Update on Risk Insights and Severe Accident Vulnerability Information Submission Expectations for LWR Construction Permit Applications

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Purpose of Meeting

- **Demonstrate progress** on staff's initiative to develop guidance
- **Communicate** overview of initial staff perspectives
  - **Respond to feedback** received at March 2023 meeting on this topic
- **Request additional feedback**

Progress

- 1st Public Meeting – March 30, 2023 (ML23104A312)
  - Obtain industry/public feedback on initiative to develop PRA guidance for an LWR CP
- 2nd Public Meeting – July 27, 2023
  - Provide staff update on guidance development
  - Discuss staff progress on topics of industry/public interest from 1st public meeting
  - Obtain additional feedback

Objectives for Guidance on PRA and Severe Accident Information Supporting LWR CP Applications

- Identify minimum level of detail and scope of PRA and severe accident information supporting a LWR CP application
- Describe content of PSAR to evaluate risk insights and severe accident information commensurate with
  - design readiness at time of CP application submission
  - risk insights and information to support staff findings
- Close existing gap in guidance regarding content of CP application

Feedback Items from March 2023 Public Meeting

PSAR Content

- Description of comprehensive and systematic search to identify all hazards and plant operating states (§ 50.34(a)(4)).
- Discussion of dispositioning the search results by—
  - screening methods
  - PRA logic modeling
  - risk-informed supplemental evaluations (e.g., PRA-based seismic margins analysis, conservative estimates of non-seismic hazard risk)
  - crediting deterministic design basis
- Demonstration that for the at-power plant operating state, the applicant—
  - is technically qualified to develop an acceptable PRA (§ 50.34(a)(9))
  - established an acceptable foundation for upgrading the PRA as the design progresses

PSAR Content (Cont'd)

- Identification of the uses of the CP-stage PRA. Example:
  - Selection of licensing basis events
  - Determination of non-safety-related systems subject to regulatory treatment
  - Demonstration of margins to the Commission's safety goals
- Demonstration of the systematic process for identifying and dispositioning PRA uncertainties, including treatment of key assumptions and sources of uncertainty.
- Identification of the limitations of the CPA PRA's scope, level of detail, and plant representation and the impact of these limitations.
- Ensure that the risk insights and information support staff findings that the PSAR content is sufficient to issue a construction permit.

Minimum Scope of PRA at CP Stage (Commensurate with Design Readiness)

- At-power internal events PRA
  - In general, Capability Category I of NRC-endorsed PRA Standard is acceptable
- Risk-informed supplemental evaluations for remaining identified hazards
  - Address site-specific information and considerations
- Use of PRA is encouraged for all hazards at CP stage
  - Detailed and more actionable risk insights for applicant and staff
  - Easier transition between CP and OL review for staff

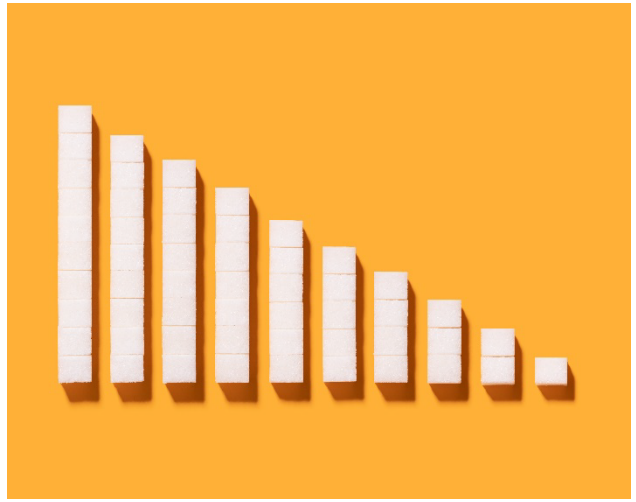
Minimum Scope of PRA at CP Stage (Commensurate with Design Readiness)

Minimally Acceptable PRA Elements for Internal Events PRA	Minimally Acceptable Non-PRA Elements	Additional Elements*
Initiating Event Analysis	Plant Operating State Analysis	Internal Flood PRA
Accident Sequence Analysis	PRA-based Seismic Margins	Internal Fire PRA
Success Criteria Development	Non-Seismic Hazard Assessment (Includes Hazard Screening)	Seismic PRA
Systems Analysis	Low Power and Shutdown Assessment	High Winds PRA
Human Reliability Analysis		External Flooding PRA
Data Analysis		Other Hazards PRA
Accident Sequence Quantification		Low Power and Shutdown PRA
Risk Integration		Source Term Analysis
Large Release Frequency Analysis		Radiological Consequence Analysis

*** Applicant can choose to perform an "additional element" instead of a "non-PRA element"**

Data Analysis: Initiating Event Frequencies and Component Failure Rates

- Parameter estimates may be generic, design-specific, or plant-specific with justification
- Initiating event frequencies should be representative of initiating event categories/groups
- Data analysis should account for SSC boundaries, failure modes, failure rates, and CCFs
- PSAR should include, at a minimum:
  - Discussion of sources of frequency and failure rates
  - Justification for use of generic estimates
  - Justification for the failure rates used for first-of-a-kind components
  - Appropriate uncertainty and sensitivity analyses

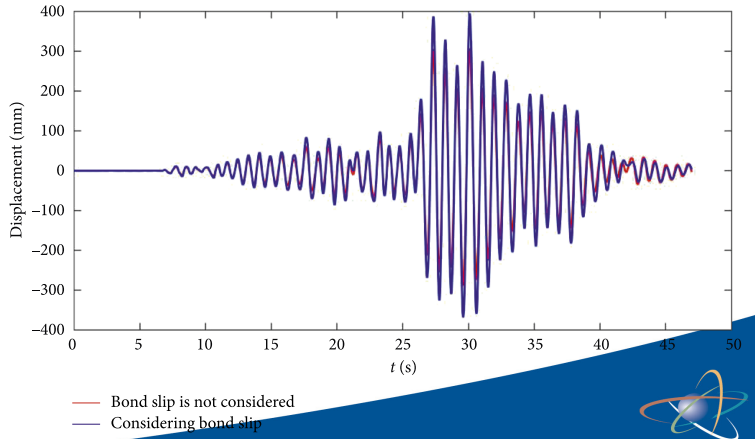


PRA Self-Assessment

- PRA self-assessment should be performed at the CP application stage
  - Commensurate with design readiness at CP application submittal
- PSAR should include, at a minimum:
  - Description of PRA self-assessment
  - Summary of any limitations associated with assessment
- While beneficial, a formal peer review against PRA Standards at the CP application stage is not required

Seismic Hazard

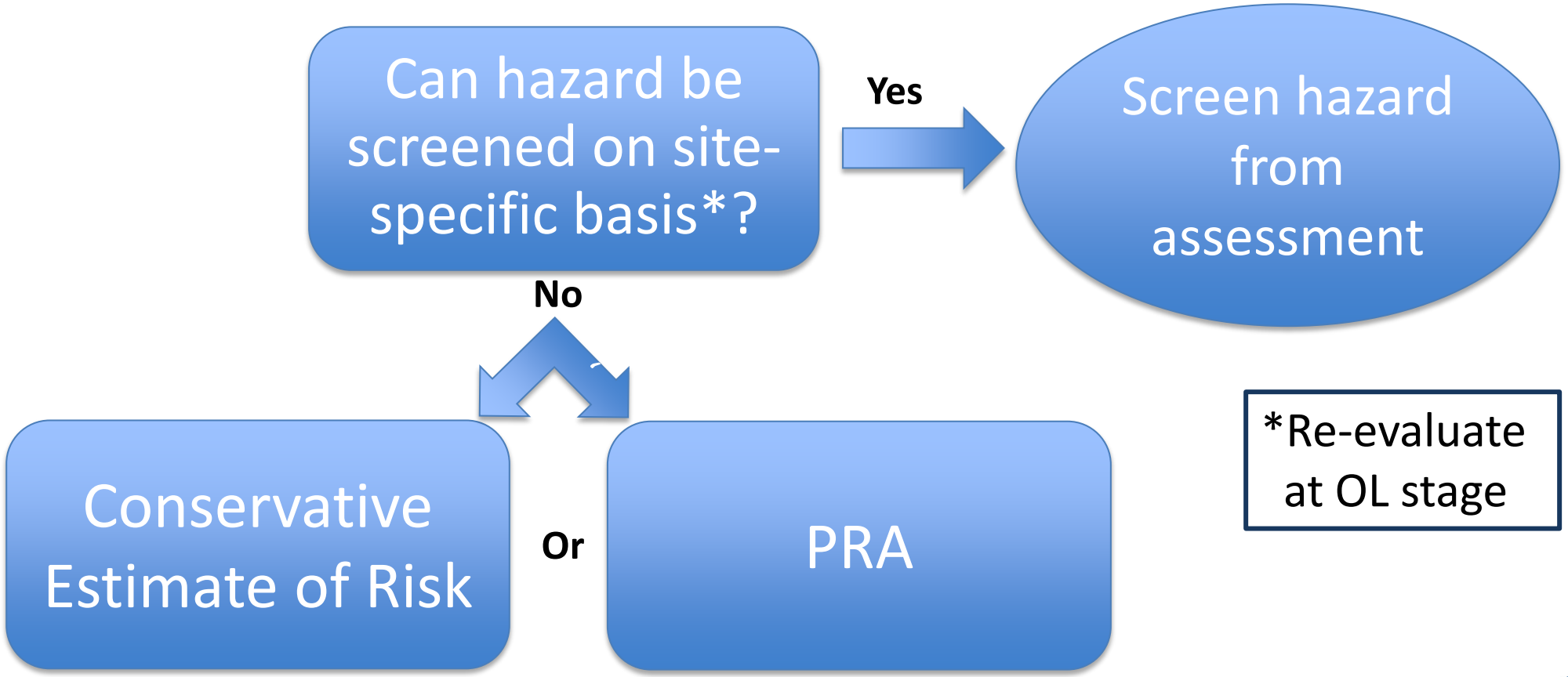
- Either PRA-based SMA or seismic PRA is viable for supporting a CP application
- Site-specific response spectra should be consistent with that provided in PSAR Ch. 3
- For PRA-based SMA,
  - site-specific response spectra or demonstration that site-specific response spectra are bounded by design response spectra (DRS) used in the PRA-based SMA
  - SRP 19.0 may be used
- For seismic PRA,
  - site-specific response spectra



PRA-Based SMA or Seismic PRA

- PSAR should include, at a minimum:
  - Description of seismic hazard information used, including site-specific issues
  - Description of seismic fragility evaluation, including justification for use of generic fragility values
  - Description of plant response analysis
  - Results and insights, including meeting 1.67 times safe shutdown earthquake for PRA-based SMA
  - If a DRS approach is used, demonstration that the site-specific GMRS is bounded by the DRS

CP Non-Seismic Hazards Evaluation



CP Non-Seismic Hazards Evaluation

- Non-seismic hazards include those identified in Table D-1 in Appendix D to RG 1.200, Rev. 3
- All non-seismic hazards should be systematically evaluated on a site-specific basis
  - Screening Evaluation
    - Description of screening criteria
    - Description of site-specific screening evaluation
  - Conservative Estimate of Risk
    - Description of the approach to determine the conservative estimate
    - Demonstration that CP site is enveloped by representative site
    - Description of key assumptions and uncertainty used for conservative estimate
  - PRA
    - Description of PRA development, including changes made to internal events PRA model
    - Key results, key assumptions, uncertainty, sensitivity studies

Configuration Control

- Description of configuration control program to demonstrate that:
  - The PRA and non-PRA risk assessments continue to reflect new vulnerabilities and design changes leading up to the OL application
  - Maintain computer codes used to support development of PRA and non-PRA risk assessments
  - Reviews of the PRA (i.e., self-assessment, peer review, etc.) are identified and performed

Issues Under Discussion by NRC Staff to Determine Minimum PSAR Information

- Regulatory Treatment of Non-Safety Systems
- Internal Fire and Flood Non-PRA Risk Assessment
- Low Power and Shutdown Non-PRA Risk Assessment and PRA
- Severe Accident Analysis

Next Steps

- Continue guidance development and engagement
- Draft guidance for comment by late fall of 2023
  - Currently, white paper appears to be practical option
- Additional public meetings, if requested by external stakeholders
- Design-specific pre-application engagements are encouraged

List of Abbreviations

ADAMS	Agencywide Documents Access and Management System
CFR	*Code of Federal Regulations*
COL	combined license
CP	construction permit
DC	design certification
DRS	design response spectra
FOAK	first-of-a-kind
FR	*Federal Register*
GMRS	ground motion response spectra
ISG	interim staff guidance
LWR	light-water reactor
SRM	staff requirements memorandum
SSC	structure, system, and component

List of References

SRM-SECY-2015-0002 "Proposed Updates of Licensing. Policies, Rules and Guidance for Future New. Reactor Applications," ADAMS ML15266A023

NUREG-0660, NRC Action Plan Developed as a Result of the TMI-2 Accident, May 1980.

Individual Plant Examination for Severe Accident Vulnerabilities - 10 CFR 50.54(f) (Generic Letter No. 88-20), November 23, 1988

Severe Reactor Accidents Regarding Future Designs and Existing Plants; 50 FR 32138, August 8, 1985

Safety Goals for the Operations of Nuclear Power Plants; 51 FR 28044, August 4, 1986

Use of Probabilistic Risk Assessment Methods in Nuclear Regulatory Activities; 60 FR 42622, August 16, 1995

Regulatory Guide 1.70, "Standard Format and Content of. Safety Analysis Reports for Nuclear Power Plants," Revision 3, November, 1978

Regulatory Guide 1.200, "Acceptability of Probabilistic Risk Assessment Results for Risk-Informed Activities," Revision 3, December, 2020

NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition - Severe Accidents."

DC/COL-ISG-028, "Assessing the Technical Adequacy of the Advanced Light-Water Reactor Probabilistic Risk Assessment for the Design Certification Application and Combined License Application," December 2016

DNRL-ISG-22-001, "Safety Review of Light-Water Power Reactor Construction Permit Applications," Interim Staff Guidance, October 2022, ML22189A099

Questions, Comments, or Feedback