

# **Exploring Risk-Informed Rulemaking for Decommissioned Plants**



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# **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**

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- ◆ **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

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- ◆ **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

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- ◆ **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

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## ◆ 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**

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- ◆ **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**

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- ◆ **Consider comments, questions, and technical information from the industry and public stakeholders**
  
- ◆ **Contact: Mr. Richard Dudley  
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Mail Stop O-11D19  
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E-mail: [RFD@nrc.gov](mailto:RFD@nrc.gov)**

# **Background Information on Zircaloy Fire**

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- ◆ **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**

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**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

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- ◆ **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**

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- ◆ **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**