ACRS Briefing on Spent Fuel Pool Accident Risk for Decommissioning Plants

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Presentation Purpose

- Broad scope effort
- Following process
- Technical assessment progressing
- Addressing stakeholder concerns
- Results will be incorporated into rulemaking and interim exemption criteria

Decommissioning Background

- Most NRC operating reactor regulations were not developed considering the transition from power operations to decommissioning
  - Staff currently issues exemptions on EP and others on a case-by-case basis
- Commission directed staff to resolve this situation by issuing rules for decommissioning
  - Integrated
  - Risk-informed
- Staff formed the Technical Working Group (TWG) to study spent fuel pool (SFP) accident risk

Technical Working Group (TWG) Product

- TWG output is to provide a technical basis on spent fuel pool (SFP) accident risk that will assist NRR:
  - Develop an integrated rulemaking
  - Provide guidance for interim exemption criteria during rulemaking activities
  - Identify areas of large uncertainty that may merit additional work
- Expectation: Generic study such that licensees would not be required to perform site-specific SFP analysis for reduction in regulation

Technical Working Group (TWG) Study

- A comprehensive review of SFP accidents and associated risk at decommissioning plants did not exist

- Key areas of draft report:
  - Decay time estimation based on thermal hydraulic code analysis
  - Risk assessment

- Risk assessment used a broad set of initiating events:

Loss of SFP cooling	Tornado missiles	Seismic
Heavy load handling	Internal fire	Aircraft
Loss of SFP inventory		

TWG Study (cont.)

- Issued draft in June
  - Stakeholder interest in study
  - TWG to gather feedback and additional information
- Staff held several public meetings - April, May, June, July (2-day workshop)
- Received comments and information from stakeholders (e.g., NEI, UCS, individuals) via meetings, telecons, and correspondence
- Major industry concern was that the risk analysis did not give sufficient credit for plant conditions and personnel actions

Areas of Stakeholder Comment

- Probabilistic assessment:
  - Seismic events
  - Human reliability
  - Heavy loads
- Deterministic assessment:
  - Adiabatic spent fuel heatup calculation
  - Zirconium ignition temperature
- Criticality
- Safeguards
- Normal operations
- Concrete aging
- Others

Human Reliability Analysis (HRA)

Issue: HRA values do not give sufficient credit for operator actions

TWG Resolution/Actions:

- **Issued draft HRA approach for long term events to identify conditions needed to support a claim of high human reliability**
- **Provided approach to two HR experts and the public for comment**
- **No technical comments from public to date**
- **Based on expert feedback, TWG is revising HRA approach and it will be included in the independent review & final assessment**

Heavy Loads

Issue: Heavy load risk assessment does not give sufficient credit for NUREG-0612 actions (Control of Heavy Loads) and uses upper bound values

NEI Actions: Proposed that all decommissioning plants meet NUREG-0612 Phase I and II actions (operating reactors are required to meet Phase I) and provided raw data on cask lifts

TWG Resolution/Actions:

- **Reassessed assuming NEI's proposal, improved statistical methods and new information**
- **Risk values from the reassessment have been included in the independent review**

Seismic Events

Issue: Unique pool characteristics may result in vulnerabilities above the nominal plant (outside scope of TWG assessment)

NEI Action: Action item at workshop to propose seismic checklist

TWG Resolution/Actions:

- **TWG initial review finds the NEI input is useful for seismic screening of SFPs**
- **NEI's proposed checklist is included in the independent review**
- **Additional interactions in the future expected**

Criticality

Issue: Draft study did not sufficiently evaluate potential for criticality

- **Evaluated using deterministic, physics approach**

TWG Resolution/Actions:

- **Reassessing criticality using expanded scope of scenarios**

Other Activities

- Continuing work to finalize study
  - Additional technical work by NRC contractors
  - Independent, technical, quality review (ITQR)
  - Application of risk-informed principles

Risk-informed Decision Making

- Conclusions from the technical study will be formulated using the risk-informed regulatory principles in RG 1.174:
  - Core damage frequency (CDF) & large early release frequency (LERF) goals
  - Defense in depth
  - Safety margins
  - Performance monitoring
- Based on all inputs, a realistic, risk-informed assessment will be developed

TWG Product And Schedule

TWG is following its plan to finalize its assessment and address stakeholder concerns that will result in a solid technical basis for the development of rulemaking and interim exemption criteria

- **Release draft report for public comment in early January 2000**

- **Release final report in early April 2000**

BACKUP SLIDES

Thermal Hydraulic Assessment

- GSI-82 - Severe accidents in SFPs for operating plants
  - Complete drain of the pool & heat up of the fuel and clad to the temperature of zirconium oxidation and subsequent ignition
  - 2 -3 years required to provide sufficent decay such that could not raise clad tmeperute to oxidation temperature
  - Dependent on storage configuration and burnup

Thermal Hydraulic Assessment

- Issue: Maximum clad temperature is too conservative (low) compared to zirconium ignition temperature
- Maximum temperature based on preventing temperature excursion due to "runaway" oxidation
- TWG Resolution/Actions:
  - Improve discussion in report to explain the zirconium oxidation reaction and structural limitations on temperature limit

Adiabatic Spent Fuel Heatup Calculation

Issue: Conservative calculation

- Calculated time for one fuel rod to heat up to temperature of zirconium ignition
- Conservative, simple vs. realistic, complex

TWG Resolution/Actions:

- Calculation performed as generic approach of site-specific application
- Conservative assumptions in deterministic calculations can simplify analysis and save licensee and staff resources
- No current plans to use as a generic criterion

Preliminary Risk Assessment

- Estimated the frequency of fuel uncovery using:
  - Broad range of initiating events
  - Information gathered on visits to decommissioning sites on system configurations and procedures
  - Amount of redundancy and diversity of SFP heat removal systems, SFP makeup systems, and their support systems is an important assumption

Preliminary Risk Assessment (cont.)

- The frequency of fuel uncovery is close but not equivalent to the frequency of zirconium fires in SFPs at decommissioned plants
- Personnel identification and response to adverse plant conditions influenced results
  - No automatically actuated systems
- TWG preliminary results identified several credible initiators for decommissioning plants