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Spent Fuel Pool Beyond-Design-Basis Earthquake Consequence Study

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Objectives & Technical Approach

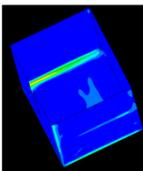
- Objectives
 - Determine if accelerated transfer of spent fuel from the spent fuel pool to dry cask storage significantly reduces risks to public health and safety
 - update publicly available consequence estimates of a postulated beyond-design-basis earthquake affecting a SFP under high-density and low-density loading conditions
- Two conditions considered
 - Representative of the current situation for the reference plant (i.e., high-density loading and a relatively full SFP)
 - Representative of expedited movement of older fuel to a dry cask storage facility (i.e., low-density loading)
- Elements of the study include
 - Seismic and structural assessments based on available information to define initial and boundary conditions
 - SCALE analysis of reactor building dose rates
 - MELCOR accident progression analysis (effectiveness of mitigation, fission product release, etc.)
 - Emergency planning assessment
 - MACCS2 offsite consequence analysis (land contamination and health effects)
 - Probabilistic considerations
 - Human reliability analysis of mitigation measures

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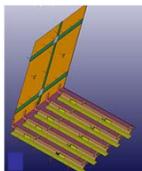
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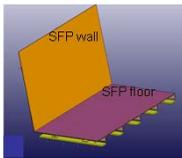
Seismic/Structural Analysis



Maximum liner strains to show locations of strain concentrations



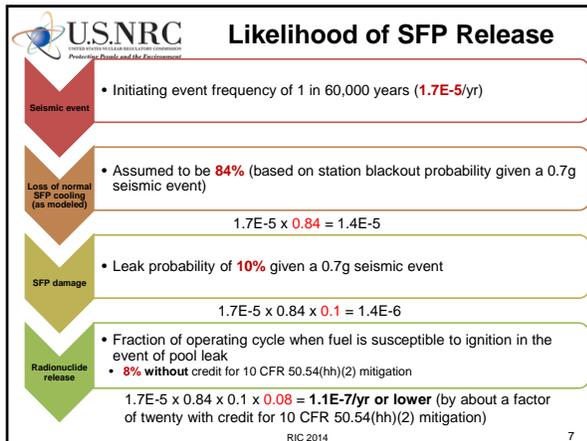
Liner attachments

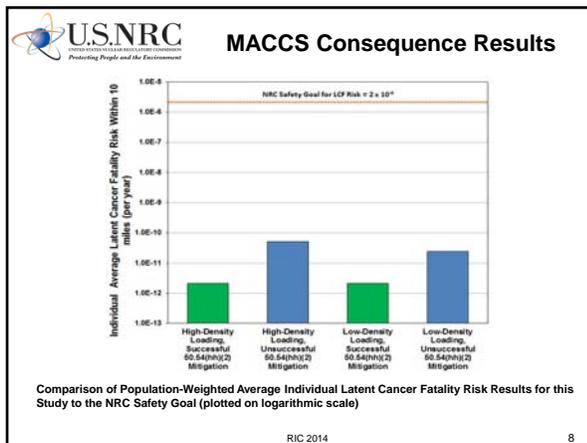


- Considered a 1 in 60,000 year seismic event
- No liner tearing and no leaking with 90% likelihood
- Liner tearing spreading along the base of the walls with 5% likelihood (Moderate leak state)
- Liner tearing localized in parts of the liner at the base of the walls with 5% likelihood (Small leak state)
- 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

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SFPS Summary

- The study analyzed the potential radiological consequences of a postulated beyond-design-basis earthquake affecting the spent fuel pool for a U.S. Mark I boiling water reactor under both high-density and low-density loading conditions.
- The structural analysis shows the spent fuel pool in this study has a 90-percent probability of surviving the severe earthquake with no liner leakage (or conversely, a 10-percent probability of damaging the liner such that leakage will occur).
- In the unlikely situation that a leak occurs, spent fuel is only susceptible to a radiological release within a few months after the fuel is moved into the spent fuel pool. After that time, the spent fuel is coolable by air for at least 3 days.
- The study estimated the likelihood of release from the SFP for the seismic event studied to be about 1 time in 10 million years or lower.
- A favorable loading pattern or successful mitigation strategies significantly reduced potential releases.
- For such a radiological release, this study shows public and environmental effects are generally the same or smaller than earlier studies.

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SFPS Summary

- No early fatalities were predicted for any of the scenarios studied.
- Individual latent cancer fatality risk is low for the scenarios studied because effective protective actions limit exposure.
- Implementation of protective actions may require significant land interdiction and displacement of individuals.
- Individual risks are dominated by long-term exposures to very lightly contaminated areas for which doses are small enough for the areas to be considered habitable.
- The regulatory analysis indicates that expediting movement of spent fuel from the pool does not provide a substantial safety enhancement for the reference plant.
- The insights from this analysis informed a broader regulatory analysis of the SFPS at all U.S. operating nuclear reactors as part of Japan Lessons-learned Tier 3 plan.
- The staff continues to believe, based on this study and previous studies, that spent fuel pools provide adequate protection of public health and safety.

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SFPS Project Resources

- Most of the technical work was performed in-house by RES with little support from contractors (~\$200K).
- RES has the overall lead for the project with about 10 members of the technical staff spending between 50% - 75% of their time for about 2 years.
- This project required a broad spectrum of technical disciplines (e.g., seismic, structural, severe accident and consequence analysis, and probabilistic considerations including human factors).
- Another 30 technical staff members were directly involved in the project from various offices including NRR, NRO, NSIR, NMSS, FSME, OPA, OCA, OEDO, and the Regions.
- Results of the study were published in a technical report and made available for review. A final NUREG is in preparation including responses to reviewer comments.

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