



United States Nuclear Regulatory Commission

*Protecting People and the Environment*

# **Public Workshop on Seismic Risk Evaluations for Operating Reactors**

May 18, 2011

# Objectives of Meeting

- Provide a forum to discuss
  - Information needs for Regulatory Analysis
  - Potential methods to obtain necessary information
  - Timelines/schedules for results
  - Long-term strategy to address new information
- Obtain feedback from stakeholders

# Presentation Outline

- Overview of Generic Issue (GI)199
- Information Needs for GI-199
- Possible method(s) to be used in developing requested information
  - Seismic hazard methodology
  - Plant evaluation methodology
- Schedule and Strategies for overcoming resource challenges

# The Generic Issues Program (GIP)

- Agency-wide program administered by Office of Nuclear Regulatory Research (RES), implemented by Management Directive 6.4
- Value Added
  - Advance understanding of the issue
  - Find the best place for the issue to be worked
  - Develop NRC consensus
  - **Engage stakeholders**

(<http://www.nrc.gov/about-nrc/regulatory/gen-issues.html>)

# Generic Issues Program Stages

1. Identification
2. Acceptance
3. Screening
4. *Safety/Risk Assessment*
  - Issue Analyzed
  - Paneled, Report Issued
  - Recommendations Endorsed

 **5. Regulatory Assessment**

## **Overview of Generic Issue 199 Safety/Risk Assessment Results**

- Operating power plants are safe
- Though still small, some seismic hazard estimates have increased
- Assessment of GI-199 will continue
  - Information is needed to perform regulatory assessments
  - NRC will request the needed information

# Information Needs for Proposed Generic Letter

- Updated site specific hazard curves and response spectra
- Fragility information
- Contributors to seismic risk
- Identification of potential plant-specific improvements

# Seismic Hazard Methodology

- Perform *PSHA* to develop site-specific base rock hazard curves
  - CEUS-Seismic Source Characterization (2011)
    - Local refinements unnecessary
  - EPRI (2004, 2006) Ground Motion Prediction Equations
- Perform *site response* to determine control point elevation hazard curves
  - Site amplification curves
    - Base on original site investigations
    - Adequately incorporate uncertainties
    - Develop over broad range of annual frequencies
- Limited CAV filtering



## Seismic Hazard Methodology (cont.)

- Perform deaggregation to determine low- and high-frequency *Controlling Earthquakes* at frequencies of  $10^{-4}/\text{yr}$  and  $10^{-5}/\text{yr}$
- Develop performance-based Ground Motion Response Spectra (*GMRS*) using RG 1.208
- Hazard Screening Evaluation
  - Compare GMRS with SSE
- Use plant specific site corrected hazard curves for plant evaluation

## **Attributes of Plant Evaluation Methodologies**

- Should be able to be applied consistently and uniformly across the plants
  - So that comparison of results is meaningful
  - Should meet provisions of ASME/ANS standard and guidance of RG 1.200
- Provide robust measures of plant seismic risk in-terms of core damage frequency distribution and containment performance
  - Can be used in subsequent regulatory analysis
  - Provide meaningful comparison with other initiators
  - Can be extended to full Level 2 or Level 3, if necessary

## **Attributes of Plant Evaluation Methodologies (Cont.)**

- Should have an integrated model which includes all systems (both safety and non-safety) that are used in plant response to the seismic initiating event and event progression.
  - Focus on total plant behavior to get more realistic understanding of accident progression and post-accident response.
  - Develop effective accident mitigation and management strategies
- Should be an integrated assessment of design, seismic capacity, equipment reliability, operating procedures, operator actions, maintenance, and as-built condition
  - To identify contributors to the accident sequences
  - To identify potential improvements to hardware, operating procedures, training, etc.

## **Attributes of Plant Evaluation Methodologies (Cont.)**

- Should be capable of addressing secondary effects, such as seismic-induced fires, floods, and spent-fuel pool sequences
- Should realistically reflect effects of current ground motion in responses and fragilities
- Should be capable of being easily used to evaluate effects of new perception of seismic hazard and ground motions

## Available Methods

- Seismic PRA
- Enhanced Seismic Margin (ASME/ANS Standard)
- Seismic Margin Methods
  - EPRI Success Path
  - NRC Margin Method
- Others – Combination of methods

## Limitations of Margin Methods

- Estimates of CDFs are not robust and, not necessarily bounding
- Limited to two initiators – transients and small-LOCA
- Robust treatment of non-seismic failures and operator actions difficult
- Extension to containment and spent fuel pool not possible
- “EPRI Success Path” approaches will not get us there

# Implementation Challenges

- Bases for plant evaluation method
- Availability of expert resources  
(particularly for fragility evaluations and peer reviews)
- Time to complete analysis

## **Strategies for Overcoming Challenges**

- Prioritization of plants
- Team approach for similar designs
- Submittal of information in stages



## **Schedule/Timeline**

- Issue Generic Letter – End of 2011
- Provide seismic hazard results – 180 days
  - Screening evaluation
  - Selection of plant evaluation methodology
- Perform plant evaluation – staggered schedules