Exploring Risk-Informed Rulemaking for Decommissioned Plants

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- 10 CFR 50 regulations emphasize operating reactor risk, which generally bounds spent fuel risk

- Permanently shutdown reactors have a reduced risk to the public

- Need appropriate level of regulation that is commensurate with the risk

Exploring Risk-Informed Rulemaking for Decommissioned Plants

- Two efforts are underway to explore risk-informed rulemaking for decommissioned reactors:

  - Technical Staff is evaluating risk and technical information pertaining to spent fuel pool (SFP) issues that supports predictable methods of granting relief to decommissioned plants.

  - Decommissioning Projects is reviewing individual rulemakings in progress to assess whether they appropriately consider risk.

Exemptions from Regulations

- Decommissioned plants are requesting exemptions to regulations such as offsite emergency preparedness, safeguards, insurance indemnification, and others
- To date, the staff has reviewed the licensee's requests on a case-by-case basis
- Predictable, risk-informed review criteria is needed to address SFP accidents at decommissioned plants
- The staff considers such criteria essential to maintain safety and reduce unnecessary regulatory burden
- The staff is sensitive to the need to improve efficiency and effectiveness and increase public confidence

Current Technical Task

- Staff has recently assembled a Working Group of technical experts in the areas of SFP systems, thermal hydraulics, probability, criticality, dose assessment, fire protection, structures, maintenance rule and QA

- Technical Working Group is currently reviewing and evaluating available information and methods pertaining to SFP accidents to formulate a risk-informed, technical basis for reviewing exemption requests and follow up actions to applicable rulemaking

- Technical Working Group will assess the potential scenarios, probabilities, and consequences of SFP accidents during decommissioning based on available information

Outputs

- **Technical Working Group Outputs:**

    - To establish a risk-informed, technical basis for SFP accidents that supports predictable methods for reviewing exemption requests and follow up actions to rulemaking related to EP, safeguards, and other areas based on available information

    - To identify the need for follow up research or other technical activities to address any large uncertainties in the available information

Long Term Outcome

- The long term outcome is to achieve realistic, risk-informed criteria to address SFP accidents at decommissioned plants in a predictable manner while ...

  - maintaining safety,
  - reducing unnecessary regulatory burden,
  - increasing public confidence, and
  - improving effectiveness and efficiency

Industry and Public Stakeholder Interest

- Consider comments, questions, and technical information from the industry and public stakeholders

- Contact: Mr. Richard Dudley
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Background Information on Zircaloy Fire

- Decommissioned plants requested offsite emergency preparedness exemptions since operating reactor events were no longer a concern

- Staff identified a spectrum of accidents, including beyond design basis accidents, that could cause offsite consequences

- The loss of water from the SFP and a subsequent self-sustaining zircaloy oxidation (Zircaloy "fire") was a concern due to the potential for significant offsite consequences

Available Information on Zircaloy Fire

In support of Generic Safety Issue (GSI) 82, Sandia, Brookhaven, and Lawrence Livermore National Laboratories (NLs) studied the probability, phenomena, and consequences of self-sustained zircaloy oxidation (zircaloy fire) in air for operating reactors

- If the decay heat in spent fuel was only air cooled, the onset of clad blistering could occur at 565°C and self-sustaining oxidation could occur at approximately 850-900°C

- A zircaloy fire could involve more fuel than the last core

- The conditions which could lead to oxidation of the clad are extremely dependent on storage configuration and decay power

Available Information on Initiating Events

National Laboratories investigated loss of water accidents

- Structural failure due to Seismic Event:
  - Mean: 1E-6 per reactor-year (ry)
  - Range: E-5 to E-11/ry
- Structural failure due to Cask Drop:
  - Without NUREG-0612 recommendations: 3.1E-5/ry
  - With all NUREG-0612 recommendations: 3.1E-8/ry
- Structural Failure due to Aircraft crash: <1E-10/ry
- Other Loss of Coolant Accidents
- Human Error

Zircaloy Fire Consequences

- After a certain time period post-shutdown, air cooling is sufficient to remove decay heat and zircaloy oxidation can not occur
- National Laboratory studies identified that the dose consequences was significantly different if the accident resulted in fire or gap release
- Within the time between final shut down and when a zircaloy fire can not occur, safety margin increases due to
  - Decrease in decay heat
  - Decay of short-lived radionuclides
  - Increase in the time available for mitigating actions or recovery

Solicitation for Additional Information

- Identification of initiating events and accident sequences
- Probability of initiating events and accident sequences
- Methods or criteria to assess scenarios and consequences
- Mitigative actions or features
- Characteristics of zircaloy fire
- Dose from fire after 30 days post-shutdown and beyond