



## Regulatory Information Conference

Risk Assessment at the NRC: Emerging Challenges and Opportunities

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Biff Bradley, NEI

Tuesday, March 13, 2012

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## Overview of Risk Assessment Activities for New and Advanced Reactors

Lynn Mrowca

U.S. Nuclear Regulatory Commission

Office of New Reactors

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## New Reactor Reviews

- Accomplishments
  - AP1000 DC amendment
  - Vogtle and V.C. Summer COL safety evaluations
  - ESBWR DC rulemaking safety evaluations
- Status
  - AP1000 COLs
  - U.S. EPR DC and COLs
  - US-APWR DC and COLs
  - ESBWR COL
  - ABWR

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### New Reactor Reviews (cont.)

- Next Steps
  - Complete ongoing technical reviews
  - Prepare for license amendments
  - Prepare for construction inspection (i.e., activities related to PRA)
  - APR-1400 DC application submittal

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### Advanced Reactor Reviews

- Accomplishments
  - Policy papers
  - NuScale PRA pre-application audit
- Status
  - Policy papers (e.g., risk-informed Standard Review Plan, advanced reactor pilot study)
- Next Steps
  - SMR DC application submittals
  - TVA Clinch River construction permit (mPower design) application submittal

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### Infrastructure Activities: Risk-Informed Regulatory Guidance for New Reactors

- Accomplishments
  - Summary of tabletops and staff recommendations provided to ACRS
  - ACRS Reliability and PRA Subcommittee meeting
- Status
  - Provide final staff recommendations to Commission
- Next Steps
  - Await Commission direction

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### Infrastructure Activities: Staff Technical Reviews

- Status
  - Standard Review Plan revision
  - Design Specific Review Standards development (advanced reactors)
  - Interim Staff Guidance development to address PRA Standards for new reactors
- Next Steps
  - Engage with stakeholders on draft regulatory guidance

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### Infrastructure Activities: Staffing

- Status
  - PRA Knowledge Management
  - Developing and maintaining PRA staff expertise

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### Emerging Challenges and Opportunities

- SPAR model development
- Risk management task force results
- Post-Fukushima activities (e.g., NTTF Recommendations 1.0, 2.1, 2.3, 4.1, 8)

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## Overview of New Topics in PRA Research

Kevin Coyne

U.S. Nuclear Regulatory Commission  
Office of Nuclear Regulatory Research

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## PRA Research Strategic Goals

- Supporting the Reactor Oversight Process
- Improving the Efficiency and Effectiveness of Risk-Informed Regulation
- Extending PRA Technology to New Technologies
- Improving the PRA State-of-the-Art

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## Supporting the Reactor Oversight Process

- SAPHIRE 8
- Risk Assessment Standardization Project (RASP) Handbook
- Standardized Plant Analysis Risk (SPAR) Models

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### SPAR – Focus Areas in the Coming Year

- Other hazard and NFPA-805 fire models
- Support system initiating events
- Integrated capabilities model
  - 1 SPAR model with all modes/hazards/levels that SPAR currently covers
- Confirmatory success criteria analysis
  - 4-loop Westinghouse plant
- Resolution of ASME Peer Review Findings and Observations

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### Common-Cause in Event Assessment

- Draft NUREG-XXXX, “*Common-Cause Failure Analysis in Event and Condition Assessment: Guidance and Research*,” issued for comment
- Topics treated in the NUREG include:
  - Treatment of CCF potential conditioned upon an observed component failure
  - Limitations of current CCF modeling and issues with alpha-factor estimates
  - Future research needed for data collection, parameter estimation and casual models

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### Improving the Efficiency and Effectiveness of Risk-Informed Regulation

- Improved Methods
  - Consequential SGTR
- Regulatory Guides
  - RG 1.174, 1.200
  - RG 1.221 (Hurricane Missiles)
- PRA Standards

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## PRA Standards

- PRA standards under development
  - Level 1 (CDF) and LERF for low power and shutdown conditions addressing both internal and external hazards for operating LWRs
  - Level 1 (CDF) and LERF for at-power conditions addressing both internal and external hazards for LWRs in design stage (pre-operational)
  - Level 2 for at-power conditions addressing both internal and external hazards for operating and advanced LWRs
  - Level 3 for all operating modes, all hazards, and both light water and non-light water reactors
  - Level 1 and Level 2 for all operating modes addressing both internal and external hazards for non-light water reactors

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## PRA Standards (cont'd)

- NEI has develop/developing peer review guidance
  - NEI 00-02/NEI 05-04 addresses Level 1/LERF for at-power conditions for operating LWRs for internal events and internal flood
  - NEI 07-12 address Level 1/LERF for at-power conditions for operating LWRs for internal fires
  - NEI developing guidance for seismic PRA for Level 1/LERF for at-power conditions
- PRA Standards and peer review guidance endorsed in RG 1.200
  - NRC issuing Interim Staff Guidance documents providing interim staff endorsement on updates to the standard until next revision

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## Extending PRA Technology to New Technologies

- Advanced Reactor PRA Guidance
- Digital I&C
- New Reactor SPAR Models

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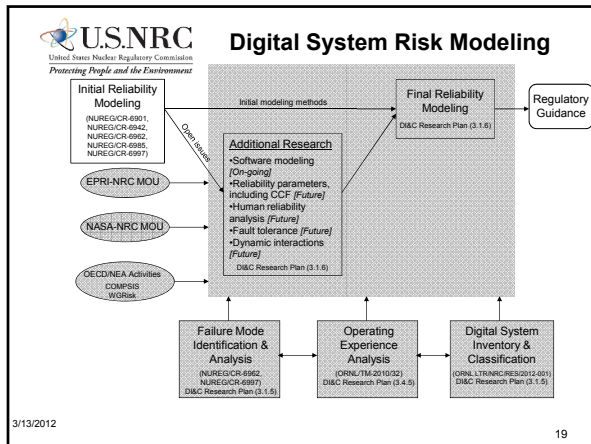
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- U.S.NRC**  
United States Nuclear Regulatory Commission  
Protecting People and the Environment
- New Reactors SPAR Models**
- AP1000
    - Seismic model incorporated into the SPAR model
  - ABWR
    - ABWR GE SPAR model
    - ABWR Toshiba SPAR model
    - LPSD model for the Toshiba design is being developed
  - US-APWR
  - EPR- in progress
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- U.S.NRC**  
United States Nuclear Regulatory Commission  
Protecting People and the Environment
- Improving the PRA State-of-the-Art**
- Dynamic PRA
  - Long Term Research
    - Advanced PRA Methods
    - Sources of PRA Uncertainty
  - Site Level 3 PRA (SRM SECY 11-0089)
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## Site Level 3 PRA – Objectives

- Develop a Level 3 PRA that:
  - reflects technical advances since the last NRC-sponsored Level 3 PRAs were completed over 20 years ago, and
  - addresses scope considerations that were not previously considered
- Enhance PRA capability, expertise, and documentation
- Demonstrate technical feasibility and evaluate the realistic cost of developing new Level 3 PRAs

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## Site Level 3 PRA – Approach

- Scope includes all internal and external initiating event hazards, all modes of operation, and site radiological sources (all reactor cores, spent fuel pools, and dry storage casks on site),
- In general, the Level 3 PRA study will be based on current “state of practice”
- The study will be for a single site; therefore, it will not necessarily provide insights applicable to all sites and all technical issues.

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## A Proposed Risk Management Regulatory Framework

William Reckley  
U.S. Nuclear Regulatory Commission  
Risk Management Task Force  
Office of Commissioner G. Apostolakis

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## Risk Management Task Force Approach

- Provide a vision for a regulatory system 10-15 years in the future.
- The approach should build on the experience of the last 20 years and should be evolutionary rather than revolutionary.
- The need for a new regulatory approach was also recognized by the Fukushima Near Term Task Force Recommendation 1:
  - *Establish a logical, systematic, and coherent regulatory framework for adequate protection that appropriately balances defense-in-depth and risk considerations*

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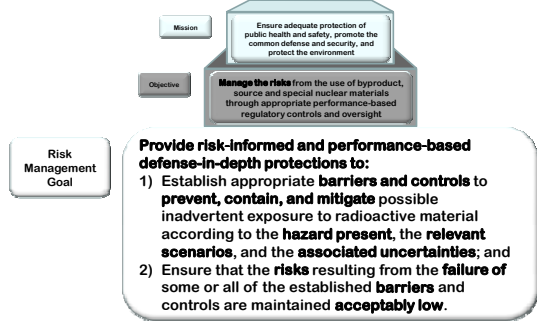
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## Risk-Informed, Performance-Based Defense in Depth



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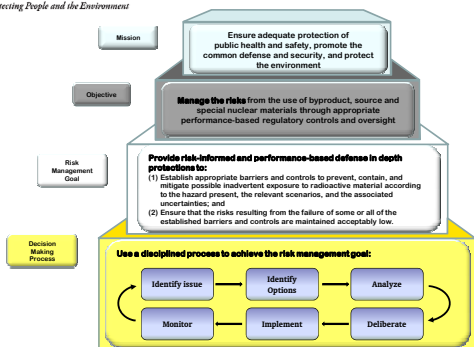
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## Proposed Risk Management Regulatory Framework



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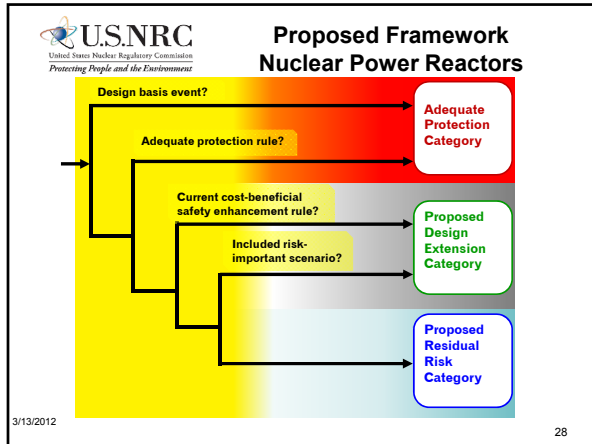
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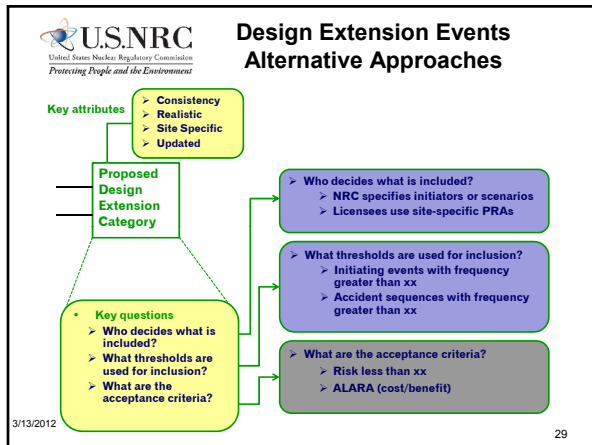
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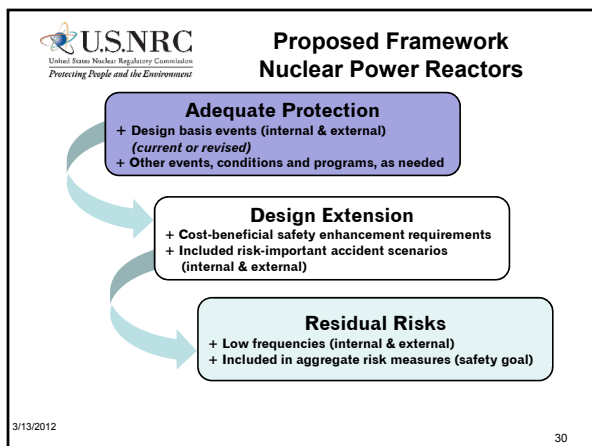
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## Benefits & Challenges

- **Benefits**
  - Incorporation of updated knowledge from risk studies into the regulations; realism
  - Performance-based approach improves flexibility and better focuses resource allocation
  - Improved process for decision-making
  - Greater consistency across the agency
  - Improved communication internally and externally
- **Challenges**
  - Culture change and long-term commitment
  - Communications
  - Resources

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## Acronyms

- ACRS - Advisory Committee on Reactor Safeguards
- CCF - Common Cause Failure
- CDF - Core Damage Frequency
- COL - Combined License
- DC - Design Certification
- I&C - Instrumentation and Control
- LERF - Large Early Release Frequency
- LPSD - Low Power Shut Down
- NTTF - Near Term Task Force
- SMR - Small Modular Reactor
- SPAR - Standardized Plant Analysis Risk

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