External Flooding PRA Guidance

7th Annual Probabilistic Flood Hazard Assessment Workshop

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Background

- Past EPRI projects have provided guidance supporting implementation of the ASME/ANS PRA Standard to assess risks of internal and external hazards.
- The current project expands the external flood PRA effort by integrating available information on external flood modeling to develop a practical methodology for the development of the external flooding PRAs
- Flood related combined/correlated hazards screening methodology is currently being developed and will be captured in the final draft of the External Flooding PRA guidance
- Lessons learned from the past external flood events will supplement the External Flooding PRA guidance and provide practical guidance in preparing for and mitigating external floods at NPPs

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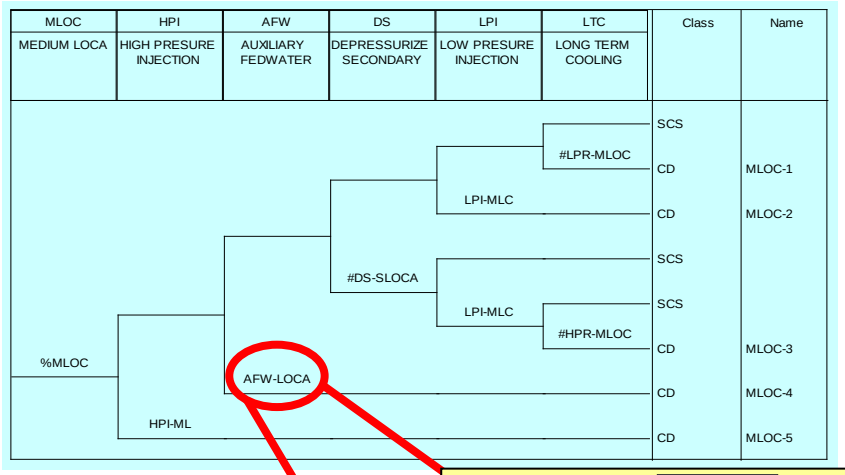
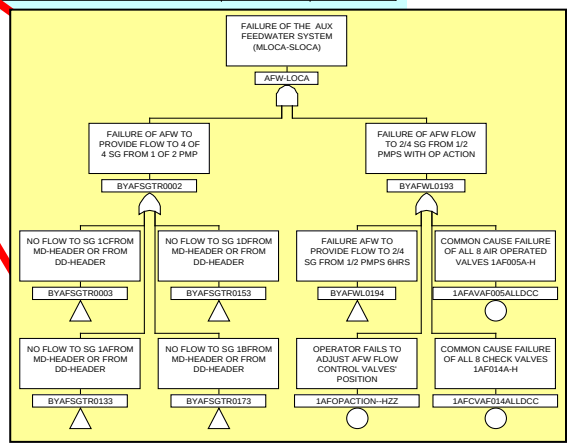
External Flood Guidance for Probabilistic Risk Assessment

- Provides a structured roadmap for performing an External Flood PRA (XFPRA) consistent with meeting requirements of the ASME/ANS PRA Standard.
- Includes guidance for:
  - Defining and characterizing the external flood hazard
    - Including estimation of external flood hazard frequencies, severity and associated uncertainties
  - Identifying flood induced failure modes and develop external flood fragility curves for flood significant Systems, Structures, and Components (SSCs).
  - Preparing and quantifying a PRA external flood event tree.





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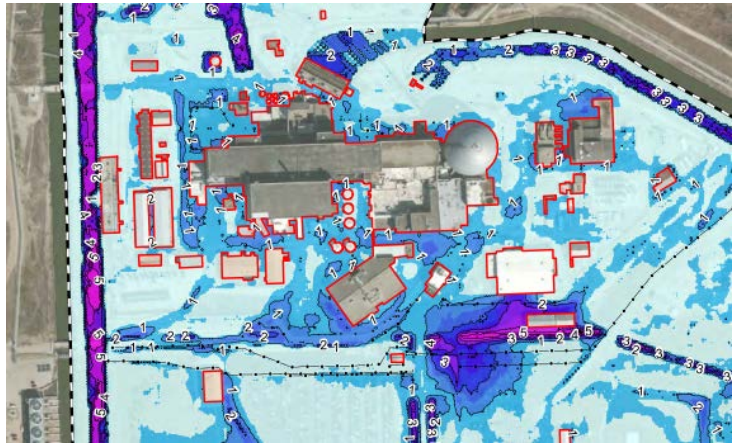
External Flood Guidance for Probabilistic Risk Assessment

- Guidance uses baseline internal events and internal flood PRAs as basis for developing relevant flood-induced failures for the External Flood PRA.
- Guidance is structured consistent with the ASME/ANS PRA Standard
- Guidance builds upon prior relevant EPRI references for hazard screening and example PFHA studies for representative NPPs
- Where available and appropriate USACE and NRC documents and methods are identified to support both PFHA and fragility assessments
- Methodology has been reviewed by EDF and found to be consistent with the EDF external flood PRA process



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External Flood PRA Process

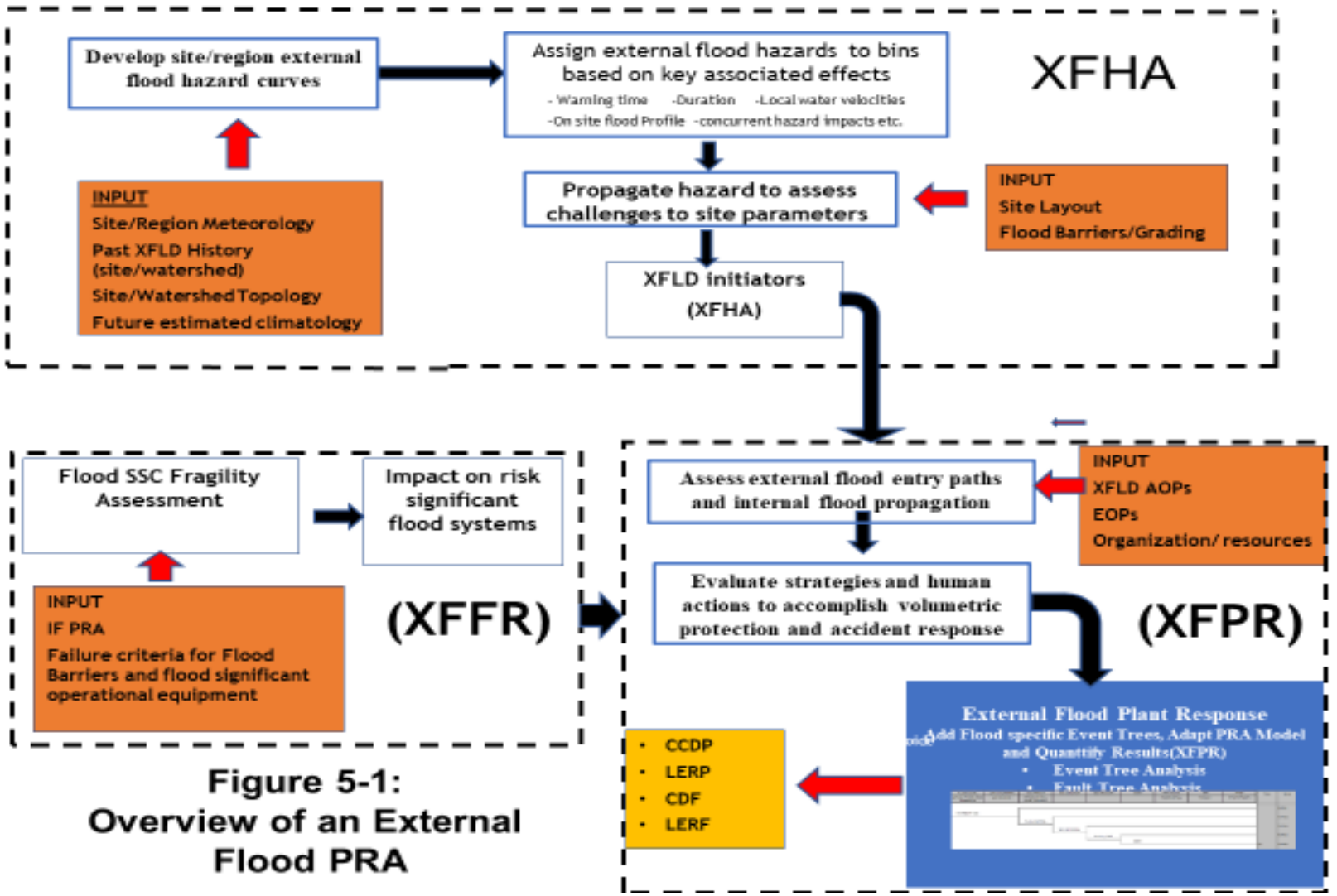

Figure 5-1: Overview of an External Flood PRA

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Flood Related Combined Hazards

- Process extends External Flood Hazard identification and characterization to consider impact of secondary flood and other coexistent hazards
- Provides basis for more realistic treatment of complex flood hazards for External Flood PRAs
- Process uses a framework that extends the EPRI Combined Hazard Screening Process (developed initially in EPRI TR 3002005287)
- Focus on characterization of complex flood hazards by identification of combined hazards and their respective impact on external flood PRA scenarios

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Flood Related Combined Hazards

- Approach includes potential for considering multiple coexistent hazards within the External Flood PRA model
- Identifies those coexistent hazards that should be considered within the site-specific external flood hazard including those that may be Correlated, Consequential or Random
- Structured process provides a vehicle for evaluating completeness of primary External Flood PRA characterization; supplemental matrix identifies treatment considerations identified within the matrix

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Practical Insights from External Flood Events

- New task to present insights from operational experiences to support development of actionable guidance/ recommendations for developing flood hazard coping and mitigation strategies.
- Focus is on lessons learned from external flood events and findings at Fort Calhoun Station but will also consider insights from regulatory and international experience.
- Guidance supports development, validation, and improved procedural guidance and overall preparedness for responding to external flood challenges.

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Major 2022 Project Activities

- Comparison between EPRI and EDF External Flooding PRA methodologies and combined hazards screening approach - In progress (target end of April)

- Final draft available for NRC-RES review – May 2022

- Draft EPRI white paper on the Operating Experience and Lessons Learned – July 2022

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