide
 - Industry experimental experience with penetration seal performance
- Uses PRA concepts to establish practical risk informed process for categorizing/ranking penetration seal risk significance.
- Focus is on providing utility with a prioritization process for establishing flood significance of penetration seals:
 - Screens low risk seals
 - Identifies seals with high and medium flood significance
- Prioritization process may be used to support seal treatment programs associated with maintenance, inspection, repair and replacement on flood penetration seals.



Flood Seal Prioritization Process

- Establishes practical process to “Risk” Rank External Penetration Seals in Response to External Flood risks. The overall process is intended to be:
 - Practical (does not require External Flood PRA)
 - Hierarchical (Two part process; provides both high level and detailed binning/ranking)
 - Captures plant-specific knowledge of challenges, plant layout passive flood barriers and active mitigation strategies
 - Explicitly consider seal design features, and location
- Process builds upon deterministic information available from plant post-Fukushima Hazard Re-evaluation Reports (HRRs) and External Flood Integrated Assessments (IAs) along with Deterministic and Probabilistic Internal Flood Studies
- Process integrates insights EPRI Flood Protection Systems Guide and limited amount of utility seal test data

External Flood Penetration Binning Process: Two Part Process

■ **Part 1: Ranking of Exterior Flood Penetration Seals**

- ❑ Bins/Ranks exterior flood penetration seals based on bounding external flood parameters
 - ❖ Part 1A: Bins seals with significant potential for dislodgement into High Flood Significant Bins
 - Binning primarily focused on seal properties affecting dislodgement and expected degree of seal submergence
 - ❖ Part 1B: Bins seals directly protecting Motor Control Centers with submergence and potential for direct-in leakage into cabinets as High Flood Significant
 - ❖ Part1C: Ranks remaining seals according to postulated in-leakage of intact seals
 - In-leakage model based on limited test data and reflects potential for leakage around penetrations and seal outer periphery.
 - Seals to be binned into medium and low flood significance based on application

External Flood Penetration Binning Process: Two Part Process

■ **Part 2: Risk Ranking of Flood Penetration Seals**

- ❑ Ranking based on potential Risk Impact of Flood Significant Components (FSC)
- ❑ Expands Part 1 binning to include flood relevant interior penetration seals
- ❑ Uses bounding hazard and leakage information generated in Part 1 to assess FSC Flooding
 - ❖ Extends impact assessment to directly Map seals with Flood Significant Components (FSCs) and associated enclosures
 - ❖ Characterizes FSC Water-Induced Failure Conditions
 - ❖ Building-specific flood calculations used to identify submergence potential of internal penetration seals
 - ❖ Room specific volumetric inflows
- ❑ Seals ultimately ranked/binning by their potential impact on FSCs
- ❑ Ranking/ Binning using three bins (H,M, L for flood significance)

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