U.S.NRC
UNITED STATES NUCLEAR REGULATORY COMMISSION
Protecting People and the Environment

Spent Fuel Pool Safety and Consideration of Expedited Transfer To Dry Cask Storage

Commission Meeting

January 6, 2014

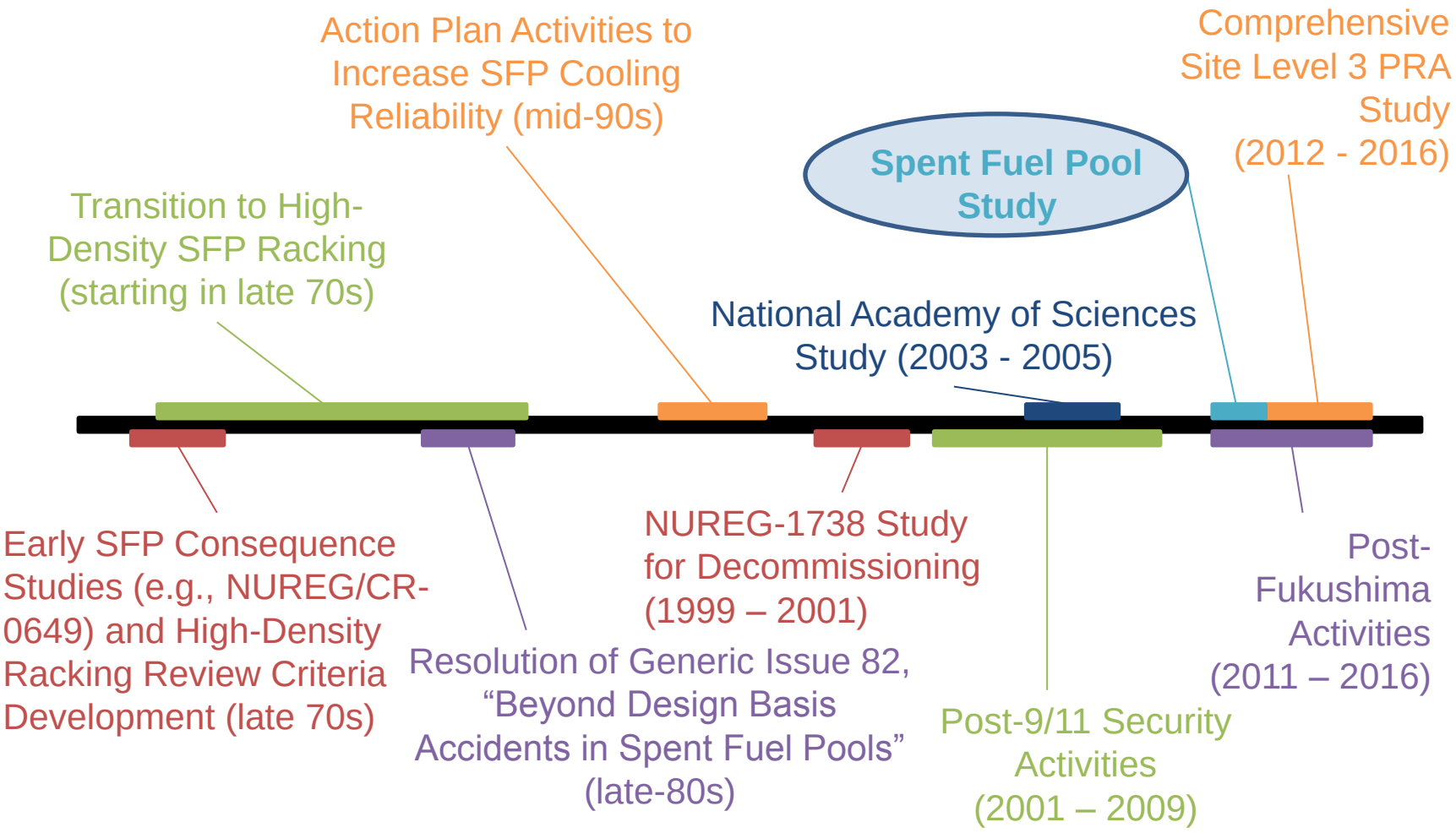
Agenda

• Introduction	M. Johnson
• Background & Overview	J. Uhle
• Spent Fuel Pool (SFP) Study	B. Sheron J. Pires H. Esmaili
• Tier 3 Evaluation Process	F. Schofer
• Findings and Recommendation	M. Johnson

Safety Perspectives

- SFPs provide adequate protection
- Safety and security improvements have been implemented
- Low-density loading provides only minor or limited safety benefit
- Expedited transfer does not meet thresholds for pursuing regulatory actions or additional studies

Timeline of Major SFP-related Activities



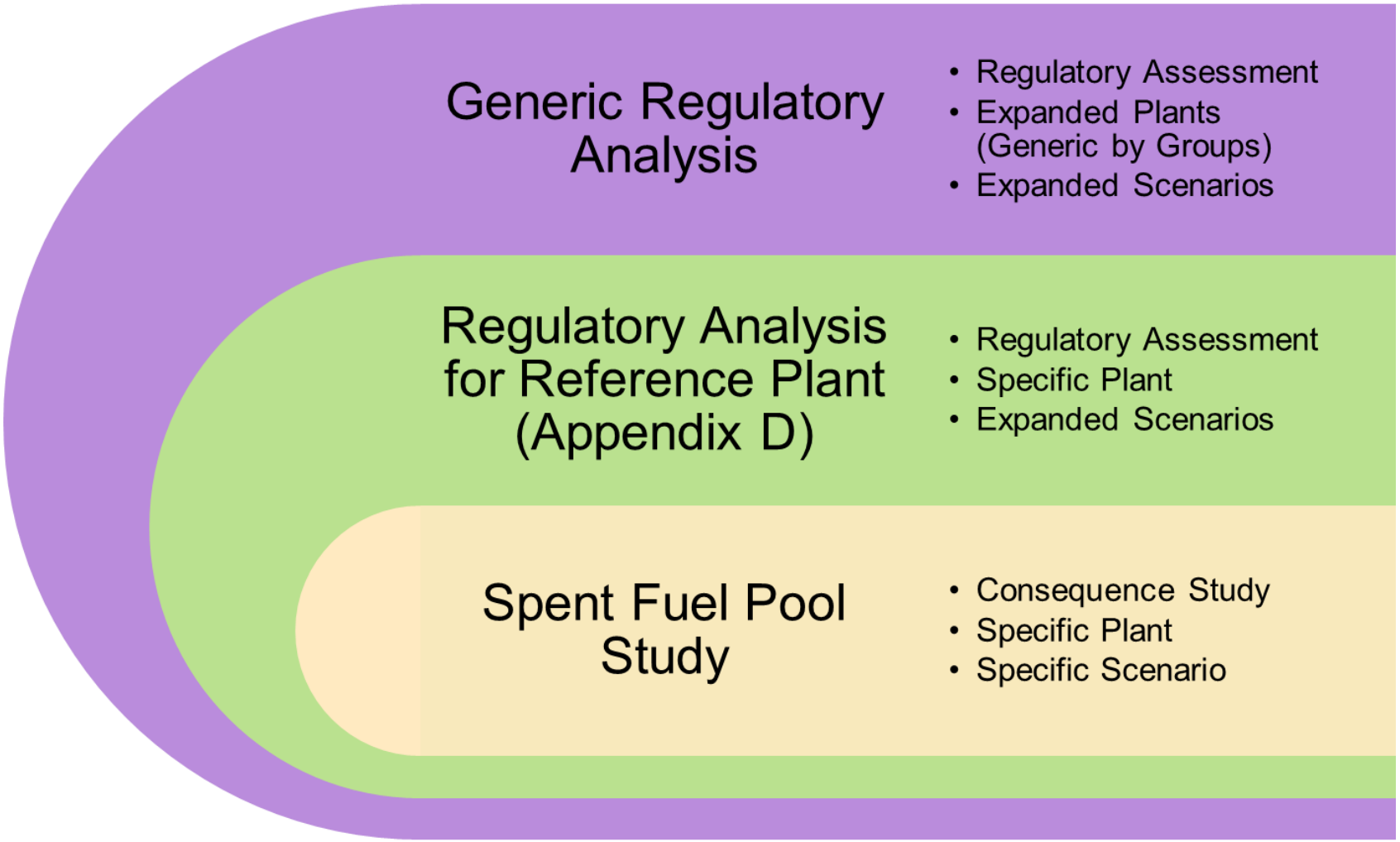
Tier 3 Issue

- Determine whether regulatory action is needed for expedited transfer of spent fuel to dry casks
- Tier 3 plan reflects Commission direction and alignment with relevant activities
  - Phase 1: Evaluate whether additional studies are needed to determine if regulatory action might be warranted (COMSECY-13-0030, November 12, 2013)
  - Phases 2 and 3: If directed, perform additional analyses to reduce conservatisms and consider other factors

Decision-Making Process

- Staff followed normal regulatory process utilizing Regulatory Analysis Guidelines (NUREG/BR-0058)
- Used information from past SFP evaluations and the recent SFP Study
- Conservative analysis that increases calculated benefits of expedited transfer
- Recommendation based on safety goal screening and cost-benefit analysis

Tier 3 Analysis Overview



SFP Study Objectives

- Determine if accelerated spent fuel transfer to dry cask at a reference plant substantially enhances public health and safety
- Calculate public consequence estimates for a beyond-design-basis earthquake affecting a spent fuel pool under high- and low-density loading conditions
- Provide input to the regulatory analysis for this Tier 3 issue

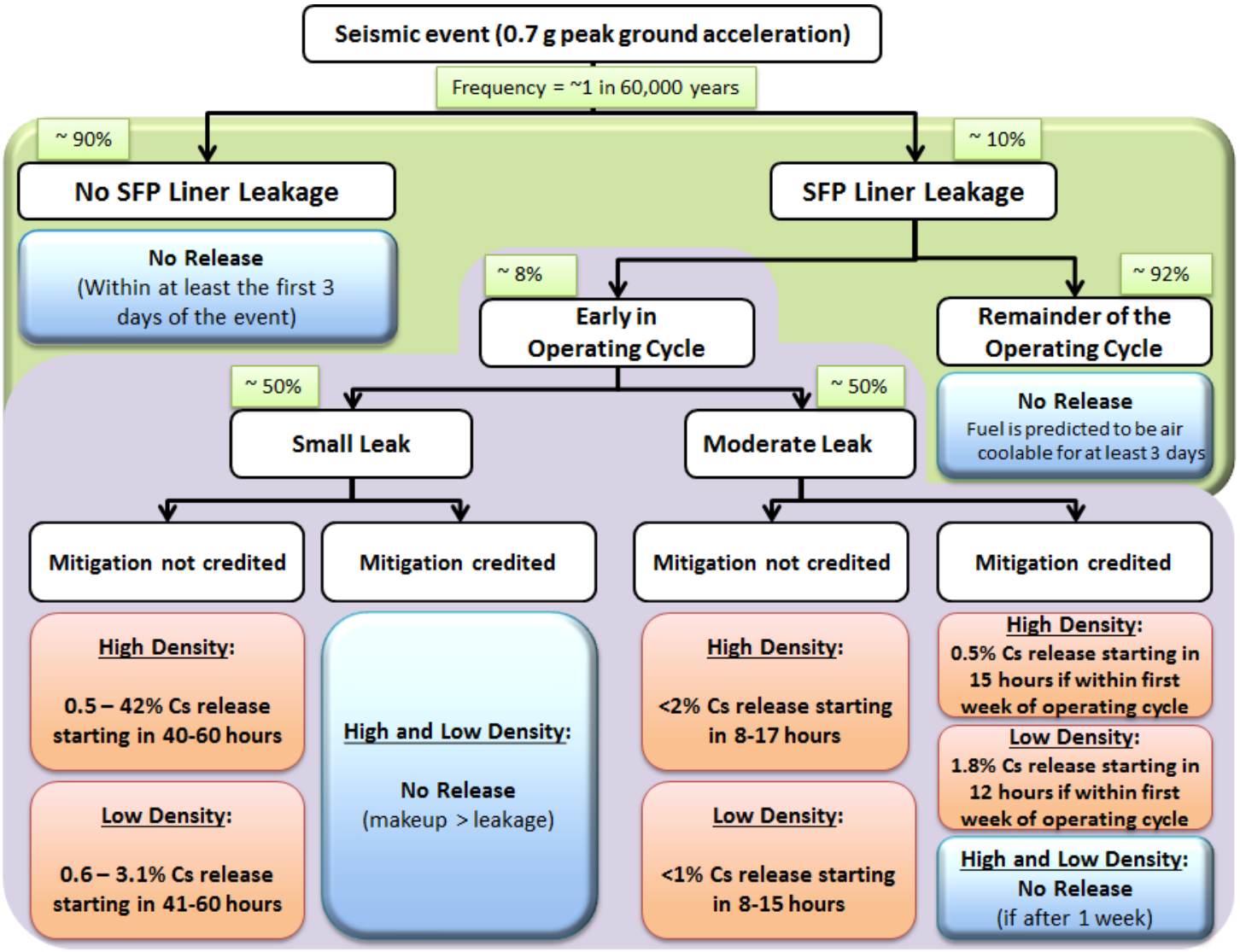
SFP Study Approach

- Detailed analysis of a BWR Mark I reactor SFP modeled after Peach Bottom
- Initiating event is a severe earthquake (highest risk contributor)
- Detailed analysis of structural effects for the severe earthquake
- Uses state-of-the-art computational codes
- Analyzed scenarios with and without successful mitigation

Seismic/Structural Assessment

- Considered a 1 in 60,000 year seismic event
- No liner tearing and no leaking with 90% likelihood
- Liner tearing spreading along the base of the walls with 5% likelihood (moderate leak state)
- Liner tearing localized in parts of the liner at the base of the walls with 5% likelihood (small leak state)
- No leakage of water below the top of the fuel was reported for 20 SFPs affected by two major recent earthquakes in Japan
  - Consistent with low likelihood of leakage estimated for this study

SFP Study Results



Note: The low-density pool has about 1/3 of Cs-137 inventory compared to high-density pool. Early in the operating cycle refers to early time after shutdown.

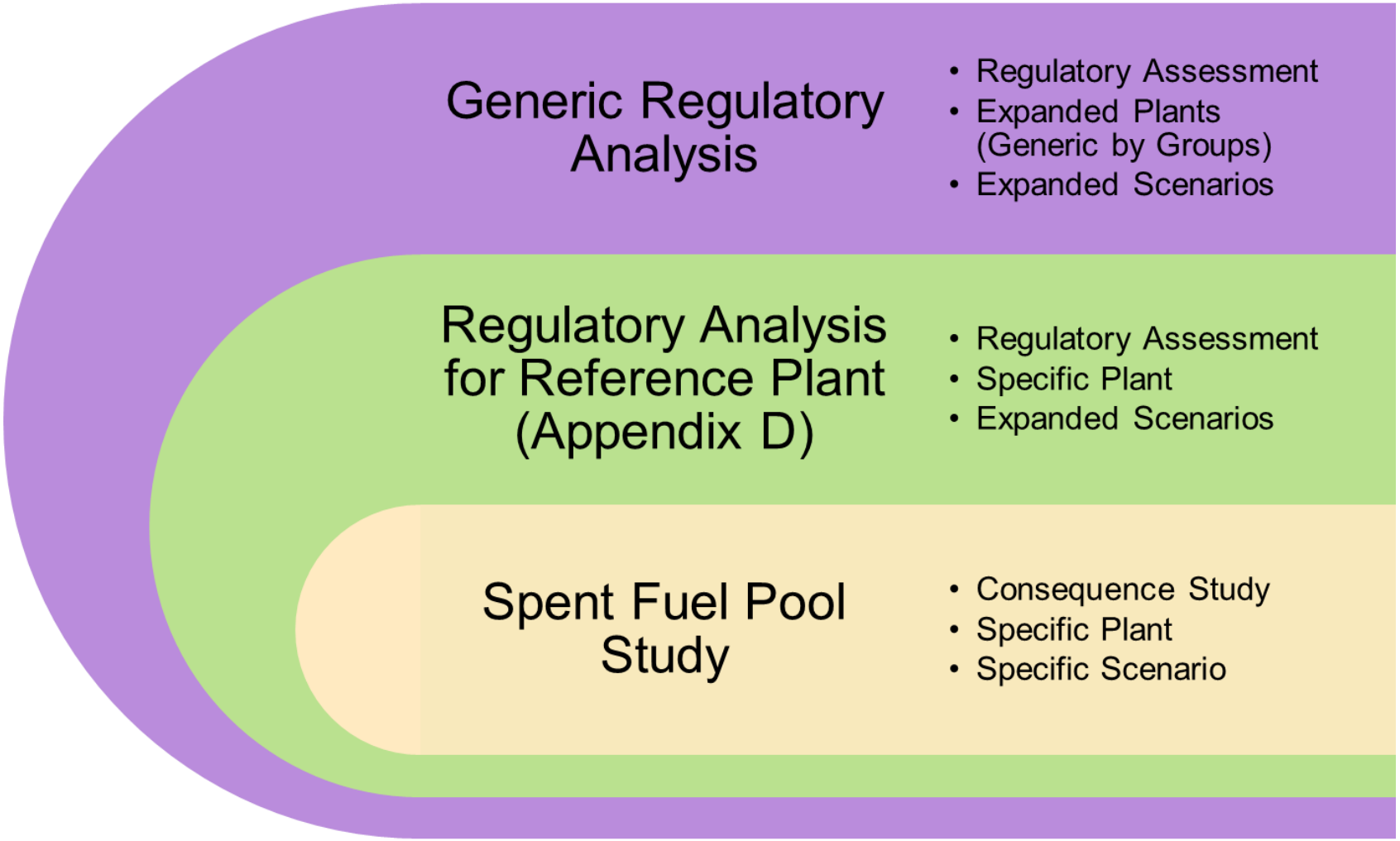
SFP Study Results

- For the severe earthquake studied, the SFP is unlikely to leak (partial draindown not credible)
- For the analyzed configurations, spent fuel can be cooled by air within a few months after it is moved into the pool (even with closed-frame racks)
- Both high- and low-density pool loads generate a release with similar (but very low) frequency; high-density loading can lead to a larger release
- While accidents involving high-density pools could lead to greater economic impacts, public health effects are relatively insensitive to loading patterns

SFP Study Results, cont'd

- Estimates of public health and environmental effects are generally the same or smaller than earlier studies
- The Study confirms SFPs adequately protect public health and safety
- The regulatory analysis for the reference plant indicates that faster spent fuel transfer does not substantially enhance safety and costs outweigh benefits

Tier 3 Analysis Overview



Tier 3 Evaluation Process

- Safety Goal Screening Evaluation
  - Designed to answer when a regulatory requirement should not be imposed generically because the residual risk is already acceptably low
- Cost/Benefit Analysis
  - Analyzed to compare estimates of potential benefit against cost to determine whether the alternative is cost-justified

Safety Goal Screening Results

- Did not pass the safety goal screening
  - No risk of immediate fatalities due to nature of release
  - SFP accidents are a small contributor to the overall risks for public health and safety (less than one percent of the quantitative health objectives
- Although the safety goal screening did not pass, proceeded to cost-benefit analysis to provide information to the Commission

Cost-Benefit Analysis Overview

- Screening evaluation representing operating and new plants
- SFP Study and earlier SFP studies provide inputs to the analysis
- Modeled both high- and low-density SFP configurations
- Conservative analysis weighted to favor expedited transfer

Key Conservative Assumptions

- Initiating event frequency
- Failure of SFP liner (liner fragility)
- Inadequate cooling (air coolability)
- Mitigation capabilities
- Amount of material released

Cost-Benefit Analysis Results

- Did not pass the safety goal screening
- Even if expedited transfer passed the safety goal screening, expedited transfer is not cost-justified
- The staff considers the regulatory analysis an appropriately conservative approach for the decision on whether to proceed with further study in Phases 2 and 3

Stakeholder Interactions

- Issues raised by stakeholders have been considered by staff
  - SFP Study public comments
  - Consideration of security within analysis
  - Proper use of the Safety Goal Policy Statement
  - ACRS comments on crediting of mitigation
- Other alternatives considered
  - Alternative loading patterns, enhancement of mitigation
  - Does not pass safety goal screening criteria

Conclusion

- Current SFPs provide reasonable assurance of adequate protection of public safety
- Expedited transfer of spent fuel would provide only a minor or limited safety benefit
- The costs of expedited transfer of spent fuel to dry cask storage outweigh the benefits
- Additional studies are not needed
- No further regulatory action is recommended and this Tier 3 item should be closed

Acronyms

- ACRS – Advisory Committee on Reactor Safeguards
- BWR – Boiling Water Reactor
- Cs – Cesium
- PRA – Probabilistic Risk Assessment
- SFP – Spent Fuel Pool