EPRI Risk & Safety Management Program
Research Priorities

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Research in Light of Fukushima
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RSM Research Priorities Derive from EPRI Mission

EPRI Mission

Advancing safe, reliable, affordable and environmentally responsible electricity for society through global collaboration, thought leadership and science & technology innovation

Risk & Safety Management Strategic Vision

Provide practical technology to help nuclear power plants to achieve safe, reliable operation
Achieving the Risk & Safety Management Vision

Risk & Safety Management Strategic Vision

Provide practical technology to help nuclear power plants to achieve safe, reliable operation

RSM Program Mission:
To equip members to implement a risk-informed framework to support

- Identifying cost-effective ways to improve **safe operations**, *while also*
- Enhancing **operational flexibility**

Mission achieved through

- Developing and improving **technical methods** and **analysis tools**
- Providing **guidance** for effective use of methods and tools
Organization of RSM Research Areas

Technical Methods and Guidance

- Methods & Guidance for Risk Assessment
  - General PRA Methods
  - External and Other Hazards
- Applications
  - Risk-Informed Regulation & Applications
  - Reliability Assessment
  - Security and Emergency Planning

Risk & Safety Technology

- PRA and Safety Software
- Technology Transfer

Special Projects

- Fukushima-Related Activities
Objectives for Long-Term Research in RSM

- Enhance ability to understand risks for more effective decision-making
- Enhance risk analysis process to
  - Provide greater efficiency for timely probabilistic risk assessments (PRAs) and applications
  - Facilitate ability to extract meaningful risk insights

Examples of relevant research priorities

- Improvements in **seismic fragility analysis**
- Methods and guidance for risk assessment of **external flooding**
- Advances in **human reliability analysis**
- Advanced **PRA software platform**
Improvements in Seismic Fragility Analysis

- Fragility analysis captures likelihood of failure as a function of earthquake intensity
- Research underway to
  - Improve ability to model structural response
  - Apply experiential data to inform fragility analysis
  - Develop new approach to fragility assessment
Using Data to Inform Fragility Assessment

- Examining earthquake experience database for representative equipment
  - Augmenting or reformulating methods for seismic capacities
  - Assessing whether alternate approaches exist to characterize fragility better
  - Initial results from pilot study: consistent increases in assessed median capacity

- Mining data from extensive qualification testing

- New testing of components for sensitivity to high-frequency motions
Scenario Earthquake Approach to Fragility Analysis

- **New approach for seismic PRA**
- **Concept**
  - Use large number of earthquake time histories to characterize probabilistic ground motion
  - Eliminate reliance on uniform hazard spectra to connect hazard to fragility analysis
- **Objective**
  - Decrease uncertainty in seismic motions imputed to buildings and equipment
  - Understand potential conservatisms in current seismic PRA methods

Promising technical approach – if complexity can be reduced
External Flooding Research

Overall research focus

- Better characterization of probabilistic flood hazard
- Improved understanding of potential impacts on plant (inundation, debris, dynamic forces)
- PRA modeling of plant response

Examples of research priorities

- Improvements in *seismic fragility analysis*
- Methods and guidance for risk assessment of *external flooding*
- Advances in *human reliability analysis*
- Advanced *PRA software platform*
External Flooding Research (continued)

Recent and near-term activities

- Completed pilot studies:
  - Flooding of river site
  - Intense precipitation

- In progress:
  - Dam failure rates and mechanisms
  - Coastal flooding from storm surge
  - Human response to implement flood protection
Human Reliability Analysis

- Practical methods with strong basis from psychological literature
- Adapting/extending methods for
  - External hazards, starting with seismic and external flooding
  - Assessment of actions not covered by explicit procedures ("recovery")
  - Use of portable/flexible capabilities (e.g., FLEX in US)
  - Assessment of actions after onset of core damage (severe-accident management)

Examples of research priorities

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Key Alarm Not Attended To

- Cognitive Workload/Distraction
- HSI
- Perceived Urgency/Significance
- LOW
- HIGH
- POOR
- NOMINAL/GOOD
- LOW
- HIGH
- LOW
- HIGH

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Advanced PRA Software

Phoenix: Meeting needs for

- Supporting increasing regulatory application of PRA
- Effective risk-informed decision-making
- Extending plant operating life
- New plants

Key Features of Phoenix

- More efficient ways to construct and evaluate risk models
- Better ways to visualize results

Examples of research priorities

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Summary

EPRI Risk & Safety research priorities address

✓ Common cause failures due to external and internal events
✓ Technologies to prevent/mitigate severe accidents
✓ Severe accident analysis
✓ Emergency preparedness and response
✓ Post-accident recovery
Together…Shaping the Future of Electricity