

# UPDATES ON THE REVISION AND EXPANSION OF ASME/ANS EXTERNAL FLOODING PRA STANDARD

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# Background and Context

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## **ASME/ANS PRA Standard for Level 1/Large Early Release Frequency Probabilistic Risk Assessment (PRA) for Nuclear Power Plant (NPP) Applications**

### **Purpose**

- Sets forth requirements for probabilistic risk assessments (PRAs) used to support risk-informed decisions for commercial nuclear power plants
- Prescribes a method for applying these requirements for specific applications

# Background and Context

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## **ASME/ANS PRA Standard for Level 1/Large Early Release Frequency Probabilistic Risk Assessment (PRA) for Nuclear Power Plant (NPP) Applications**

### **Structure**

- Parts (Hazard Groups)
- Technical Requirements
- High-level Requirements
- Supporting Requirements
- Capability Categories
- Commentary/Non-Mandatory Appendices

# Background and Context

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## **ASME/ANS PRA Standard for Level 1/Large Early Release Frequency Probabilistic Risk Assessment (PRA) for Nuclear Power Plant (NPP) Applications**

### **Key notes**

- Consensus Standard
- “What to do” not “how to do”
- Reflects current state of practice
- Periodically revised

# Structure of XFPRA Standard

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**Uses three technical elements (like other external hazard groups)**

1. Hazard Analysis Technical Element
2. Fragility Technical Element
3. Plant Response Technical Element

# Structure of XFPRA Standard

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## **1. Hazard Analysis Technical Element**

- Screening
- Data collection, site characterization, and walkdowns
- Hazard severity characterization
- PFHA and development of hazard curves

# Structure of XFPRA Standard

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## **3. Fragility Technical Element**

- Identification of SSCs for which evaluation is needed (in conjunction with plant response)
- Walkdowns
- Identification of local hazard conditions (demands placed on SSCs)
- Fragility evaluation

# Structure of XFPRA Standard

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## **3. Plant Response Technical Element**

- Scenario identification and mission times
- Initiating events, accident sequences, and accident progression sequences
- Walkdowns, exercises, and simulations
- Human action identification and reliability assessment
- Quantification of CDF and LERF



# Revision of Standard

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## **Standard (all parts) currently being updated**

- Modification, deletion, and creation of requirements
- Varying degrees of revision between Parts
- Consistency efforts (particularly between Parts)

## **Significant effort undertaken by Project Team 8 to revise Part 8**

### **Current version of Part 8**

- Limited in detail
- Judged external flooding to be of low significance
- Allowed aggressive screening

### **Revised version of Part 8**

- Significantly more detailed

# Revision of XFPRA Standard

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## **Revision recognizes current knowledge and recent lessons-learned**

- Understanding of flooding hazards and risks
- Operating experience
- Hazard and plant response insights from Post-Fukushima activities

## **Revision recognizes limitations in current state of practice**

- Uses many non-prescriptive requirements
- Provides significant flexibility in addressing requirements

## **Developed extensive non-mandatory appendix**

- Provides commentary, clarifications, and insights

# Challenges Encountered During Revision of XFPRA Standard

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## **Nature of flooding hazards**

- Diverse flooding hazards
- Diverse characteristics of flooding events

## **Plant Impacts From Flooding Hazards**

- Diverse ways flood hazards may affect site
- Diverse strategies that may be employed to protect against or mitigate
- Warning time and (potentially) extensive human actions

# Challenges Encountered During Revision of XFPRA Standard

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## **Limited state of practice of NPPs**

- Unique relative to other applications

## **Other issues**

- Define scope
- Assign responsibility between hazard groups
- Offer flexibility while avoiding ambiguity
- “To screen or not to screen... that is [one key] question”

# Challenges: Nature Of Flooding Hazards

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## **Multiple and diverse phenomena may lead to flooding at NPP sites**

- Natural (weather, geo-hazards)
- Man-made

## **Combinations of flood-causing mechanisms**

- Independent events
- Common cause events
- Induced events

## **Coexistent hazards**

- Events involving multiple hazard groups
- Identifying which hazard “leads the analysis”

# Challenges: Nature Of Flooding Hazards

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## **Flooding events are complex**

- Temporally and spatially dynamic
- Multiple measures of severity (e.g., flood height and associated effects)
- Warning time and (potentially extended) duration of inundation

# Challenges: Plant Impacts From Flooding Hazards

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## **Plant response strategies differ across sites and flooding mechanisms**

- Protection approaches
  - Passive/active
  - Permanent/temporary
  - Different strategies for different hazards
- Mitigation approaches
  - Unconventional strategies (particular for hazards not considered in original design)
- Manual actions
- Equipment that are not modeled in the baseline PRA

# Challenges: Plant Impacts From Flooding Hazards

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## **Warning time may be available**

- Changes in operating mode
- Plant re-configurations
- Installation of plant protective features

## **Duration of event may be days to weeks (or longer)**

- Differs from conventional PRA mission times



# Summary

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## **Revision of Part 8 ...**

- Is significantly expanded and more detailed than previous version
- Recognizes that external flooding is a potentially significant risk contributor
- Includes a large number of new requirements (full re-write)
- Affords significant flexibility in addressing most requirements
- Includes a detailed non-mandatory appendix (companion document)

## **Status**

- Final technical review by Part 8 underway
- Awaiting outcomes of broader consistency efforts
- Expected to be reviewed/balloted in coming months