



**U.S. NRC**

UNITED STATES NUCLEAR REGULATORY COMMISSION

*Protecting People and the Environment*

# **Japan Lessons Learned Tier 3 Issue: Expedited Transfer of Spent Fuel to Dry Cask Storage**

*Public Meeting*

**August 22, 2013**



# Agenda

- Objective & Background
- Regulatory Analysis Process
- Spent Fuel Pool Study Appendix D –  
Regulatory Analysis and Backfitting  
Discussion
- Preliminary Outline of Regulatory Analysis  
for all Spent Fuel Pools



# Presentation Objective

- Inform stakeholders about the staffs activities on the Japan lessons learned Tier 3 activity on expedited transfer of spent fuel
- Discuss the staff's plans for expanding the regulatory analysis contained in the Spent Fuel Pool Study (SFPS) reference plant to make it applicable to all Spent Fuel Pools (SFPs)
- Gather stakeholder feedback for the upcoming Commission paper on this issue



# Background

- Objective of Tier 3 Plan:
  - Determine whether regulatory action needs to be taken to require expedited transfer of spent fuel to dry casks
  - Provides additional regulatory context of the results from the SFPs
- Schedules are aligned to improve the public's ability to understand the relationships between the Tier 3 issue, the SFPs, ongoing Waste Confidence activities, and related policy issues



# Background, cont'd

- Spent Fuel Pool Study initiated in July 2011
- SECY-12-0095 (7/13/2012) established the general plan to address the transfer of spent fuel to dry cask storage
- Related Commission Documents:
  - June 7, 2012 Meeting with ACRS (SRM 7/16/2012)
  - August 7, 2012 Japan Lessons Learned Briefing (SRM 8/24/2012)
  - May 7, 2013 Memorandum to the Commission outlining updated Tier 3 plan

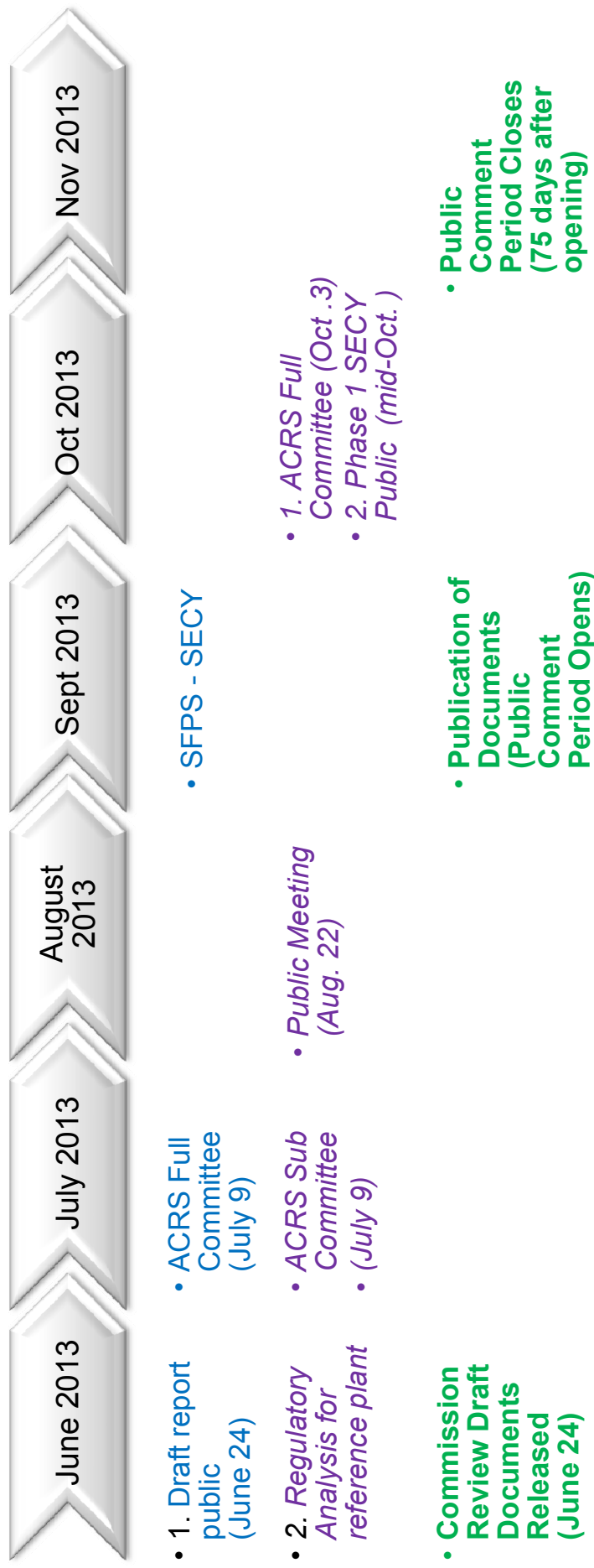


## Tier 3 Plan

- Three phases with Commission papers:
  - Phase 1 – Evaluate whether substantial increase in public health and safety exists (Commission paper by October 2013)
  - Phase 2 – If necessary, perform detailed analysis of costs and benefits (Commission paper by July 2015)
  - Phase 3 – If necessary, consider other factors (criticality, mitigating strategies, solar storms, economic consequences, new regulatory framework, etc.) (Commission paper by July 2017)



# Planned Spent Fuel Storage Regulatory Milestones



Legend  
 Spent Fuel Pool Study  
 Tier 3 Expedited Spent Fuel Transfer Plan  
 Waste Confidence



# What is a Regulatory Analysis?

- An analytical tool provided to decision makers which:
- Recommends a preferred alternative from the potential courses of action studied
  - Contains estimates of benefits and costs with a conclusion whether the proposed regulatory action is cost beneficial





# Elements of a Regulatory Analysis

- Statement of the Problem and Objective
- Identification of Alternatives
- Estimation and Evaluation of Values and Impacts
- Presentation of Results
- Decision Rationale
- Implementation



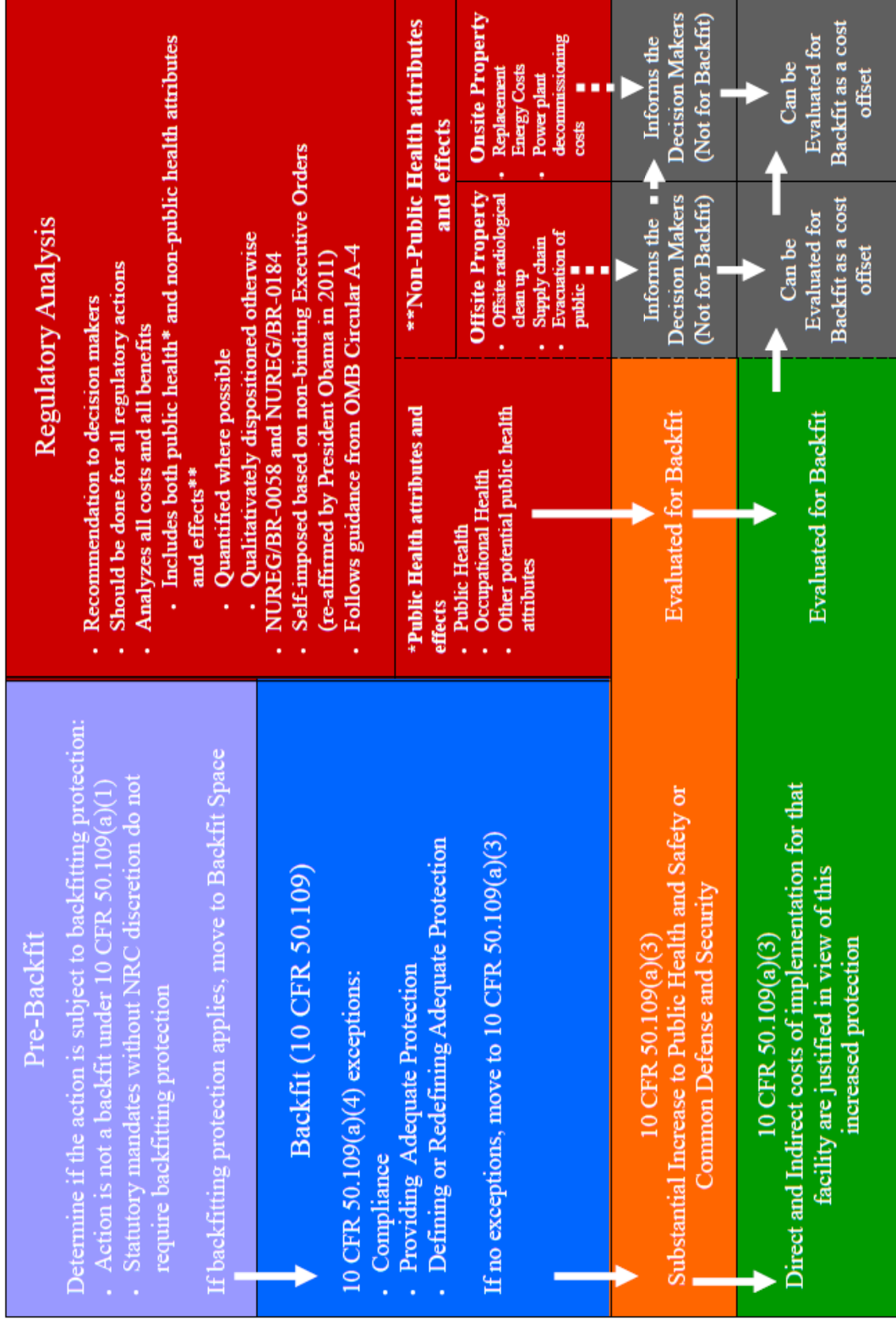
# Attributes Considered in a Regulatory Analysis

- Public Health (Accident) • NRC Operation
- Public Health (Routine) • Other Government
- Occupational Health (Accident) • General Population
- Occupational Health (Routine) • Improvements in Knowledge
- Offsite Property • Regulatory Efficiency
- Onsite Property • Antitrust Considerations
- Industry Implementation • Safeguards and Security Considerations
- Industry Operation • Environmental Considerations
- NRC Implementation • Other Considerations



# Regulatory Analysis vs. Backfit

## REGULATORY ACTIONS (Operating Reactors)





# Spent Fuel Pool Study Regulatory Analysis Overview

- The regulatory analysis was performed to provide regulatory context for the Spent Fuel Pool Study
- The analysis assesses whether any significant safety benefits (or detriments) would occur from expedited transfer of spent fuel to dry casks for the reference plant as modeled, and the potential costs associated with such expedited transfer



## **Data Used in the Regulatory Analysis**

- Spent Fuel Pool Initiator Release Frequency
- Duration of On-site Spent Fuel Storage Risk
- Cost/Benefit Inflation
- Dollar per Person-Rem Conversion Factor
- Onsite Property Decontamination, Repair, and Refurbishment Costs
- Replacement Energy Costs
- Occupational Worker Exposure (Accident)
- Long-Term Habitability Criteria
- Other Key Data



# Assumptions used in the Regulatory Analysis

- Fuel Assembly Decay Heat as a Function of Burnup and Cooling Time
- Dry Storage Upfront Costs
- Incremental Costs Associated with Earlier Dry Storage Cask Purchase and Loading
- Incremental Annual Independent Spent Fuel Storage Installation Operating Costs
- Dry Storage Occupational Exposure (Routine)
- Number of Projected Dry Storage Casks Required



# Sensitivity Analysis

- Present Value Calculations
- Dollar per Person-Rem Conversion Factor
- Replacement Energy Costs
- Consequences Extending Beyond 50 Miles
- Combined Effect of Consequences Extending Beyond 50 Miles and Dollar per Person-Rem Conversion Factor



# Reference Plant Regulatory Analysis Results

- Total Cost to the Reference Plant
  - \$47 million (using a 7-percent discount rate)
  - \$42 million (using a 3-percent discount rate)
  - Range from \$16 to \$47 million (sensitivity analyses)
- Value of Benefits to the Reference Plant
  - \$500,000 (using a 7-percent discount rate)
  - \$700,000 (using a 3-percent discount rate)
  - Range from \$500,000 to \$43 million (sensitivity analyses)
- Costs to NRC
  - Were ignored to calculate the maximum potential benefit





# Reference Plant Decision Rationale

- Regulatory Analysis
  - Alternative considered does not achieve a cost-beneficial increase in public health and safety for the reference plant
  - The three sensitivity studies also showed that the low-density spent fuel storage alternative was not cost-justified for any of the discounted sensitivity cases
- Backfit Analysis
  - Comparison to Safety Goal Policy Quantitative Objectives
    - No early fatalities predicted within 1 mile from site boundary which meets the individual early fatality risk goal
    - SFP accident represents 0.13% fraction of  $1.84 \times 10^{-6}$  per year societal risk goal
  - Cost-justified criteria are not met when evaluating the averted accident consequences
    - Not met when evaluating the averted accident consequences within 50 miles of the site consistent with the regulatory framework
    - Not met for any of the discounted sensitivity cases that extend the analyses beyond 50 miles



## **Expanded Regulatory Analysis For All Spent Fuel Pools**

- **Objective is to expand the Spent Fuel Pool Study Regulatory Analysis (Appendix D) to all Spent Fuel Pools**
  - SFPs Reference Plant is based on a BWR Mark I with elevated SFP
  - Staff developing methodology to apply SFPs results to other reactors, including PWRs and new reactors



# Grouping/Sensitivity Studies

- **Spent Fuel Pool Grouping by Configuration/ Design**

1. BWR Mark I / II with non-shared spent fuel pool (SFP) located well above grade
2. PWR & BWR Mark III with non-shared SFP located at grade with at least one exposed side
3. Advanced reactor SFPs
4. Shared SFPs
5. SFPs located below grade
6. SFPs at decommissioned plants (fuel in pool)
7. Decommissioned plants with fuel in ISFSI or shipped offsite

- **Sensitivity Studies**

1. Consequences beyond 50 miles
2. Population density
3. Discount factors (7%, 3%, 2%)

# Regulatory Analysis Inputs

Parameter	Low Est.	Base Case	High Est.
Site seismicity <ul style="list-style-type: none"> <li>Bin 3 (SFPS F4)</li> <li>Bin 4</li> </ul>	1.7x10 <sup>-5</sup> (PB3) 4.9x10 <sup>-6</sup>	1.7x10 <sup>-5</sup> (PB3) 4.9x10 <sup>-6</sup>	3x10 <sup>-5</sup> (Brunswick) 4.9x10 <sup>-6</sup>
Ac power fragility	1.0 (bounding)	1.0 (bounding)	1.0 (bounding)
Refueling freq.	24 months	18 and 24 months	18 months
Liner fragility <ul style="list-style-type: none"> <li>Bin 3 &amp; 4</li> </ul>	1.0 (bounding)	1.0 (bounding)	1.0 (bounding)
Insufficient nat. circ	8.2 – 100%	8.2 – 100%	100% (bounding)
Flex mitigation likelihood	Higher success than SFPS	Same as SFPS or higher	Same as SFPS
<b>Source Term</b>			
SFP loading configuration	1x4 immediately (PB3)	1x4 immediately (PB3)	Uniform for 25d then 1x4 (assumed)
Release fraction	Based on previous studies	Based on previous studies	Based on previous studies



# Regulatory Analysis Inputs (cont'd)

Parameter	Low Est.	Best Case	High Est.
<b>Dose Consequence Analysis</b>			
Population density & demographics	93 & 169 people/sq mi	317 people/sq mi	688 people/sq mi
Weather conditions & modeling	Same as SFPS (PB3)	Same as SFPS (PB3)	Same as SFPS (PB3)
Exposure & health effects modeling	500 mrem annual - LNT	2 rem first year, 500 mrem thereafter - LNT	2 rem annual - LNT
Evacuation assumptions & modeling	Same as SFPS (PB3)	Same as SFPS (PB3)	Same as SFPS (PB3)
<b>Offsite Property Analysis</b>			
Economic data	Site specific using SECPOP2000 (Palisades)	Site specific using SECPOP2000 (Surry)	Site specific using SECPOP2000 (PB3)

# Regulatory Analysis Alternatives

- Regulatory Baseline (1x4 high density loading)
- Low-Density Storage (1x4 for most recent discharged fuel)
- High-Density Storage (1x8, or other beneficial arrangement)
  - May require temporary increase in rate of transfer to dry cask storage
- Enhanced Mitigation Consistent with Storage
  - Further reduce the likelihood of spent fuel pool fires



## **Next Steps**

- **Finish Tier 3 Phase 1 Analysis with consideration of stakeholder feedback**
- **ACRS Full Committee Meeting  
October 3, 2013**
- **Tier 3 Phase 1 Commission Paper  
Mid-October**