

# Proposed Alternative Approach for the Integrated Assessment of External Flooding

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# Problem Statement

- Draft (partial) ISG for the Flooding Integrated Assessment (IA):
  - Requires quantification of failure likelihoods for flood protection features
  - Provides no criteria for acceptable features (gradient approach)
- There are no consensus methods for quantification of many aspects

# Alternate Approach

- Define performance criteria that provide high confidence of flood protection
  - Similar philosophy to a margins type approach
- Build from
  - Applicable elements of Reg. Guide 1.102
  - Traditional engineering practices
  - Attributes to assure reliability of equipment and operators

# Background: Reg. Guide 1.102

- RG 1.102 seems to do a pretty good job on criteria for “exterior” and “incorporated” barriers
- Criteria for crediting operational actions such as shutting down the reactor are also included
- Criteria for the acceptability of other mitigation options is less clear

# Elements of Alternate Approach

- Propose defining performance criteria for four categories of flood protection features:
  - Exterior/incorporated passive barriers
  - Credit for shutdown of reactor and reconfiguration of plant as part of overall protection strategy
  - Temporary passive barriers
  - Active mitigation features
- Plants may rely on one or more types of features, depending on the site, hazards, and plant design

# Exterior & Incorporated Barriers

- RG 1.102 characterization of “Exterior Barrier”:
  - Engineered features outside of the immediate plant area
- RG 1.102 characterization of “Incorporated Barrier”:
  - Engineered features in the structure/environment interface
- RG 1.102 provides a reasonable outline of the design requirements for exterior and incorporated barriers
- RG 1.102 does not address operational requirements for these barriers, similar to FLEX, such as:
  - Surveillance/Inspection
  - Design Control
  - Maintenance
  - Testing

# Credit for Shutdown of Reactor and Configuring for Flood Response

- RG 1.102 requires:
  - Only those warning systems located at the site and under control of plant personnel should be needed
  - Development of procedures requiring shutdown to govern plant response
  - Substantiation of the adequacy of the time available
  - Communication systems to alert both onsite and offsite company personnel
- RG 1.102 does not address:
  - Any unique training requirements
  - Reconfiguring for a flood occurring during non-power operations
  - Reliance on non-safety related plant equipment
  - Use of realistic success criteria (vs. design basis assumptions)

# RG 1.102 Less Explicit For Other Flood Protection Features:

- Temporary Passive Barriers
  - Examples: flood doors, flood gates, sand bags
- Active Mitigation Features
  - Examples: temporarily installed and elevated pumps, portable pumps



# Temporary Passive Barriers

- Possible Performance Criteria Dimensions :
  - Design of passive barrier for anticipated conditions (static and dynamic effects) – same criteria as incorporated barriers?
  - Warning systems, procedures, communications
  - Credibility of operator actions (see Operator Action Performance Criteria Dimensions )
  - Criteria for active system defense-in-depth e.g., sump pumps for leakage – see Active Mitigation Features criteria
  - Operational criteria, similar to FLEX, such as:
    - Surveillance/Inspection
    - Design Control
    - Maintenance
    - Testing

# Active Mitigation Features

- Possible Performance Criteria Dimensions:
  - Functional requirements and required margin
  - Reliability/redundancy of equipment
  - Pedigree of equipment (commercial/augmented quality/safety related)
  - Sustainability of active feature
  - Credibility of operator actions (see Operator Action Performance Criteria Dimensions)
  - Operational criteria for features, similar to FLEX, such as:
    - Surveillance/Inspection
    - Design Control
    - Maintenance
    - Testing

# Operator Action

## Performance Criteria Dimensions

- Time Available to Justify Feasibility
- Time Available to Ensure High Confidence
- Environmental Factors (Onsite and offsite)
- Equipment Functionality and Accessibility
- Available Cues/Indications of Functional Success
- Communications
- Portable Equipment (Availability & Transport)
- Personnel Protection Equipment
- Procedures and Training
- Staffing
- Demonstration of Actions

# Summary

- Defining required performance criteria would:
  - Provide clear criteria for utility use in developing acceptable protection approaches
  - Avoid challenges of quantifying everything, esp. human / organizational reliability
  - Provides certainty by defining what needs to be achieved